The Platform Economy Matures:
Measuring Pervasiveness and Exploring Power

Abstract:

Online platforms are pervasive and powerful in today's economy. We explore the increased centrality of platforms through two empirical contributions. First, we measure the extent to which platforms are insinuating themselves into the economy. We accomplish this by undertaking an analysis of the presence of platforms as intermediating organizations across all US service industries at the six-digit NAICS code level. Our results show that 70% of service industries, representing over 5.2 million establishments, are potentially affected by one or more platforms. Second, we undertake a detailed firm-level case study of the mega-platform, Amazon that demonstrates the ways that the earlier macro-level data is expressed by a single platform firm. This case study shows that Amazon's growth trajectory has resulted in it entering and transforming existing industries and sectors. We conclude by reflecting upon the limitations and implications for future research.

Keywords: Platform Economy, Industrial Organization, Amazon, Digitization, Technology, Governance

JEL classification: J0, O1, O3

1. Introduction

Online platform firms have insinuated themselves into ever more sectors of the economy and accumulated power as critical intermediaries (Kenney and Zysman, 2016; Srnicek, 2016; Van Dijck et al., 2018; Zuboff, 2019).[1] In contrast, initially many social scientists believed that a new era of "sharing" was dawning and platforms would decentralize power, allowing individuals and small businesses to compete with traditional firms (Einav et al., 2016). Others asserted that platforms would encourage "sharing" and, perhaps, even lead to greater economic democracy (Benkler 2006; Frenken and Schor, 2017; Schor, 2016; Sundararajan, 2013; 2016). Yet, nearly two decades after the emergence of online digital platforms, we argue that platforms have done the opposite—platforms are not only creating new markets bot reorganizing ever greater number of more traditional industrial sectors so as to extract value from participants (Cutolo and Kenney, 2021; Cutolo, Hargadon, and Kenney, 2021). In other words, their reach and sway over the economy is becoming ever greater.

The pervasiveness and power of platforms is remarkable. Facebook and WhatsApp, Google Search, the Chrome browser, Android, YouTube, Google Maps, and Amazon exceed two billion monthly active users. In December of 2020, five platform firms—Microsoft, Apple, Amazon, Google's parent Alphabet, and Facebook—accounted for 22% of S&P 500 market capitalization (Wigglesworth, 2020). Along with two Chinese platforms—Alibaba and Tencent—the top seven most valuable publicly traded firms in the world are platform firms (on

[1] In this paper, we define **platforms** as online places or infrastructures (i.e., websites and mobile apps) designed specifically to facilitate transactions and other valued exchanges of goods, information, and opinion (Gawer, 2014) These can be considered exchange platforms, and are fundamentally different from product platforms, where complementors create value by creatively drawing on certain fixed core elements (e.g., industry standards; Baldwin, 2019). A platform is based upon the formation of an **ecosystem** when the platform attracts a myriad of other contributors (Jacobides et al. 2018). A platform acts as an **intermediary** by facilitating transactions for contributors within the ecosystem. We define a **mega-platform firm** as a firm that operates multiple platforms across industries, whereas a **sectoral platform firm** is a firm that operates in a single industry and, most often, a single platform.

Chinese firms, see Jia and Kenney, 2021).[2] Moreover, due to the Covid-19 crisis of 2020, these platform firms increased their value as most other firms saw their value decline. To paraphrase Marc Andreessen, founder of Netscape and prominent venture capitalist, platforms are consuming the world (Parker et al., 2016).

Our purpose in this paper is to explicate the expansion of platforms and their power. In **Section 2**, previous research on the study of the spread of platforms and the sources of their power are considered. To further this discussion, the distinction between the direct and indirect influence of platforms on particular industries is introduced. **Section 3** develops an original framework to descriptively measure the pervasiveness of platforms across the US economy using North American Industry Classification System (NAICS) codes. This section demonstrates that platform firms are insinuating themselves into ever more industries, and provide the first comprehensive, quantitative evidence for the extent to which platforms are intermediating business activities in US service industries. The results show that 70% of service industries, representing over 5.2 million establishments, are being affected directly or indirectly by one or more platforms.[3] In **Section 4**, a detailed case study of Amazon's expansion identifying eight expansion vectors shows how Amazon not only diversified, but more importantly, leveraged its assets in one industry to enter yet other industries.[4] Precisely because the Amazon case so clearly displays the diverse mechanisms by which platforms spread and entrench themselves it is

[2] The Saudi Arabian government monopoly, Aramco, is the most valuable firm in the world. However, it remains 98% owned by the Saudi government and thus is only marginally public.

[3] Establishments are defined as single physical locations at which business is conducted or services or industrial operations are performed. In 2017, there were 7,860,674 establishments in the US. In the services sector, defined as NAICS (44-81), there were 6,368,619 establishments in 2017 (Census Bureau, 2020d).

[4] This case study extends the work of Aversa et al. (2020) by providing a granular analysis that explores Amazon's expansion strategies, which has led to it becoming one of the most powerful firms in the world, and generally, explores issues of platform power and expansion (Tiwana et al., 2010).

a useful lens with which to reflect on the platform phenomena. **Section 5** discusses the implications of the increasingly pervasive and powerful role of platforms in reorganizing industries and reflects upon paths for future research.

2. Previous Research on Platform Pervasiveness and Power

One of the earliest indicators of the power of platforms to shape business was their emergence as intermediaries between customers and vendors in the late 1990s (Parker and Van Alstyne 2005). And yet, at the time, few understood how powerful platforms would become as a way of organizing markets and industries. Platform adoption was accelerated by technical developments such as the introduction of the smartphone, which connected yet more people to the Internet, and freed the Internet and users from the Microsoft-controlled personal computer. The result of the movement of social and economic activity online meant that it could be intermediated by platforms (Van Dijck 2013; Van Dijck, Poell, & De Waal, 2018). Not only did online activity become embedded in a web of platforms, but also for non-platform businesses, platforms increasingly shape how customers find and interact with them, how they hire, handle paperwork (information and data), connect with customers, and ship products. This led Koen Frenken et al. (2018) to argue that platform firms combine the institutional logics of markets, corporations and the state into a single organizational form.

There have been various studies that identify which industries might be susceptible to platformization. As is the case with nearly every study, platform researchers, such as, for example, Cusumano et al. (2019) list the various platforms and conclude that many industries are or will be affected. However, they do not undertake exhaustive analysis of the industries that have been impacted. In a general sense, Parker et al. (2016) suggest that in traditional industries,

firms that compete on the basis of resources that are owned internally are increasingly being outcompeted by platforms' ability to create new infrastructures to coordinate buyers and sellers. Similarly, Rahman and Thelen (2019, 4) assert that the platform strategy represents an aspiration to become the foundational infrastructure for a sector, or multiple sectors.

There have been a number of qualitative and quantitative studies attempting to measure the effects of platforms in the economy. This research has focused almost exclusively on the few sectors where platform presence is most visible, such as transportation, accommodation, professional services, publishing, advertising, and finance (OECD, 2019, 43; Petropoulos et al., 2019, 84-86). For example, numerous studies attempt to measure the effect of ridesharing firms such as Uber and Lyft on the taxi industry (see, for example, Parrott and Reich, 2018). In another study, Pan and Qiu (2018) found that ride-sharing firms depressed mass transit usage. Further, the business press suggests that ride-sharing firms also impacted the rental car market (Reints, 2019). Thus, in the case of ride-sharing platforms, three different industries were impacted: taxis, mass transit, and car rentals.[5] Much research has shown that the accommodation industry has been impacted by Airbnb (Scott and Orlikowski, 2012; Zervas et al. 2017). In the restaurant industry, researchers have found that Luca Yelp ratings are important for revenue (Luca 2016).[6] The impact of Amazon on the retailing has been remarked upon in the business press and among policy-makers, but remarkably little academic research (Khan, 2016; LaVecchia & Mitchell, 2016). Finally, there have been a remarkable outpouring of studies of online gig labor contracting platforms (e.g., Kassi & Lehdonvirta 2018). These studies illustrate that a wide

[5] When we refer to an industry, we are using the North American Industry Classification System (NAICS). Taxis are in NAICS Code 48531, Mass Transit is in NAICS Code 48511, Car Rentals are in NAICS Code 532111.
[6] Hotels are in NAICS Code 721110 and Restaurants are in NAICS Code 722511.

variety of industrial sectors have been affected by the presence of platforms.[7] However, as studies of single firms, they cannot illuminate the larger picture and thus the implications for the entire economy.

During the last two decades, in one industrial sector after another, platforms have become intermediaries by leveraging the strength of network effects, the winner-take-most characteristics of their markets, and the modular character of many digital technologies that afford generativity (Eaton et al. 2011). Analysis is further complicated by the fact that platforms can leverage the data they capture from their users to expand into new, adjacent industries or deepen the services they offer in that particular industry (Eisenmann et al., 2011; Parker et al., 2016). When the new services are offered in other industries, they would be classified as belonging to a different industrial code. As we will show in the case of Amazon, digital technologies were used to create new services or identify new growth opportunities, thereby resulting in unexpected expansion paths (Henfridsson et al., 2018).

Platforms generate value, not only by their own activities, but also, and perhaps more importantly, by the often vast ecosystems that emerge around each platform (Cusumano et al., 2019; Parker et al., 2016). For the larger platforms, these ecosystems can be quite complex and contain a diversity of actors that depend upon the users that the platform attracts.[8] It is necessary to understand both the structure of the platform firms and the ecosystems of value creation that coalesce on the various sides of the platform (Rochet and Tirole 2003; platform sides).

[7] For a study of platforms' effect on market organization in the cases of Airbnb and Lyft, see Kirchner and Schuessler (2019).
[8] For an in-depth discussion of the power that these platforms exert over the complementary members of the ecosystem, see Cutolo and Kenney (2021).

Platform power derives, as the Amazon case will demonstrate, from these value creating ecosystems. The expansion and centrality of platform firms translates into their exceptional power over other actors in the ecosystem. Without the ecosystem of complementors, a platform firm is nothing more than a "product" firm. Such firms would be powerful, but would not have the enormous power that comes from the thousands and even millions of firms and individuals whose activities are coordinated and directed through the platform. Consider again, the power that accrues to Amazon through having 2 million active sellers, or that Google derives from cataloguing and ranking well over a billion websites—all of which want to be catalogued. Similarly, Booking.com claims to book over 1.5 million rooms per day—effectively, hotels have been integrated into Booking.com and its two competitors' ecosystems. It is essential to understand the size and dynamics of these ecosystems to see the broader economic significance of platform firms.

Platform power, the literature shows, has two aspects: *artifactual* and *contractual* (Cutolo and Kenney 2021). The artifactual aspect is inherent in the software and algorithmic structure of the platform. The software itself structures action—it enables certain activities and blocks others (Barrett et al., 2016). The platform owner can change the code and algorithms at will, thereby reengineering a user's engagement with the platform. In addition to the algorithmic structure, platform users contract with the platform by agreeing to a set of terms and conditions. The typical terms and conditions reserve essentially all powers to the platform owner. The algorithmic affordances and contractual conditions provide platforms nearly total control over users and firms utilizing the platform as it is private property (Cutolo and Kenney, 2021).

The contractual levers of power that the platform wields, in respect to the complementors in its ecosystem, are enshrined in the "terms and conditions" that all actors must agree to prior to using the platform. These contracts specify the terms of usage for the participants. The most important clause in these contracts is that the platform has the right to unilaterally change the contract at its discretion. This contractual right transcends specific questions or grievances such as changes in the firm's "placement" in an Amazon, Google Search or Booking.com list, whether a platform such as Amazon can use a merchant's data to develop its own white label products, or whether buyers and sellers can interact directly and thus disintermediate the platform. The terms and conditions are, in effect, private regulatory systems that exercise power. Given the reach and pervasiveness of these mega-platforms such as Google Search, Google Maps, Amazon, Facebook, and Apple (in its ecosystem), the establishment of an economy increasingly organized by platforms raises fundamental questions of what entities should have what type of power. What is appropriate power in the market and society? Declaring principles for a digital economy is not sufficient; as emphasized by Lessig (1999), those principles have to be expressed in code and in contract.

The power of platforms lies in how they can orchestrate the activities of various participants, and that they determine the operation of the far more numerous ecosystem complementors. The foundations of platform power and their expression can be complex, scope-like extensions such as when Google began offering Maps, which built upon its strengths in cataloguing enormous amounts of data and providing searchability. Building on the same competencies, Google acquired and expanded YouTube. These expansions can also be less obvious; for example, Google is a leader in developing autonomous vehicles, which is, in part, dependent upon excellent maps even as the vehicles produce spatial and visual data that can

improve maps (Bergen, 2018; Wilken and Thomas, 2019). This complex interaction between the vehicles and maps is all supported by Google's ability to process and catalogue enormous amounts of data. Another expansion vector available to platform firms is to integrate other layers in the software stack. For example, Google has done this through its introduction of the Android operating system. These multidimensional expansions may be through acquisitions or new product development.

Platform presence may have begun with an innovative set of newcomers, but the original "newcomers" such as Google, Amazon, and Facebook, have grown into giants redefining the economy. But it is not just the giants on which one needs to focus. The task of the next section of this paper is to measure the extent of the insinuation of platforms into the economic fabric by creating a measure of pervasiveness.

3. Measuring the Pervasiveness of Platforms

While it is universally recognized that platforms have reorganized many industries, particularly within the enormous service sector (Cusumano et al., 2019, 234), the presence of platforms across industries has been underexplored. David Evans and Annabelle Gawer (2016) counted the number of "platform firms" globally, but did not enumerate the industries they impacted. More recently, Lafontaine and Sivadasan (2020) used a time series of NAICS retail establishment data to show that the growth of online commerce had a negative impact on physical retail in terms of numbers of establishment, employment, real sales and real payroll, including big box retailers. Geissinger et al. (2020) used mentions of platform firms in various Swedish media to measure their presence across sectors. Their results identified 17 sectors and

47 sub-sectors, including on-demand services, fashion and clothing, and food delivery, as being part of the "sharing economy," i.e., platforms.

3.1 Methodology for determining platform presence at six-digit NAICS code level

This section explores the presence of platforms across service industries using North American Industry Classification System (NAICS) codes.[9] NAICS is an industrial classification system that was developed in 1997, and has been updated most recently in 2017. NAICS divides industries into a two- through six-digit hierarchical system, with six-digits representing the greatest level of detail. Even at the six-digit level, which includes 1,057 codes, there are a variety of firms undertaking different activities (Census Bureau, 2020a). In our analysis, we include 451 service industries that are diverse in their primary business activities and represent 43% of all NAICS industries.[10] [11]

For each of the 451 six-digit industries, we consider whether a platform with reasonable market presence is intermediating transactions. In platform models, transactions are intermediated in two different ways. First, the platform may intermediate transactions between third-parties and consumers. In this case, we define the transaction through the platform as a

[9] Our analysis is confined to service industries, but platforms are having an impact in other sectors. For example, see Kenney, Serhan, and Trystram (2020) for a preliminary discussion of their impact in agriculture.

[10] For the list of 460 NAICS industries we used in our classification, please see Census Bureau (2020b). We dropped nine service industry classifications because they were excluded from the Statistics of U.S. Businesses, which we use for establishment data, thus our final population of NAICS codes was 451. The industries dropped include rail transportation (NAICS 482), Postal Service (NAICS 491), pension, health, welfare, and vacation funds (NAICS 525110, 525120, 525190), trusts, estates, and agency accounts (NAICS 525920), and private households (NAICS 814) (Census Bureau, 2020c). We also dropped Offices of Notaries (NAICS 541120) as a result of statistical challenges.

[11] Although manufacturing industries are also affected by platforms, platforms have not directly affected the manufacturing processes, thus, they are excluded from this analysis. To illustrate, the Tide product was not changed because of platforms, but Procter & Gamble has designed the 'Tide Eco-Box' so that it is more easily deliverable by platform firms such as Amazon (Meyersohn, 2018).

direct effect of platform presence, as platforms directly consummate the transactions and capture value through their website or app. Second, the platform may connect users and possible providers, but no transaction occurs on the platform. We term this an *indirect* effect of platform presence, as platforms passively capture value through advertising, click streams, consumer data, and more but do not execute the final transaction. In other words, transactions are completed on another webpage, app, or in-person, but they are enabled by improved discovery through the platform. Conversely, in traditional business models, transactions are ordered in a linear process extending from suppliers to the consumers, and platforms have *no effect* on value capture. Our classification of NAICS codes at the six-digit level is based on this logic, summarized in **Table 1**.

Table 1: Effects of Platform Firms in a NAICS Code

Definitions		**Share of industries in sample affected**	**Number of establishments in sample affected**
Direct effect	A transaction between a buyer and seller occurs on the platform; value capture occurs directly on the platform.	34%	2.0 million
Indirect effect	Platforms connect buyers and sellers, but no transaction occurs on the platform; value capture occurs indirectly through passive data collection.	36%	3.2 million
No effect	Transactions remain unchanged by platforms.	30%	1.2 million

Classifying platform presence in industries is difficult. We chose to examine whether a platform was intermediating transactions in a particular industry. This is because platforms

reconfigure the way that transactions are completed, but not necessarily the end product. In order to standardize the classification process, we developed a classification protocol to determine the nature of transactions in each industry included in our sample. Further details on the methodology are in the Appendix. For example, the following questions were asked for each industry: are any transactions intermediated in a significant way by a platform firm? Are transactions completed through the platform's website or app? Are transactions completed as a result of clicking an ad viewed on the platform's website or app, which then directs the user to make a purchase on another website?[12]

3.2 NAICS Codes Analysis Results

Our overall finding was that platforms had a direct impact on 34% of the industries (2,037,384 establishments), an indirect effect on 36% (3,234,412 establishments), and no identifiable impact on 30% (1,096,823 establishments) of the 451 industries (**Table 1**). These results at the six-digit NAICS code level indicate that an enormous number of US service sector establishments are in industries that are being reorganized by platforms.[13]

At a higher level of aggregation, such as, the distribution of platforms by subsector (three-digit NAICS code level) and sector (two-digit NAICS code level) yields interesting results. When one considers the share of six-digit industries affected by platforms in each subsector, we find that platforms affect business activity in 45 out of 52 subsectors (87% of subsectors). Certain subsectors are more susceptible to platformization than others (i.e., more than 70% of industries in the subsector are affected by platforms). In particular, these subsectors

[12] For the full classification protocol, please see the Appendix.
[13] This is particularly remarkable considering that we are only including exchange platforms in our analysis.

are in sectors, including retail trade (44-45), transportation and warehousing (48-49), information (51), arts, entertainment and recreation (71), accommodation and food services (72) and other sectors (for greater detail, see Appendix Tables 1.1 and 1.2).

In the subsectors affected by platforms, we consider whether the direct or indirect effect dominates (i.e., more than 70% of industries in a subsector are affected either directly or indirectly; Appendix Table 1.2). In 16 subsectors, including electronic and appliance (443), transit and ground passenger transportation (485), and accommodation (721), the direct effect dominates. In 6 subsectors, including motor vehicle and parts dealers (441), scenic and sightseeing transportation (487), and food services and drinking places (722), the indirect effect dominates. In 10 subsectors, including gasoline stations (447), pipeline transportation (486), and telecommunications (517), no effect dominates. The possible reasons that certain business activities are more susceptible to direct or indirect effects are discussed later in this section.

The analysis identified a number of platforms that affect multiple industries at the six-digit NAICS code level. One of the most significant of these was Amazon, which directly affected 9% of all 451 industries (601,824 establishments). The Amazon marketplace is powerful, but as discussed in the next section, the platform also expands into many other industries aside from retail. More surprisingly, Yelp indirectly affected establishments in 11% of all 451 industries (1,759,157 establishments).[14] In the case of Yelp, the modus operandi was similar—collect reviews and sell advertising against these searches.

[14] The percentages reflect only the industries where both coders agreed on Amazon and Yelp. In reality, the number may be greater.

The analysis also identified many narrower platforms that affect clusters of industries, usually within the same or similar subsector at the three-digit level. For example, platforms such as Lyft and Uber in transportation, Realtor.com and Zillow in real estate, Airbnb, Booking.com, and TripAdvisor in travel and accommodation, Upwork and Fiverr in professional industries, Netflix, Spotify, and YouTube in entertainment, and CarGuru and Edmunds in auto sales. These platforms largely remain within traditional industrial verticals, while creating a demand for their services.

Table 2 lists a sample of the industries to illustrate the different effects of platforms on transactions in particular industries. In each case, we list one or more of the platforms that are present in the focal industry.

Table 2: Examples of Industry Typology for Platform Pervasiveness

Industry	*Number of establishments (2017)*	*Platform example*	*Effect*	*Details*
Electronic Stores (443142)	13,670	Amazon	Direct	Amazon entered the electronics industry in 1999, but the most important impact has come through the Amazon Marketplace where thousands of vendors sell all manner of electronics products.
General Warehousing and Storage (493110)	12,317	Flowspace	Direct	Flowspace was founded in 2016 as an on-demand warehouse listing and booking with over 1,000 certified warehouses in the network. The platform raised $15.4 million in funding, including $12 million in Series A funding in 2019 (Branley, 2019).
Ambulance Services (621910)	5,513	Uber/Uber Health	Direct	Uber was founded in 2009. Uber's entry into a city was found to reduce ambulance use by 7% (Moskatel and Slusky, 2019; Frakt, 2018).

News Syndicates (519110)	412	Facebook, Instagram, Google News	Indirect	Facebook is one of a number of platforms that has profoundly reorganized the production, discovery, and consumption of news (Nechushtai 2018).
Direct Life Insurance Carriers (524113)	8,561	SelectQuote	Indirect	SelectQuote matches consumers with insurance providers. The platform raised $360 million during its IPO in May 2020 (Franklin, 2020).
Full-Service Restaurant (722511)	250,871	Yelp	Indirect	Yelp is used by consumers to find restaurants, but transactions are not completed on the platform.
Pipeline Transportation of Crude Oil (486110)	802	N/A	No effect	In this niche industry, no platforms were identified that affect business activity.
Elementary and Secondary Schools (611110)	22,164	N/A	No effect	In this industry, ongoing personal relationships are important. No platforms were identified that affect business activity in this industry. We do not include internal platforms such as Blackboard or tools such as Zoom. During the Covid-19 crisis, these digital tools have become increasingly important in providing remote education.
Food Service Contractors (722310)	27,844	N/A	No effect	No platforms were identified that affect business activity in this industry, which is composed of a group of establishments that provide contract food services at institutional, governmental, commercial, or industrial locations. This industry is likely firms that are engaged in mostly B2B transactions.

For industry descriptions, see Census Bureau (2017). Establishment data from Census Bureau (2020d). Establishments are defined as single physical locations at which business is conducted or services or industrial operations are performed.

First, we consider industries *directly affected* by platforms. Take Electronic Stores (Industry 443142), which encompasses retailing consumer-type electronic products. Amazon has directly affected the firms in this industry by shifting transactions that would have previously

taken place in stores like Radio Shack have largely shifted to the Amazon Marketplace. Of course, Amazon also directly affects many other retail industries, as well as non-retail industries such as Couriers and Express Delivery Services (Industry 492110) through Amazon Flex delivery partners. Similarly, firms in General Warehousing and Storage (Industry 493110) are directly affected by Flowspace, a platform that lists warehouses and fulfillment centers, and users pay via the platform to rent the space.[15] Finally, firms in Ambulance Services (621910) are directly affected by Uber, which has been shown to reduce ambulance use by 7% (Moskatel and Slusky, 2017). Uber Health, which provides healthcare organizations with non-emergency medical transportation, is also directly competing with firms in Ambulance Services.

Second, consider industries *indirectly affected* by platforms. Facebook is one of a number of platforms that has profoundly reorganized the News Syndicates (519110) industry. Facebook increasingly intermediates the production, discovery, and consumption of news in through the Newsfeed, whereby users find articles and other content. Facebook passively captures value from data collection on user preferences and ad revenue, but the platform does not directly capture value from transactions that result from discovery on the Newsfeed, Marketplace, or other Facebook features. This is because the user would be redirected to an auxiliary website or individual, and if a transaction were to occur (e.g., subscription to a newspaper, payment for an article, purchase from a person) it would take place there. Another example is the Direct Life Insurance Carriers (524113) industry, where the insurance discovery process has been affected by platforms such as SelectQuote and ConsumerAdvocate, but the product remains unchanged. SelectQuote, for example, "allows consumers to compare insurance policies for life, auto, and

[15] We note that Amazon has also entered the logistics industry and built warehouses, however, this is not part of Amazon's platform; rather, employees or contractors of Amazon are working in Amazon-owned warehouses, in a manner that is consistent with traditional warehousing.

home insurance from providers including American International Group, Prudential Financial Inc [sic] and Liberty Mutual" (Franklin, 2020). Insurance discovery platforms indirectly affect insurance industries because transactions continue to take place between traditional insurance providers and consumers, but increasingly, consumers are using platforms to compare policy options and subsequently get routed to providers.

A final example of an indirect effect is in the Full-Service Restaurant (722511) industry, where individuals increasingly turn to Yelp (or Google) for reviews and recommendations. Once a person decides on which restaurant they will dine, they purchase their meal from the restaurant, however, Yelp and other review platforms are crucial in the decision-making process, and they passively capture value through users' data. In some sense, Yelp is similar to Yellow Pages, whereby consumers discover phone numbers and addresses of restaurants, but recent reports have exposed that Yelp is creating their own phone number on restaurant pages so that they can charge restaurants a 15 to 20% "referral fee" (Jeffries, 2019). Of course, with Covid-19 pandemic the role of platforms as intermediaries became more pronounced than ever.

Third, consider industries that are *not affected* by platforms. In general, industries that are unaffected by platforms tend to be in niche markets (e.g., Pipeline Transportation of Crude Oil—486110, or financial services industries), or in markets where ongoing interpersonal relationships are important (e.g., Elementary and Secondary Schools—611110). Industries that are dominated by B2B services, such as Food Service Contractors (722310), also tend to be unaffected by platforms. Although B2B platforms are growing—for example, Amazon has a special program for selling to businesses—B2C platforms are currently more pervasive.[16]

[16] In some cases, we were uncertain as to whether a platform was impacting the industry. To illustrate, for Formal and Costume Wear Rental (532281), while we believed that platforms might exist, we were unable to identify them,

This section showed that platforms are active in a far broader range of industries than previously understood. We have introduced direct and indirect effects, the effects of the latter should not be underestimated as we demonstrated above in the case of Yelp, whose pervasive impact has only been increased by the Covid-19 pandemic. Moreover, it is possible that industries that have not yet been affected by platforms could become susceptible to platform transformation in the future. As Section 4 will show using a detailed case study of Amazon, once planted in an industry, a platform firm can rapidly spread across industries and accumulate power.

4. Amazon—The Expansionary Trajectory of a Mega-Platform Firm[17]

The previous section identified the remarkable number of NAICS codes within which Amazon is present. In this section, we explore the macro-level evolution of platforms by

suggesting that if they do exist, they do not possess significant market power, so they were classified as unaffected by platformization.

[17] Methodological Note: The Amazon data used in this section was collected from a variety of sources. The most important sources for acquisitions were CrunchBase and Wikipedia, both of which have lists of Amazon acquisitions. For line extensions, the entire corpus of Amazon Annual Reports and press releases for all nations were downloaded. The Amazon website was also examined historically through the Wayback Machine. Three books on Amazon were used. The most important books were *The Everything Store* by Brad Stone (2013), *One Click* by Richard Brandt (2011), and *Amazonia* by Richard Marcus (2005). We also read countless newspaper articles. Unfortunately, the level of detail in press releases was too great to catalogue every product extension onto a spreadsheet. We also did not read the press releases for non-US countries, as the paper is not about the diffusion of Amazon services globally. Finally, press releases are useful but also limited. They do not announce every market withdrawal, nor do they announce every extension in sales categories or in private-label goods. For example, one of Amazon's largest private label goods is batteries (Cresswell, 2018), and yet we do not include its introduction in our timeline, instead subsuming it under the private label vector. Also, listing every acquisition or sales line extension, e.g., tab listed on what is now a drop-down list on the landing page, is not possible. We listed only the ones we judged to be the most important. Similarly, Alexa Internet, Inc., a web traffic analysis firm, was acquired in 1999 by Amazon for $250 million. It remains a subsidiary, but should it be included in a graphic of Amazon's expansion? Alexa Internet is also expanding by offering new services, but in revenue terms it is not significant. And yet, as a web services vendor, it can be seen as the precursor to AWS. Moreover, it also contributed the brand name "Alexa", the name for Amazon's cloud-based voice service.

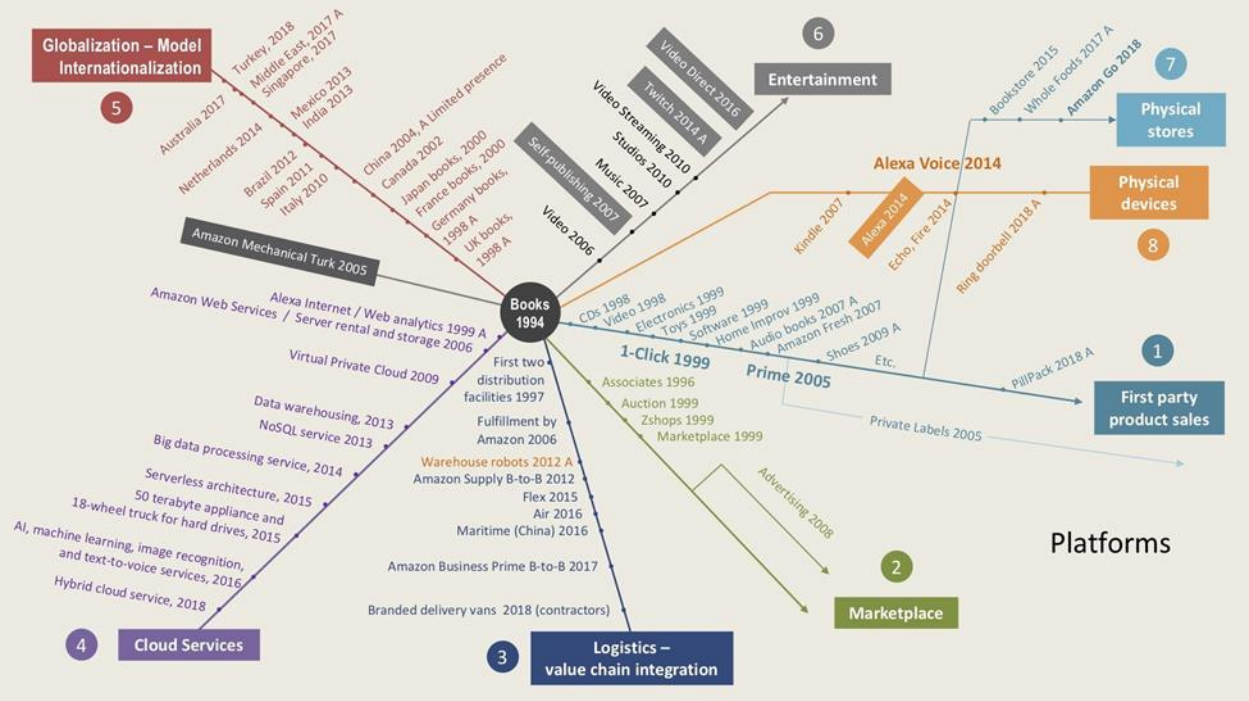
investigating the scale, scope, and dynamics of Amazon's expansion.[18] We identify eight expansion vectors that illustrate the ways through which Amazon is intermediating increasingly large sectors of the economy and how the firm's power has become so encompassing.[19] When it is applicable, we note the similarities between Amazon's expansion vectors and the growth of other mega-platforms.

As **Figure 1** shows, Amazon is not one platform, but rather a constellation of services and platforms that include the Marketplace, Web Services, Logistics, Whole Foods, and beyond. **Figure 1** divides the many Amazon services and platforms into eight expansion vectors: first party product sales, Marketplace, logistics, cloud services, model internationalization (globalization), entertainment, physical stores, and physical devices. While these vectors are visually depicted as separate, Amazon connects them by drawing upon its complementary assets such as massive computing capability, a logistics network, and a huge consumer base (Aversa et al., 2020). An important part of Amazon's strategy has been to invest heavily in infrastructure, including the development of a powerful logistics channel and data services for its own use and to rent to other firms, and Amazon Prime, which bundles entertainment channels, discounts of various products, and rapid delivery. Amazon Prime was a unique marketing initiative, which, as a subscription that provides discounts, knits many of these vectors together for the consumer.

Figure 1: Amazon Expansion Vectors

[18] Helmond et al. (2019) show this evolution can and does occur at the micro-level of the boundary resources that gradually envelope ecosystem complementors.

[19] Because of the nature of digital technologies, Amazon operates with decentralized product teams that can constantly undertake experiments, such as A/B testing and introduction of beta versions, to gauge market reaction, effectively probing the market digitally and in a variety of directions simultaneously. Amazon is constantly iterating and evolving, thus, linear models cannot adequately describe the platform's expansion vectors. It is also important to understand that these expansions often draw on a variety of Amazon capabilities



In the following sections, we explore these eight expansion vectors that show Amazon's growth from when the company was founded in 1994 to the present. Each vector is studied as a separate dimension. It is the unfolding and evolving synergies between these various vectors that make Amazon's business model so dynamic and sector entry often irresistible.[20] When Amazon enters a sector, the competition is effectively skewed as its entrance is supported by powerful complementary assets and possibility of cross-subsidization.

4.0 A Brief History of Amazon's Early Growth

In 1994, Amazon was established as an e-commerce book retailer . The goal was to create an easy-to-use retail website that had an enormous searchable catalog and the ability to deliver the book to its purchaser rapidly,[21]effectively as an intermediary with fulfillment

[20] On dynamic capabilities, see Teece et al. (1997).

[21] At its inception, Amazon could offset part of the delivery price by not charging state and local sales tax—a subsidy that balanced part of the delivery cost.

outsourced to third parties (Stone, 2013). During the dot-com bubble, Amazon was one of hundreds of retail websites—nearly all of which initially specialized in selling a single product. In 1996, in an effort to attract more customers, it introduced the Amazon Associates Program to encourage referrals, whereby anybody with a website dedicated to books could link to the Amazon site and get commission for any purchases—creating a digitally-enabled ecosystem of recommenders. In 1997, Amazon established two distribution centers to ship its most popular books.

With the website growing rapidly and having established two distribution centers, in 1998, Amazon began selling CDs. CDs, as a product, were similar to books: a non-perishable, standardized product that benefit from a large searchable catalog. Selling books and CDs meant that Amazon's data centers would see increased traffic, with orders of the most popular titles fulfilled from Amazon's distribution centers—thus increasing their utilization—and the other fulfilment outsourced to distributors. With the addition of CDs, Amazon collected more data on customer's preferences, improving their recommendation algorithm. As we will point out repeatedly in this case, constantly improving and extending data and software allows for the creation of "value paths," which is the integument that links all of Amazon's business processes together. In 1998, Amazon began its international expansion. By 1999, just four years after it was founded, Amazon had become the largest bookseller in the United States.

4.1 Vector One: First-Party Product Sales

Horizontal expansion began with book sales, illustrated at the center of **Figure 1.** This vector exploited the growing number of shoppers that Amazon's website attracted. This traffic could be leveraged to add new product categories. Additional product categories resulted in

economies of scope, as the initial products added had many similarities with books and could be sold in a similar fashion, but also economies of scale as the number of website visitors increased . Amazon also benefited from the fact that the fixed costs of the data centers, though high, would achieve greater utilization and could be expanded at relatively low-cost. By the mid-2000s, Amazon had become a first-party seller of a remarkable variety of goods spanning a wide variety of retail categories, including compact disks, video cassettes, electronics, toys, and home improvement tools. In 2007, Amazon Fresh was launched for home delivery of groceries.

The evolution of the Amazon landing page illustrates the horizontal expansion across product sales. In 2000, the Amazon (2000) landing page displayed eight header tabs for books, music, DVD and video, electronics and software, toys and video games, home improvement, auctions, and zShops. These eight product categories and two services were listed on the left-hand sidebar of the landing page. By 2004, the number of header tabs had decreased to six, only including books, apparel and accessories, electronics, toys and games, music, and magazine subscriptions (Amazon, 2004). Yet, the left-hand sidebar listed 29 product categories and subcategories and ten other services. In 2020, Amazon's landing page did not list any products in the headers, but had a dropdown search menu at the top of the page with over 50 categories.

In 2005, Amazon launched its private label products business, which has significantly expanded since.[22] For example, Amazon's most successful private label product is batteries. In the US, Amazon controls about one-third of all online battery sales and the share is growing

[22] The introduction of its own private label merchandise, which is not unique to Amazon, introduced another source of competition for Amazon's direct suppliers and also to vendors in the Marketplace. The introduction of private labels has been criticized, because Amazon has so much information on customers, it can optimally position its private labels against the suppliers of its inventory and the Marketplace vendors that are dependent upon it (Khan, 2016; Cutolo and Kenney, 2021).

(Kabiri and Helm, 2018). While the exact size of Amazon's private label business is unknown, estimates ranged from $1 billion to $2.5 billion in 2019. Beyond its most important white-label brand, Amazon Basics, there were at least 135 separate Amazon brands (Kart, 2019).

In 2005, Amazon introduced what would be a key marketing innovation, Amazon Prime. For $79 per year, Amazon offered free, two-day shipping within the contiguous United States on all eligible purchases and discounted one-day shipping rates. As a result, Prime members were locked into Amazon as their primary online vendor. However, Prime became a major drag on Amazon's earnings because shipment was increasingly expensive—a point we return to in the logistics section—though it also forced competitors to respond in kind, thereby increasing costs of competitors even more as they had less volume (Sainato 2019).

Each product extension leveraged the increasing digitization of a remarkable variety of content-based industries. The most significant product extension came in 2005, when Amazon began offering authors the opportunity to digitally self-publish their book to be sold directly on the Amazon marketplace. In this instance, Amazon used digital technologies to enter into direct competition with book suppliers, namely, publishing houses. In 2008, Amazon purchased Audible to deliver audiobooks. These initiatives were synergistic with the introduction of the Kindle e-reader in 2007, but with Kindle it controlled the customer interface. Amazon continued to expand to encompass many segments of the supply chain—from publishing to selling and distributing books—as the digitization of books proceeded.

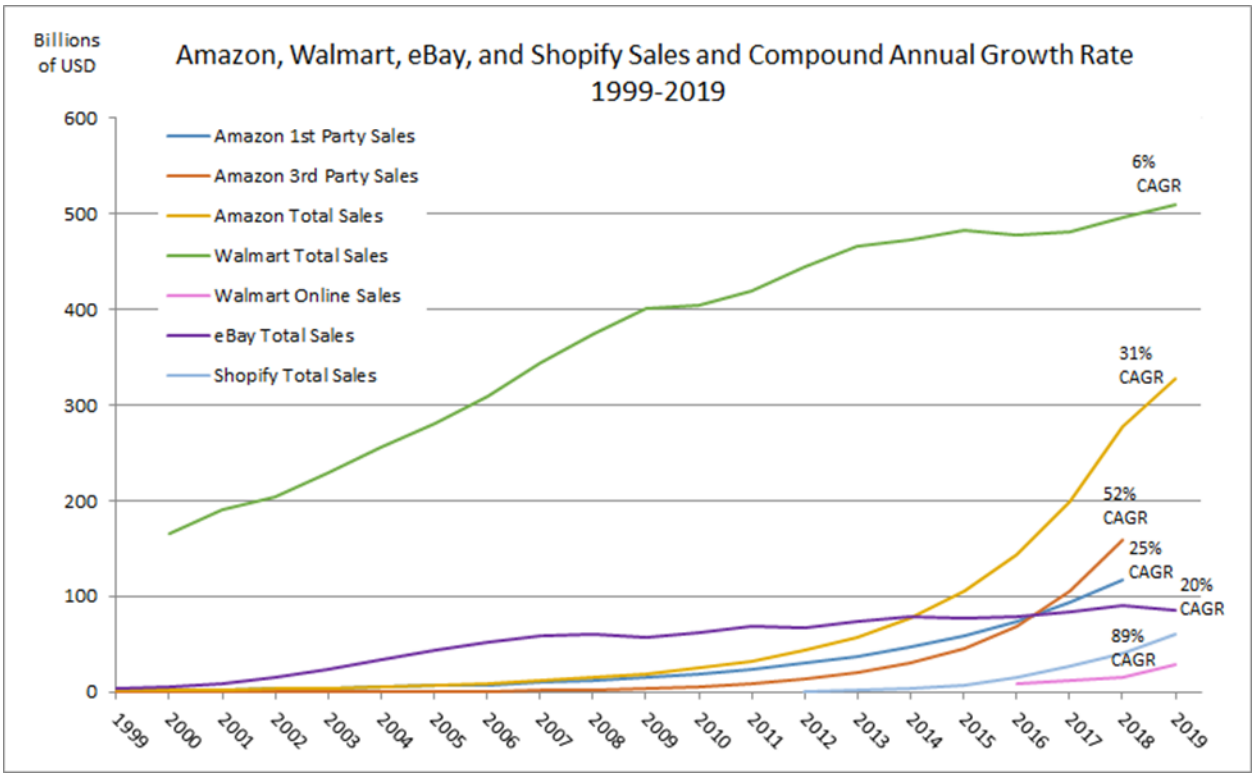
In 2012, Amazon introduced a business-to-business sales platform through which manufacturers and wholesalers could sell to retailers and each other. The decision to enter the wholesale market leveraged the same data and logistics networks Amazon developed for

consumers and, if widely adopted, will allow Amazon increased algorithmic visibility into a new part of the supply chain.

As can be seen in **Figure 2**, Amazon sales grew rapidly. By the mid-2010s, Amazon had become a rival to the world's largest physical retailer, Walmart, as measured by total sales compound annual growth rate. At that time, Amazon did not have physical stores and could stock a far greater number of products in its warehouse than retailers such as Walmart (Jiang et al., 2011). Yet, despite rising sales and product variety, Amazon was only minimally profitable. If Amazon wished to be "the everything store", it would have to stock an enormous number of products that would only be ordered seldomly—the eponymous but very important "long tail" of demand and inventory costs (Brynjolfsson et al., 2006).[23]

Figure 2: Amazon, Walmart, eBay, and Shopify Sales and Compound Annual Growth Rate, 1999-2019

[23] Long tails are important because when an e-commerce buyer visits a site and cannot find the item for which they are looking, another vendor is only a "click away." If that vendor has the product, the buyer is likely to return for other purchases, thus creating a potential lock-in.



Data sources: Amazon, eBay, Shopify, and Walmart annual reports. For Amazon, third-party sales were derived from Jeff Bezos's letter in the Amazon 2018 Annual Report and calculated by year. The Amazon total 2019 GMV is an underestimate because it was calculated by extrapolating the 2018 to 2019 growth rate of Amazon's sales and applying this growth rate to the Amazon's total GMV in 2018. For Walmart, estimated online sales derived from MarketPulse (2020) estimates of Walmart.com online sales since 2016.

4.2 Vector Two: The Marketplace Platform

In the late 1990s, Amazon's most significant competitor was eBay (see **Figure 2**), whose auction business model meant that it was an "asset-light" platform with its "inventory" owned by sellers. eBay merely collected fees, making it very profitable. Amazon's first effort to integrate third-parties was the previously mentioned Associates Program in 1996. In 1999, Amazon introduced an auction platform, which became Amazon's first two-sided platform. That same year, Amazon introduced zShops, which was an e-mall platform that enabled merchants to create a virtual storefront on Amazon. Both of these failed: in Auctions, eBay had already tipped the

auction market and for zShops, the e-mall concept never proved successful even for its foremost proponent, Yahoo!. Even as the eBay platform was profitable, Amazon continued to lose money on its first-party sales.

In 2002, Amazon introduced its Marketplace, which was a platform through which third-party merchants could sell goods. Amazon's innovation was that the third-party merchant's goods appeared in the search results right next to Amazon's own products if Amazon had that product in its inventory. For customers, the selection in terms of products, particularly used ones, exploded. For third-party merchants, it meant access to an enormous number of Amazon customers. Allowing third-party vendors, initially in used books, but soon in any product category, provided consumers with greater choice, attracting yet more consumers and igniting powerful cross-platform network effects. Vendors stocked an enormous variety of products, and as a result, Amazon no longer needed to stock little demanded items. To illustrate this point, Jiang et al. (2011, 757) found that Amazon listed 8,010 different digital camera products in 2010, relative to Walmart.com, which had 408 products and a Walmart store with 30 products in stock. Moreover, Amazon offered a range of price points for each camera.

The Marketplace not only allowed third-party vendors access to Amazon's customers, but it also provided them with templates and analytical tools and handled billing and payment. As **Figure 2** shows, the Marketplace grew extremely rapidly and, by 2015, accounted for more than 50% of all Amazon merchandise sales. The enormous diversity of Amazon's independent merchants meant Amazon now truly had the greatest selection of products, thereby locking customers in. These third-party sellers provided not only revenue, but also increased Amazon's sales and crowded out potential rival platforms. The increased data-processing volume allowed

Amazon to further expand its data processing operations, which benefited massively from increased scale (Facility Executive, 2016). As **Figure 2** indicates, Amazon's third party sales exploded. By 2019, when combined with its own sales, Amazon transacted approximately 38% of all online retail sales (Day and Soper, 2019). As a result, in terms of total sales, in 2020 Amazon was approaching the size of Walmart and growing far more rapidly. Moreover, though Walmart.com was created in response to Amazon and Walmart.com grew quickly, sales were largely concentrated in the online grocery sector. In 2019, Walmart.com lost an estimated $1 billion per year on $28 billion in sales (Del Rey, 2020). However, the Covid-19 crisis dramatically increased grocery sales for both Amazon and Walmart. By one estimate, Amazon Fresh and Whole Foods online sales increased 400% from March 2019 to March 2020 (Del Ray, 2020), while Walmart's online sales increased by 74%, though from a much smaller base (Bain, 2020).

Amazon Marketplace's dominance had grown to the point that in 2018, 47% of shopping searches began with Amazon, as opposed to 35% with Google. This contrasts with 2015 when Google had 54% and Amazon 46% (Garcia, 2018). Amazon's increasing importance in product search has allowed it to introduce on-site advertising for its third-party vendors. This quickly became a new source of income for Amazon, thereby squeezing its third-party vendors. As Amazon achieved dominance, it has had the advantage of being able to observe any and all products introduced by its third-party vendors and thus has unique insight into "hot" new products. Effectively, the third party sellers acted as pioneers and innovators identifying for Amazon attractive new markets for Amazon to consider entering (Khan, 2019; Zhu and Liu, 2018).

The Marketplace platform is central to Amazon's pervasiveness in retailing. The sheer variety of products sold on Amazon means that it competes with every retailer from Walmart to small shops. The third-party vendors ensure that Amazon is present in nearly all sectors of consumer retail. To ensure that Amazon has the lowest prices, it pressures sellers to not offer cheaper items through any other venue including the vendor's own store and, until 2019, had a most favored nation clause in all contracts with its vendors forbidding them to offer the product less expensively elsewhere (Kelly, 2019). This strategy reduced the consumers' incentive to buy directly from the seller's website—an action that would deprive Amazon of its commission. Amazon's market power against its third-party vendors is apparent in its ability to constantly raise listing fees, change the terms of service, and even to introduce its own private label brands in direct competition with its independent vendors (Cutolo and Kenney, 2021). Because Amazon is dominant, third-party vendors do not have the choice to exit Amazon and enter a close substitute marketplace if they dislike Amazon's terms and conditions.

Amazon's power is so great that there is even a Wikipedia (2020) entry for the "Amazon effect," which refers to the fact that Amazon's entry into a new retail market segment results in a devaluation of the incumbents in the segment. Finally, Amazon and the gradual shift to online sales has led to the closure of many brick-and-mortar retail operations, which has been accelerated by the Covid-19 pandemic of 2020, leaving Amazon more powerful than ever (e.g., Danziger, 2020; Randewich, 2020).

4.3 Vector Three: Logistics and Value Chain Integration

The developments in Amazon fulfillment must be understood in the context of the ever-increasing sales volume and increasing diversity of products sold, as described in the previous

sections. This meant that as it expanded its existing warehouses and built ever more, they also became more capable of managing product variety, not only in terms of numbers but also in shape, size, and weight. The constant addition of new warehouses meant they could be located ever closer to customers, enabling faster delivery (Kenney and Zysman, 2020), though, during the initial period, these were in states with low in-state volumes and low sales taxes. For example, Amazon served the high-sales tax California market from low-sales tax Nevada and, similarly, the high-sales tax East Coast markets from low-sales tax Virginia.

Ever-increasing volume allowed Amazon to build more warehouses in other locations, thereby increasing proximity to its customers (Kenney and Zysman, 2020). Prior to 2002, fulfilment was considered less important than expanding sales and adding new product categories. But in 2002, Amazon decided that fulfillment should be one of its core competencies and began a massive investment program to increase capabilities and capacity. This meant transforming logistics from bulk warehousing and delivery to retail outlets, to one aimed at greater efficiency in fulfilling individual product orders (Stone, 2013, 171). This transformation required new software and far greater data processing capability—once again, demanding even more data processing capability that Amazon delivered internally.

As sales grew, Amazon was able to negotiate increasingly large volume discounts from logistics suppliers. In 2006, Amazon introduced Fulfillment by Amazon that allowed its Marketplace sellers to use Amazon fulfillment infrastructure. Because of its volume, Amazon could get much better terms from shippers than its sellers could get on their own. As a result, Amazon saves money for sellers and makes a profit on the arbitrage.

As Amazon became the dominant online retail platform, Amazon collected ever more data and could discover new patterns such as what would be purchased, where, and when. Armed with this data and with the introduction of Amazon Prime two-day delivery, Amazon expanded its ownership of the physical assets, including warehouses, long-haul trucks, airplanes, and cargo ships, to deliver products for Chinese vendors. To accomplish this Amazon also built an international freight-forwarding operation. As delivery and warehouse labor became an ever greater part of Amazon's wage bill, it began automating its warehouses. In pursuit of this goal, it purchased warehouse robot maker Kiva Systems in 2012.

As it built out its warehouse operations, Amazon remained dependent upon last-mile delivery firms. But in 2015, Amazon introduced Flex, which recruited individuals with their own vehicle to deliver packages from its warehouses to consumers. With this new service, Amazon began competing with delivery firms such as FedEx and UPS. In September 2018, Amazon announced a pilot program called Delivery Service Partner. For this program, it purchased 20,000 delivery vans and recruited a massive network of dedicated contractors. Amazon provided trucks, training, and on-demand support to these delivery service providers(Soper, 2020). In late 2019, it announced the gradual purchase of 100,000 electric delivery vans (Blanco, 2019). These dedicated contractors are supplanting Amazon Flex operations. In 2019, in the US, Amazon delivered 3.5 billion packages, which accounts for 50% of all of the items sold on its website—the other 50% was delivered by USPS, UPS, and FedEx. In comparison, UPS delivered 5.2 billion packages in 2019 (Del Rey, 2019). With its infrastructure built around every major US city and the building of a network of delivery contractors, in 2019, Amazon introduced next-day delivery. While this dramatically raised Amazon's costs, the costs of

matching this initiative are proving to be difficult or impossible for its competitors. In the Covid-19 crisis, this infrastructure provided Amazon with an ability to gain even more market share.

4.4 Vector Four: Cloud Services

To operate, Amazon built an ever-expanding cloud computing infrastructure. In 2006, Amazon decided to offer the use of its computing capacity to outside entities and introduced Amazon Web Services (AWS). Amazon recognized that data processing was a commodity and processing benefited from economies of scale—bigger data centers were less expensive to operate on a per calculation basis (Barrosso and Hölzle, 2009). Amazon was the first of the mega-platforms to recognize that it could make a profit by providing on-demand computing (cloud) service to third-parties at a lower price than they could do it in-house. This initially allowed Amazon to use its own computing infrastructure more efficiently by providing the service to others and doing load shifting. Initially, AWS only provided computing, but as **Figure 1** shows it rapidly expanded to data storage, software, and other related activities. In 2016, it introduced artificial intelligence and image recognition functionalities. AWS also provided APIs so that third parties could provide yet other services to AWS users. By Quarter Four 2019, AWS was the largest software-as-a-service cloud provider with approximately 32.4% of the US market, followed by Microsoft and Google (Canalys, 2020).

While not a part of AWS, we have chosen to include Amazon Mechanical Turk (AMT) here because, like AWS, it is a service developed for internal use that was made available to outside parties. AMT is a contract labor platform upon which one can hire people to undertake

micro-tasks that require some human intelligence.[24] The tasks include classifying images to train artificial intelligence and answering simple surveys. While AMT has received much attention from academics due to its extremely low levels of compensation (Gray and Suri, 2019), the actual revenue for Amazon is minimal.

4.5 Vector Five: Globalization and Model Internationalization

Only four years after its establishment, in 1998, Amazon expanded to Western Europe by acquiring book sales websites in the United Kingdom and Germany. In 2000, Amazon established Japanese and French subsidiaries. As of 2019, Amazon operated subsidiaries in 16 countries and the Middle East, but, of course, shipped to many more countries. The decision about whether to establish a subsidiary in each country was eased as Amazon was able to analyze existing data on products and shipping to those countries, providing deep insight into the size of the market opportunity. With the exception of its abortive foray into the Chinese market, Amazon largely reproduces its US model in each country. The typical pattern is to use local logistics providers, but then expand its operations over time.

The Amazon Marketplace attracted international customers quickly. As in the US, it began building out its fulfillment infrastructure and introduced Prime to foreign countries and has become a powerful competitor in those nations, also. In 2019 Amazon was estimated to be responsible for 27% of all online sales in Germany (Lommer, 2019). In 2015, it established a German logistics network and by 2019 operated four sorting centers, thirteen distribution centers, and had started building a delivery operation (Rozycki and Kerr, 2019). In the United Kingdom,

[24] Mechanical Turk is allusion to a late 18th century fake chess-playing machine that was actually powered by a hidden human being.

Amazon captured 30% of the online retail market (Skeldon, 2019) and was expanding its logistics operations in 2019. In Japan, Amazon was in a struggle with the local e-commerce firm, Rakuten, with each capturing approximately 20% of the market (Brigham, 2019). Amazon's internationalization benefits from its infrastructure of software, data processing, and logistics knowledge, which has made it the largest online retailer, outside of China, in the world.

4.6 Vector Six: Entertainment

Amazon expanded to music and video in the mid-2000s by selling music and video downloads. In 2010, Amazon established its own studios and began commissioning exclusive content, thereby competing with established, powerful rivals including Apple, Netflix, and Disney. In 2014, Amazon purchased the gaming platform, Twitch. As was the case earlier with self-publishing, in 2016, Amazon introduced the Video Direct platform that allowed independent filmmakers to upload films and get paid per view, or 50% of the purchase price (Patel, 2019). All of these applications are extremely data-intensive and thus increased demand for computation, which was becoming one of Amazon's core competencies. While Amazon has not yet dominated the entertainment industry in the way that it has in online shopping or cloud computing, but, leveraging Amazon Prime membership and its knowledge of its customers' viewing habits, it has become a significant competitor.

4.7 Vector Seven: Physical Stores

Amazon also embarked upon what was initially a tentative expansion into physical retail by opening a bookstore in Seattle in 2015. In 2017, Amazon acquired the Whole Foods chain for $13.7 billion along with it a national network of stores and distribution centers. The acquisition

provided Amazon with a network of grocery stores that it could use to strengthen its position in the online grocery delivery sector where it competed with Walmart and traditional grocers. Finally, in 2018 Amazon introduced the highly automated Go convenience stores. By 2020, there were only 26 Amazon Go stores in the United States. With the exception of Whole Foods and the competition in online grocery delivery with grocery chains and Walmart, physical stores are only a small part of Amazon's vast portfolio.

4.8 Vector Eight: Physical Devices

As Amazon sought to lock its customers into its internet-based offerings, it found it necessary to introduce various physical devices. As an increasing amount of content was being consumed online, it might be possible for physical device or operating system firms such as Microsoft to disintermediate Amazon in core markets such as, books, music, and video. In particular, books were increasingly being read online on notebook computers. In response, Amazon began building a dedicated eBook reader, the Kindle, which it introduced in 2007. Of course, the Kindle facilitated Amazon's sales of e-books. In the following generations, the Kindle became a more capable device. In 2011, Amazon introduced the Fire, which could be used for streaming video, thus moving to protect its video sales business. In 2014, Fire TV was introduced to allow high-definition streaming for televisions. Finally, in 2014, Amazon introduced the Fire Phone, which experienced little market success.

Another important area of growth is Amazon's voice recognition software Alexa, which is used in Amazon's smart speakers, Ring doorbells, and on the Amazon app for iOS and Android. It is used in approximately 100 million home smart speakers to order products and for various other purposes. Later, Alexa was incorporated into various consumer electronics such as

smart appliances. Alexa has some open APIs that have spawned an ecosystem of app makers that have created new functionality (Hardawar 2017; Pymnts, 2020). Amazon has competition, but in voice recognition, Amazon, Google, and Apple are the world leaders.

4.9 Synthesis

Amazon began as a bookseller, but now offers tens of millions of products of different products, new and used, offered by itself and by the millions of third-party vendors. Today, Amazon is simultaneously one of the largest retailers in the world, one of the largest online marketplaces, provider of entertainment services, a provider of cloud computing services and physical logistics, and operator of a contract work platform (Amazon Mechanical Turk) across over twenty nations. On the surface, this could appear to be an incoherent conglomerate overseeing too many services to manage them efficiently. However, these services are intertwined together through data, software, and processing power into a single, expansive, and powerful firm capable of experimenting with and, where successful, growing on many vectors simultaneously.

Amazon, as one of the platform giants, is both an anomalous and iconic case study for exploring the scale and scope of the most powerful mega-platforms. It is an anomaly because of its size and power. However, it is an iconic case for the same reasons. Amazon is instructive because of its remarkable expansion into many other industries—a characteristic not only of the mega-platforms but also of the smaller sectoral platforms. This characteristics is, in large part, a result of the generativity (Zittrain, 2008) and recombinability (Henfridsson et al., 2018) of digital technologies to provide low-cost and often software-enabled opportunities for experimentation

and expansion. Successful platforms such as Amazon can become so central to socio-economic activity that they resemble infrastructure in the sectors that they organize (Plantin et al., 2018).

Amazon is not a conglomerate, in the sense of a disparate set of activities that are connected largely by financial linkages and allocation decisions (e.g., Rajan et al., 2000; Stein, 1997). As we showed, Amazon's disparate activities, including those that were entered through acquisition, are based upon synergies that are achieved through software and sharing computational and other services in such a way so as to achieve economies of scale, scope, and learning. While we simplified Amazon's expansions to eight vectors, very often a new initiative will combine two or more capabilities from the different vectors (Aversa, 2020). Because of the low cost of experimentation, a new initiative can be undertaken, and, if successful, receive more resources to expand further. If unsuccessful, it can be abandoned with little loss.

Amazon illustrates the many dimensions of pervasiveness. The first dimension is its presence across so many different retail sectors—many of which, prior to website sales, were considered different sectors, though the big box retailers such as Walmart had already begun to erode such sectoral barriers. As our study showed, Amazon, with its own inventory and the inventory of third-party Marketplace vendors, has a presence in 9% of NAICS industries. Part of Amazon's pervasiveness reflects that Amazon has rapidly grown to become the third largest package delivery firm in the US,[25] expanding its reach into logistics and warehousing industries. Similarly, AWS is the largest cloud services provider in the world and has approximately 30% of the market, excluding China, broadening Amazon's reach to IT industries.

[25] If one includes USPS, then Amazon is the fourth largest package delivery firm in the US.

Given the Covid-19 pandemic, it seems almost certain that the adoption of e-commerce will continue, with 40% of total market share prior to the pandemic, Amazon will likely become even more pervasive. It has been rumored to be considering expanding from its automobile comparison site (i.e., Amazon Vehicle) to direct sales, selling pharmaceuticals (i.e., PillPack acquisition), or even providing healthcare services. Amazon's various complementary assets, ranging from enormous amounts of data on customers, global-class AI software, inexpensive computing, and a sophisticated logistics system optimized for single-package delivery provide it with the resources to expand further into other products and services.

Because of its sheer size and the fact that for many products, it is the largest single online retailer, with 15% first-party and 35% overall market share, Amazon has enormous power over suppliers. For example, Evans (2019) estimated that "Amazon has 50% or more of the US print book market, and at least three-quarters of publishers' eBook sales." The other aspect of its power is that if it wishes to enter a segment, it can subsidize entry, lowering prices equivalent to or below cost, as it did to enter the online diaper business (Oremus, 2013). In other market segments, such as groceries, Amazon captures about 24% of the online grocery business, where it is roughly tied with Walmart. Prior to the Covid-19 crisis, this was less than 10% of the entire groceries market (Droesch, 2020). Therefore, in groceries, Amazon has little power, though it can subsidize its losses from its other more profitable business areas. In this respect, Amazon's market power must be measured in each market—and yet, it is undeniable that the movement of retailing online is having a devastating effect on many retailers whose sales are based upon physical stores.

As with any platform, Amazon has tremendous leverage over the third-party vendors in its Marketplace or, what Cutolo and Kenney (2021) term "platform-dependent entrepreneurs (PDEs)." Because of its enormous market share, Amazon can unilaterally change the terms and conditions of participation—and does so often. Moreover, it can introduce its private label competitive products in particularly lucrative segments that its third-party vendors pioneered. While the Marketplace is the largest Amazon platform, there are others such as self-publishing, Twitch, and Video Direct, where the PDEs are similarly vulnerable. While the users of AWS are larger organizations and, thus, less vulnerable and can threaten to move to Microsoft or Google's cloud offerings, if a lock-in does occur, it can be difficult to escape.

The Amazon case study illustrates how, in the digital world, one strong position can be leveraged to expand into adjacent activities. Of course, in retail, horizontal diversification is relatively clear as one can add another product or category, though even superstores such as Walmart have limited shelf space compared to a website and warehouses. Expansion can also occur in unexpected ways, such as Amazon's decision to open its website to third-party vendors—a decision that broadened selection and eliminated the need to permanently stock little demanded items, as vendors could offer no end of variety. The decision to offer cloud computing was expansion in an entirely different direction but, again, was a choice to build interfaces so external parties could use Amazon's data centers. After that decision, it kept adding more software functionality. Similarly, building a logistics network was an integration down the value chain to the final consumer, but the decisions were all predicated upon the ability to "see" where customers were and the cost of delivery. In some cases, the expansions required relatively small investments, while others, such as the building of the logistics operations, required enormous investments.

Massive expansions such as those described above attract the greatest attention, but expansion also occurs within product sectors. Amazon's expansion from physical books to e-books and audible books is well-known and quite complex (Bearson et al., 2020). However, in video, it has also expanded its presence in a variety of ways. In 1998, Amazon added video cassettes. In contrast to Netflix, Amazon simply sold video cassettes and then DVDs. In 2006, it offered video downloads and then added streaming in 2010. Also, it included video downloads into Amazon Prime, thereby leveraging the Prime customer base to the exclusion of other video services. In 2010, it also opened Amazon Studios where it commissioned content creation. In 2016, it added Video Direct, which was similar to self-publishing. In the case of video entertainment, Amazon followed the affordances created by increasing bandwidth, the ability to store and serve data, and its ever larger customer base.

As with other Amazon services, the various operations could be coordinated to reinforce each other. For example, Prime encouraged more purchasing, thus increasing the number of items to be handled. Increased purchases led to greater data flow, which could be analyzed to optimize warehouse location, delivery scheduling, and monitoring. Amazon purchased the smart doorbell firm, Ring, and introduced a service by which deliveries could be placed inside the house, if the buyer wanted more secure delivery. With the introduction of next-day delivery from Prime members, Amazon could satisfy customers far more conveniently than could traditional retailers such as Walmart and, more rapidly, than online competitors such as eBay that do not have a delivery infrastructure. While most of these delivery innovations were pioneered in the US, Amazon rapidly introduced them into Western Europe and, more slowly, but also seemingly inexorably, into Japan.

Analytically, comprehending Amazon's expansion path is difficult because it has expanded on multiple vectors simultaneously. Moreover, it has not focused on short-term profitability, but rather, growth facilitated by access to low-cost capital—first from venture capital and then from a stock market willing to forgive losses and low profit margins. Though not representative of the typical platform firm, Amazon illustrates the remarkable flexibility that digital technologies afford for expansion into other business sectors. And, perhaps, most important, how these platforms firms have become increasingly central to the operation of ever more parts of the contemporary economy.

5. Conclusion

Platforms are ever more pervasive in the global economy and, as a result, are shifting the locus of power and value capture to the platform as the intermediary. They are becoming the infrastructure of ever more industrial sectors of the economy (Plantin et al., 2018). Because infrastructures have powerful lock-ins, the users, i.e., the establishments in our NAICS industries, are often at the mercy of the platform. For example, Yelp has insinuated itself as the intermediary and, indeed, is a vital infrastructural element in the entire restaurant industry. Nonetheless, it is a profit-maximizing firm intent on extracting the maximum profit from restaurants in its ecosystem. When we view a platform in this way, we see that value creation is accompanied by value extraction that is only possible because it has become a powerful infrastructural component for the entire industry.

While this paper was largely descriptive, an appropriate strategy when examining a new phenomenon that is still developing, it suggests a number of research directions. First, the NAICS codes, themselves, allow for more granular research. Because the NAICS codes are a

long time-series, it should be possible to identify when the first platform firm entered an industry and thus discern the impact on establishment numbers and employment. It is also possible to exploit our "direct", "indirect", and "no effect" distinctions to see whether there are differential impacts—with the "no effect" being the control group. Finally, because the NAICS codes data is available at the sub-national level, it is possible to study the impact geographically. Researchers and policymakers have only recently become aware of the increasingly pervasive role platforms are playing in the economy. By providing an admittedly aggregate picture, we create the basis for further attempts to measure the impact of platforms.

The pairing of the macro-level Amazon case study with the NAICS data allowed a granular understanding of how a single platform firm grew by creating new platforms and non-platform capabilities. In the winner-take-most markets within which platforms operate, once a particular market is captured, if growth is the goal, then it is incumbent to add new services or penetrate new sectors. Amazon's expansion is thus an extreme case due to its size, but it is not atypical, rather, it exposes a dynamic. While expansion is, of course, a compulsion for capitalist enterprises; however, in the platform world these characteristics occur at the speed of software upgrades and extensions.

The insights from the case study of the Amazon, illustrates the scale and scope that platform firms can develop, as they enter and transform the dynamics of previously self-contained industrial sectors. We separated Amazon's expansion into eight vectors to clarify its evolution over time. While the case of Amazon is exceptional, it provides insight into the expansionary dynamics typical for platform economy firms. To illustrate, Uber began in black limousines, but now has many different types of services, including UberEats, JUMP Electric

Bike Share, UberCash, and Uber Health. As another example, Airbnb expanded globally from accommodation to other services such as vacation rentals, and then added multi-family property owners and hosting teams, Experiences, and Neighborhoods. Another promising field of research would be understanding the motivations and dynamics of platform expansion.

The recent investigations and enforcement actions in Europe against the mega-platforms such as Google, Amazon and Facebook, suggest policy makers in Europe and the US are becoming aware of the power of online platform firms (US House of Representatives 2020; U.S. District Court for the District of Columbia, 2020; European Commission, 2020a; European Commission, 2020b). Their focus on the mega-platforms is understandable, but we have shown that platforms are also reorganizing narrower sectors and may be having powerful impacts there as well. Our demonstration of the pervasiveness of platforms suggests that a more profound regulatory response predicated upon understanding the mechanisms that platforms use to reorganize industries may be more fruitful than the current reactive policy-making.

Platforms are becoming a fundamental organizing principle for the entire economy. Better understanding of the logic and dynamism of platform firms would contribute to the formulation of better policy, to ensure that these are not just organizations extracting value and wealth, but also contributing to greater societal goals.

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APPENDIX

Additional Details on Methodology

Two individual evaluators were trained to execute the identification process. The training involved 43 industry categories (7% of the sample of 460 NAICS codes) and the set classification protocol. The evaluators understood the definition of exchange platforms and were well-versed in literature on platforms, thus, they had substantial prior knowledge about how a platform's operation could be considered significant and the ways in which platforms intermediate transactions. Some online research was undertaken in the more obscure industry categories, but the majority of the exercise was based on pre-existing knowledge. Upon completion of the classification exercise, the coders percent agreement was 68%. If we consider only whether the coders agreed on whether platforms affected a given industry, and not on the type of effect (i.e., direct or indirect), then agreement increased to 80%. Accounting for the random chance of agreement, inter-rater reliability for the former is 0.5144 and for the latter is 0.5456, representing moderate agreement in both cases (see Appendix tables 2.1 and 2.2).

To determine the final classification, we undertook the following procedure in the case of disagreements: if the coders agreed that platforms affect the industry, but disagreed on whether the effect was direct or indirect, the default would be indirect. If the coders disagreed on whether a platform was present in the industry or not, the decision was discussed with Martin Kenney and a consensus was reached. In the few cases that remained unresolved, we defaulted to "no effect".

This exercise allowed the identification of platform presence in a remarkable diversity of service industries, and provides quantitative evidence of the extent to which platforms are

becoming pervasive. Yet, narrow functional typologies of platform firms, such as the one presented in this section, whereby platform firms are classified according to their main activity, have advantages and disadvantages (OECD, 2019, 63). In this case, there are a few methodological issues to note. First, although a framework for decisions was developed and a resolution process occurred in the case of disagreements, the analysis was still dependent upon coder discretion. We mitigated bias by using two coders. Furthermore, as noted previously, we account for random chance of agreement in our estimation of inter-rater reliability, which represents moderate agreement (see Appendix tables 2.1 and 2.2). Second, to determine whether an industry might be affected by platforms, we asked coders to identify a platform with a "reasonable market presence" in the US, which, also, is subjective. As **Table 2** shows, there are ways to interpret reasonable market impact, but they are not uniform. Third, identifying a single platform firm with market presence in an industry does not mean that the industry has been entirely transformed or reorganized by platforms.

Appendix Table 1.1: Three-Digit NAICS Code Analysis

NAICS Code	Industry	Platform Effect, Direct and Indirect (%)	Direct Effect (%)	Indirect Effect (%)	No Effect (%)
441	Motor Vehicle and Parts Dealers	100	29	71	0
442	Furniture and Home Furnishings Stores	100	100	0	0
443	Electronics and Appliance	100	100	0	0

	Stores				
444	Building Material and Garden Equipment and Supplies Dealers	100	100	0	0
445	Food and Beverage Stores	100	100	0	0
446	Health and Personal Care Stores	100	100	0	0
447	Gasoline Stations	0	0	0	100
448	Clothing and Accessories Stores	100	100	0	0
451	Sporting Goods, Hobby, Musical Instrument, and Book Stores	100	83	17	0
452	General Merchandise Stores	100	100	0	0
453	Miscellaneous Store Retailers	89	56	33	11
454	Nonstore Retailers	50	50	0	50
481	Air Transportation	80	80	0	20

483	Water Transportation	67	17	50	33
484	Truck Transportation	100	67	33	0
485	Transit and Ground Passenger Transportation	91	82	9	9
486	Pipeline Transportation	0	0	0	100
487	Scenic and Sightseeing Transportation	100	0	100	0
488	Support Activities for Transportation	15	0	15	85
492	Couriers and Messengers	100	100	0	0
493	Warehousing and Storage	25	25	0	75
511	Publishing Industries (except Internet)	100	43	57	0
512	Motion Picture and Sound Recording Industries	90	80	10	10
515	Broadcasting (except	100	100	0	0

	Internet)				
517	Telecommunications	0	0	0	100
518	Data Processing, Hosting, and Related Services	100	100	0	0
519	Other Information Services	100	75	25	0
521	Monetary Authorities-Central Bank	0	0	0	100
522	Credit Intermediation and Related Activities	57	43	14	43
523	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	50	50	0	50
524	Insurance Carriers and Related Activities	40	0	40	60
525	Funds, Trusts, and Other Financial Vehicles	50	50	0	50
531	Real Estate	56	0	56	44
532	Rental and	43	14	29	57

	Leasing Services				
533	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	0	0	0	100
541	Professional, Scientific, and Technical Services	79	42	38	21
551	Management of Companies and Enterprises	0	0	0	100
561	Administrative and Support Services	73	24	48	27
562	Waste Management and Remediation Services	9	9	0	91
611	Educational Services	71	24	47	29
621	Ambulatory Health Care Services	76	10	67	24
622	Hospitals	0	0	0	100
623	Nursing and Residential Care Facilities	83	50	33	17
624	Social Assistance	33	11	22	67

711	Performing Arts, Spectator Sports, and Related Industries	91	0	91	9
712	Museums, Historical Sites, and Similar Institutions	100	0	100	0
713	Amusement, Gambling, and Recreation Industries	70	20	50	30
721	Accommodation	86	71	14	14
722	Food Services and Drinking Places	88	0	88	13
811	Repair and Maintenance	89	0	89	11
812	Personal and Laundry Services	63	0	63	38
813	Religious, Grantmaking, Civic, Professional, and Similar Organizations	54	0	54	46

Note: For NAICS sector, subsector, industry group, NAICS industry, and national industry descriptions, please see 2017 NAICS code descriptions.

Appendix Table 1.2: Sectors with Highest Concentration of Industries Affected

Sector (Two-Digit)	Subsectors with >70% of Industries Affected, Direct & Indirect	Subsectors with >70% of Industries Directly Affected	Subsectors with >70% of Industries Indirectly Affected	Subsectors with >70% of Industries Not Affected
Retail Trade (44-45)	441, 442, 443, 444, 445, 446, 448, 451, 452, 453	442, 443, 444, 445, 446, 448, 451, 452	441	447
Transportation and Warehousing (48-49)	481, 485, 487, 492	481, 485, 492	487	486, 488, 493
Information (51)	511, 512, 515, 518, 519	512, 515, 518, 519	.	517
Finance and Insurance (52)	.	.	.	521
Real Estate and Rental and Leasing (53)	.	.	.	533
Professional, Scientific, and Technical Services (54)	541	.	.	.
Management of Companies and Enterprises (55)	.	.	.	551
Administrative and Support and Waste Management and Remediation Services (56)	561	.	.	562
Educational Services (61)	611	.	.	.
Health Care and Social	621, 623	.	.	622

Assistance (62)				
Arts, Entertainment, and Recreation (71)	711, 712, 713	.	711, 712	.
Accommodation and Food Services (72)	721, 722	721	722	.
Other Services (Except Public Administration) (81)	811	.	811	.

Appendix Table 2.1: Inter-Rater Reliability				
	Reviewer 1			
Reviewer 2		**1**	**2**	**3**
	1	126	27	37
	2	26	77	18
	3	23	13	104

1=direct; 2=indirect; 3=no effect. Inter-rater reliability was calculated using this website: http://vassarstats.net/kappa.html.

Appendix Table 2.2: Inter-Rater Reliability			
	Reviewer 1		
Reviewer 2		**1+2**	**3**
	1+2	256	55

	3	36	104

1=direct; 2=indirect; 3=no effect. Inter-rater reliability was calculated using this website: http://vassarstats.net/kappa.html.

CLASSIFICATION PROTOCOL

Instructions:
In this exercise, we are attempting to determine how platforms are affecting industries across the economy. Keep in mind that when we say "platform", we are referring to a digital exchange platform firm. In some instances, platforms are *directly* affecting an industry, meaning one may buy a good or service directly through the platform from a third-party. For example, taxi services may be bought through Uber/Lyft in the transportation industry. On the other hand, platforms may *indirectly* affect an industry, meaning that platforms connect buyers and sellers, but no purchase is made on the platform itself. For example, Yelp connects people to restaurants in the restaurant industry and Zillow connects buyers to real estate agents in the real estate industry. Finally, it is possible that some industries are virtually unaffected by platforms, meaning that their transactions have been largely unchanged by platforms.

With that in mind, please go through the following questions for each of the listed industries to determine whether and how an industry is affected by platforms. Below is an example of what your spreadsheet will look like based on the examples provided:

2017 NAICS Code (44-81)	Title	Platform	Effect	Note
485310	Taxi Service	Uber/Lyft	1	
722511	Full-Service Restaurants	Yelp	2	
531210	Offices of Real Estate Agents and Brokers	Zillow/Trulia	2	
812332	Industrial Launderers	N/A	3	

NOTE: Please only use US platform firms (i.e., founded in the US and with a reasonable, based on your interpretation, market presence in the US). You may use the same platform as many times as it is important in that particular NAICS code. You may search online for the name of a platform, however, we hope that you draw from your knowledge of popular platforms rather than researching platforms. We are excluding Google Search from this exercise because it is virtually everywhere. We are also excluding backend services such as Salesforce, Shopify, and AWS (Amazon Web Services). We are not considering Zoom. It is possible for both a direct and indirect effect to exist for a given industry. In that case, please "note" that in column E and choose the dominant effect.

You will find descriptions of the 2017 NAICS codes here.

Classification Protocol

1. In this industry, are any transactions/interactions intermediated in a significant way by a platform firm?
    a. If yes, go to question 2. Please put the name of the identified platform(s) in Column C.
    b. If no, then this industry is **not affected** by platforms, e.g., transactions remain unchanged by platforms. Please put a 3 in Column D.

2. Are transactions/interactions completed through the platform's website or app?
    a. If yes, then this industry is **directly affected** by platforms, i.e., platforms are mediating transactions between a buyer and seller. Please put a 1 in Column D.
    b. If no, go to question 3.

3. Are transactions/interactions completed off of the platform's website or app?
    a. If yes, then this industry is **indirectly affected** by platforms, i.e., individuals do not buy through the platform. Please put a 2 in Column D.
    b. If no, then go to question 4.

4. Are transactions/interactions completed as a result of clicking an ad viewed on the platform's website or app, which then directs the user to make a purchase on another website?
    a. If yes, then this industry is **indirectly affected** by platforms, i.e., individuals do not buy through the platform. Please put a 2 in Column D.
    b. If no, go to question 5.

5. Are transactions/interactions completed for "free" on the platform's website or app?
    a. If yes, then this industry is **directly affected** by platforms, i.e., platforms are mediating transactions between a buyer and seller. Please put a 1 in Column D.
    b. If no, go to question 6.

6. If none of the above are true, please explain how transactions are intermediated via platform in the "Note" Column G: _____