



Platform Competition: A Systematic and Interdisciplinary Review of the Literature

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Over the past three decades, platform competition—the competition between firms that facilitate transactions and govern interactions between two or more distinct user groups who are connected via an indirect network—has attracted significant interest from the fields of management and organizations, information systems, economics, and marketing. Despite common interests in research questions, methodologies, and empirical contexts by scholars from across these fields, the literature has developed mostly in isolated fashion. This article offers a systematic and interdisciplinary review of the literature on platform competition by analyzing a sample of 333 articles published between 1985 and 2019. The review contributes by (a) documenting how the literature on platform competition has evolved; (b) outlining four themes of shared scholarly interest, including how network effects generate “winner-takes-all” dynamics that influence strategies, such as pricing and quality; how network externalities and platform strategy interact with corporate-level decisions, such as vertical integration or diversification into complementary goods; how heterogeneity in the platform and its users influences platform dynamics; and how the platform “hub” orchestrates value creation and capture in the overall ecosystem; and (c) highlighting several areas for future research. The review aims to facilitate a broader understanding of the platform competition research that helps to advance our knowledge of how platforms compete to create and capture value.

Keywords: platform; ecosystem; complementor; two-sided market; competition

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Interest in platform competition—where competing firms facilitate interactions between two or more distinct groups of users who are connected via an indirect network—has grown significantly over the past three decades. Early examples of platforms that captured the attention of scholars include telecommunications networks (e.g., Katz & Shapiro, 1985; Majumdar & Venkataraman, 1998), electronic payments and automated teller machine networks (ATMs) used by banks (e.g., Gowrisankaran & Stavins 2004; Kauffman, McAndrews & Wang, 2000; Salop, 1990), video cassette recorders (VCRs; e.g., Cusumano, Mylonadis & Roosenbloom, 1992; Ohashi, 2003), computer hardware and software (Brynjolfsson & Kemerer, 1996; Gandal, 1994, 1995; Katz & Shapiro, 1985; D. Kim & Kogut, 1996), air transport (e.g., Encaoua, Moreaux, & Perrot, 1996), and credit cards (Rochet & Tirole, 2002, 2008). These industries demanded our attention because they exhibited patterns of price setting and customer demand that did not match traditional economic models; they often exhibited high levels of interfirm interdependency and coordination, and they often became dominated by one or a few leading platforms (Schilling, 2002; Suarez, 2004).

Notably, the rise of the internet has dramatically increased both the scale and scope of platform competition, to the point where the current economic landscape has been described as a “platform economy” by the popular business press. Digital technology has facilitated the reorganization of industries around platforms and has transformed many firms into either platform sponsors or producers of complementary goods for a platform ecosystem. Mobile operating systems (Kapoor & Agarwal, 2017), social networking services (Z. Li & Agarwal, 2017), and online video games (Boudreau & Jeppesen, 2015) are but a few examples of industries wherein platforms have become the predominant business model, and firms that successfully operate (in) these platform ecosystems often serve millions of end users.¹

The explosive rise of the platform economy has led to a flurry of academic research across a variety of disciplines, including management and organizations (M&O), information systems (IS), economics, and marketing. Scholars across these fields have addressed questions about the various aspects of platform competition, including the drivers of network effects (e.g., Brynjolfsson & Kemerer, 1996; Gupta, Jain, & Sawhney, 1999; Zhu & Iansiti, 2012); pricing strategies for multisided platforms (e.g., Hagiu, 2006; Parker & Van Alstyne, 2005; Rochet & Tirole, 2003); the effective governance of platforms (e.g., Huber, Kude & Dibbern, 2017; Rietveld, Schilling, & Bellavitis, 2019; Wareham, Fox, & Giner, 2014), including platform openness (e.g., Boudreau, 2010; West, 2003) and competing with complementors through vertical integration (e.g., Gawer & Henderson, 2007; Pierce, 2009; Zhu & Liu, 2018); and several other questions relating to the delicate balance of creating and capturing value in platform ecosystems (e.g., Adner & Kapoor, 2010; Hannah & Eisenhardt, 2018).

On the one hand, it is noteworthy the degree to which scholars across these fields agree on the questions that are deemed important. On the other hand, it is striking the limited extent to which scholars acknowledge results and insights published in fields outside of their own. This is in part due to differences in terminology that inhibited scholars from identifying each other’s work. For example, while “multihoming” (i.e., the practice of making a product compatible with multiple platforms) has recently become a hot topic in the strategic management research (e.g., K. Park, Seamans, & Zhu, in press), work in economics on “horizontal compatibility” (enabling all or most complements to multihome) or exclusive agreements between a complement and a platform (the opposite of multihoming) dates back at least to the late 1990s (e.g., Besen & Farrell, 1994; Caillaud & Jullien, 2003; Shapiro & Varian, 1998). There

is similar blurriness around other terms: Many articles published today on “platform competition” would have been termed “standards battles” in the 1990s, and there is considerable confusion in the academic community about the degree to which economic work on “two-sided markets” generalizes to the broader subject of platforms and ecosystems. It is difficult to integrate research across fields under any circumstances, but it is particularly difficult when the fields use different terminology or focus on different angles of the same phenomenon. Doing so, however, provides great opportunity to advance our knowledge, leveraging each field’s insights to the other and accumulating collective learning curve benefits. There thus appears to be an opportunity for a systematic and integrative review of the platform competition literature, summarizing insights from research across these fields.

To this end, this article offers a systematic review of the literature on platform competition, published in the fields of management and organizations, information systems, economics, and marketing in the period of 1985 to 2019. Starting from a Boolean search query on Clarivate’s citation indexing service Web of Science, we generated a sample of 333 articles published in leading academic journals within the aforementioned fields. We hand-collected several data points for each of these articles, including contributing author(s), publication title, field of study, backward and forward citations, conceptual themes, methodology, and empirical setting. The resulting data set formed the starting point for the quantitative and qualitative analyses that we conducted to arrive at the findings reported in this review.

The review makes three contributions: First, it presents an overview of the literature in terms of how research on platform competition has evolved, how it is distributed across the various fields, its methodological orientations, and so on. Second, we document four of the most prevalent themes in the platform competition research that emerged over time and represent the shifting makeup of the platform competition research community and its interests:

1. The first theme that appears in the literature (and originates with the earliest economic work) pertains to how network externalities generate “winner-takes-all” markets and the ramifications for market structure, interfirm coordination, and typical platform strategies (e.g., price, quality, bundling, trialability, licensing).
2. A second theme that emerged relatively early but got more traction later is corporate-level strategy, that is, how platform competition influences the payoff to vertical integration or related diversification. For example, when will (or should) a platform produce its own complements and engage in competition with its complementors?
3. A third theme added more nuance to the literature by documenting the effects of heterogeneity within the categories of platform, complementors, and end users. For example, it is shown that the network effects of a given installed base can be stronger or weaker depending on the nature of the product or its market. Furthermore, some complements differentially play to the strengths of a platform’s features or attract different (types of) end users. This means that the typical prediction that more users is always better is overly simplified; to be successful, platforms need strategies that account for heterogeneity in both complements and end customers.
4. Finally, a fourth theme that has gotten more recent attention in the scholarly literature focuses on the ways in which the platform governs, or orchestrates the creation and capture of value in, the ecosystem. The hub of a platform, sometimes referred to as the platform sponsor, is in a unique position to exert influence over both membership and behavior in the ecosystem. Furthermore, through its own activities (such as giving preferential access to some complementors, using price discrimination among user groups, or providing selective promotion to

some complements), it can exert significant control over the success and failure of the members of its ecosystem.

For each of these four themes, we take stock of the existing research and outline the current consensus and ongoing debates. Finally, building on these insights, we highlight several areas for future research and offer a number of suggestions for topics of further study.

This is not the first review on the topic of platform competition. A handful of review articles have preceded ours. Roson (2005) was the first to conduct a literature review on two-sided markets in economics. His review outlines the peculiar characteristics of two-sided markets and their implications for pricing and competition. It was written at a time when many of the field-defining studies had yet to be published. McIntyre and Subramaniam (2009) were the first to review the literature on network externalities from a management perspective. Their main thesis is that there is an endogenous element to the drivers of network effects, which is relatively understudied in the field of strategy. McIntyre and Srinivasan (2017) build on McIntyre's earlier work and review the literature on networks from a strategic management perspective. One important addition made by this review is the identification of complementors as an important avenue for future research. Finally, De Reuver, Sørensen, and Basole (2018) review research on digital platforms from an information systems view, focusing primarily on inconsistencies in the literature and how to best resolve them.

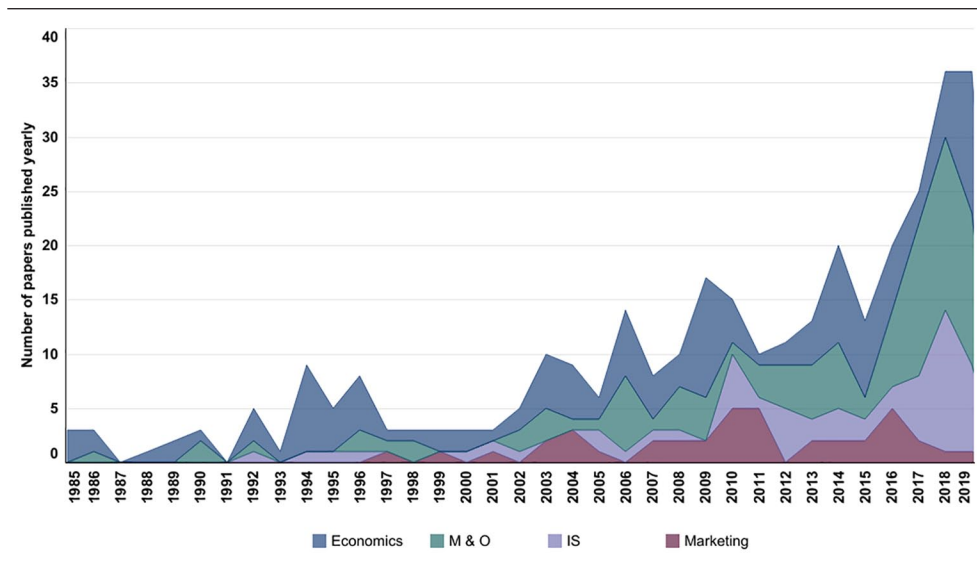
The current literature review adds to these existing works in that it is both systematic and interdisciplinary, starting from a predefined sample of academic articles published across multiple fields of inquiry. We show the evolution of the platform competition literature in these different fields of research (often under the guise of different terms), identify commonalities across fields, and characterize typical methods and empirical bases.

We proceed by outlining how the research on platform competition has evolved, where it is published, an overview of the methods used, and the empirical settings in which the research is situated. We also briefly document some of the key theoretical foundations platform competition research has drawn upon. However, since a large portion of the research on platforms has been phenomenon-driven work that builds theory rather than tests it, we have opted to organize this review around four major conceptual themes that characterize the evolution of the research on platforms. These themes emerged over time as platforms became better understood and researchers were able to shift their focus to increasingly nuanced problems. Thus, the themes offer an illuminating way of understanding both how different communities of scholars entered the platform competition research field and how platforms became increasingly better understood as a complex and dynamic way of competing. Following this, we highlight a number of avenues for future research on platform competition. We end with a brief section outlining some concluding remarks.

Overview of the Platform Competition Literature

A list of 333 scholarly publications was retrieved from Clarivate's citation indexing service, Web of Science (WOS), in January 2020 using a combination of Boolean search queries and backward citations, subject to screens for relevancy (see Appendix A for detailed information about our methods of article identification and data collection). Of the 333 articles

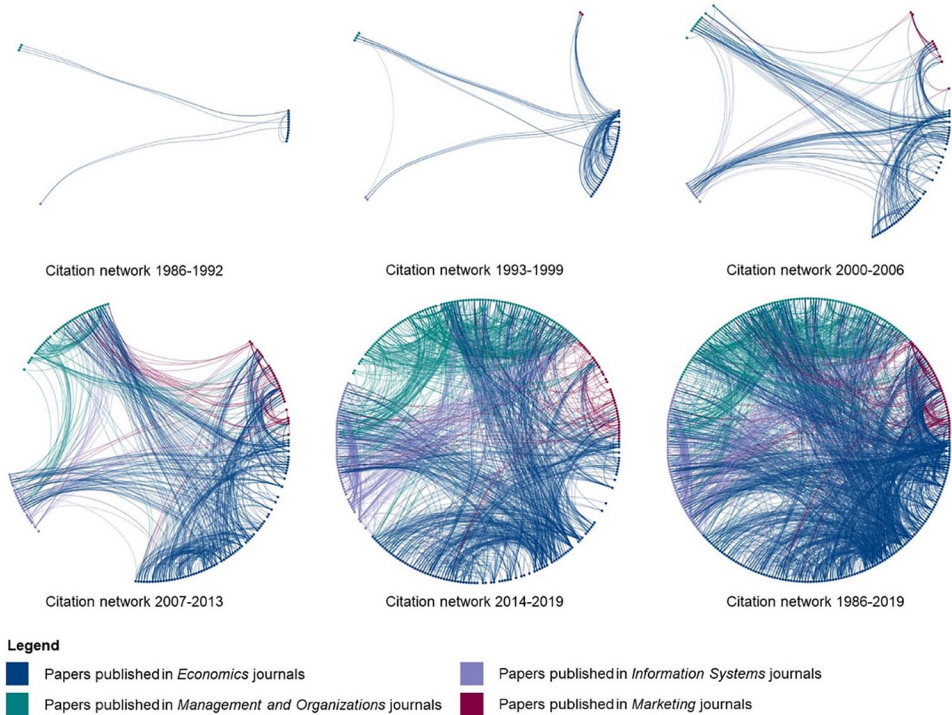
Figure 1
Number of Published Articles on Platform Competition, by Year and Field



under consideration, 130 are published in economics journals, 104 are published in management and organizations journals, 59 are published in information systems journals, and 40 are published in marketing journals. As shown in Figure 1, research on platform competition has grown exponentially since the publication of the first articles in 1985. Early contributions came from economics, while research in management and organizations, information systems, and marketing gained steam around 2003, when scholars began exploring the implications of network externalities and complementarities on factors other than price and market structure. As digitalization allowed more industries to be organized around platforms, research of this kind—especially in management and information systems—took off around 2010, and the number of articles published across all four fields has grown rapidly since.

Research on platform competition has its bedrock in economics. Concepts like network externalities (Church & Gandal, 1992; Katz & Shapiro, 1985, 1986, 1992), increasing returns and lock-in effects (Arthur, 1989; David, 1985), compatibility (Farrell & Saloner, 1985), and systems competition (Katz & Shapiro, 1994) form the basis for the bulk of the research conducted on platform competition. Not surprisingly, these early studies are among the highest-cited articles in our sample. Even when research on platform competition started branching out to management, information systems, and marketing, work in economics has remained foundational. As shown in Figure 2 and in Appendix B, until the late 2000s, articles from fields outside of economics predominantly cited work in economics. For example, nearly 80% of all backward citations in articles in management and organizations published from 2000 to 2006 in our set were to articles in economics. We find similar statistics for articles published in information systems (80%) and marketing (53%) during the same time frame. As these fields began developing a critical mass of work, citation patterns became more

Figure 2
Citation Networks in Platform Competition Research per Time Period, Color Coded by Field of Backward Citation



Note: Nodes are color coded by field and ordered by year of publication. Links are color coded by the field of backward citation. Included in each graph are the articles that were published during the relevant time period and their backward citations. The bottom-right citation network from 1986 to 2019 represents the full citation network based on the sample of 333 articles included in our article set.

inward looking. While economics still captured nearly 42% of all backward citations by articles published from 2014 to 2019, backward citations by articles in information systems, management and organizations, and marketing to articles published within the same field accounted for 37%, 50%, and 34%, respectively. These statistics far exceed the share of platform competition research articles published in these fields during the same time frame, suggesting that scholars were increasingly likely to cite work from their own field.

Though a wide range of methods is represented in our article set, the dominant method is theoretical modeling, used either exclusively (136 articles) or in combination with empirical estimation (30 articles). Table 1 shows that theoretical models are the preferred method in economics, information systems, and to lesser extent, marketing. In contrast to these fields, research in management and organizations has been mostly conceptual, with the bulk of the articles (44 articles) utilizing some form of verbal theory development or conceptualization. Hypothesis testing using large data sets is the second-most-popular methodology in management, with

Table 1
Distribution of Methods Within Field (in percentages)

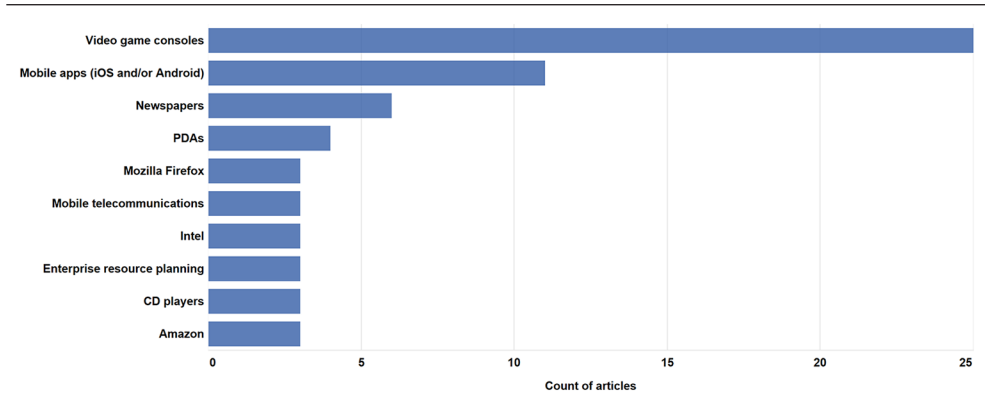
Field	Model	Empirical Estimation	Conceptual	Model and Estimation	Longitudinal Case Study	Multiple Case Study
Economics	69.47	9.92	6.87	11.45	2.29	
IS	42.37	37.29	6.78	3.39	5.08	5.08
M&O	10.58	31.73	42.31	1.92	5.77	7.69
Marketing	25.00	45.00	2.50	27.50		

33 studies claiming contributions via empirical estimation. Empirical estimation has also been an oft-deployed method in information systems (22 articles) and in marketing (18 articles). Qualitative analysis through longitudinal or multiple-case-study designs is used primarily in management and organizations (14 articles) and in information systems (6 articles).

The research on platform competition has explored a wide array of empirical contexts, such as academic journals, airlines, magazines and newspapers, spreadsheets, and VCRs (see Figure 3).² Video game consoles, often mentioned as a canonical example of a multisided platform market (e.g., Clements & Ohashi, 2005; Shankar & Bayus, 2003), is by far the most studied industry, with 25 studies in the sample analyzing data from this setting. A somewhat comparable—and more recent—industry that has been examined intensely is the mobile application (app) industry, including such players as Apple's iOS and Google's Android (e.g., Foerderer, Kude, Mithas, & Heinzl, 2018; Kapoor & Agarwal, 2017). These articles are preceded by a number of studies looking at a similar empirical context: personal digital assistants (PDAs; e.g., Boudreau, 2012; Nair, Chintagunta & Dubé, 2004). Combining studies on mobile app stores and PDAs, there are 13 studies in our sample analyzing these markets. Other contexts that have been frequently studied include newspapers (Argentesi & Filistrucchi, 2007; Seamans & Zhu, 2014, 2017), CD players (Basu, Mazumdar & Raj, 2003; Gandal, Kende, & Rob, 2000), enterprise-resource-planning software (Ceccagnoli, Forman, Huang, & Wu, 2012; Huang, Ceccagnoli, Forman, & Wu, 2013; Wareham et al., 2014), Intel (Casadesus-Masanell & Yoffie 2007; Gawer & Henderson, 2007; Perrons, 2009), Mozilla's Firefox web browser (Song, Xue, Rai, & Zhang, 2018; Tiwana, 2015a, 2015b), spreadsheets (Brynjolfsson & Kemerer, 1996; Gandal, 1994, 1995), and VCRs (Cusumano et al., 1992; Ohashi, 2003; S. Park, 2004). Single-industry studies are the norm, and only a few studies combine data from multiple settings. Notably, the majority of these studies are in marketing (i.e., R. Srinivasan, Lilien & Rangaswamy, 2004; Stremersch, Tellis, Hans, Franses, & Binken, 2007; Tellis, Yin, & Niraj, 2009; Wang, Chen, & Xie, 2010; Wang & Xie, 2011), while only one such study was published in the field of management and organizations (i.e., Schilling, 2002).

The articles in our set draw from a wide range of theories, including neoclassical economics and dynamic monopoly theory (e.g., Bensaid & Lesne, 1996; McCabe & Snyder, 2018; Rochet & Tirole, 2003), the resource-based view (e.g., Shankar & Bayus, 2003; M. Sun & Tse, 2009), dynamic capabilities (e.g., Helfat & Raubitschek, 2018; Pierce, 2009), modularity theory (e.g., Jacobides, Cennamo, & Gawer, 2018; Yoo, Henfridsson & Lyytinen, 2010), social network theory (e.g., Abrahamson & Rosenkopf, 1997; Afuah, 2013; Nambisan &

Figure 3
Top 10 Most Studied Empirical Settings in Platform Competition Research



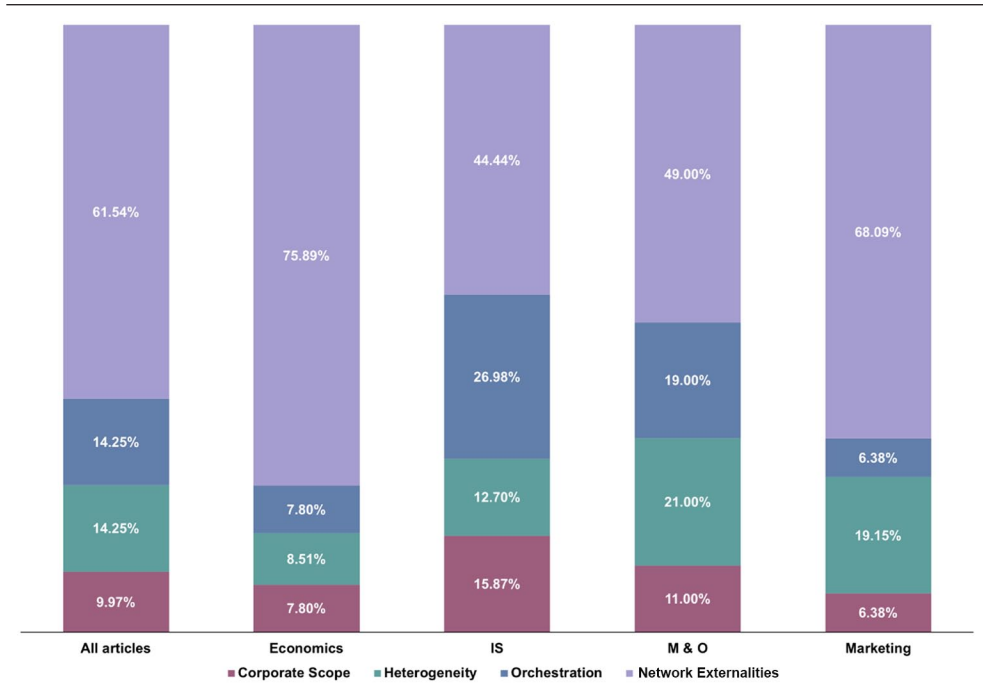
Sawhney, 2011; Suarez, 2005), transaction cost economics (e.g., Lehdonvirta et al., 2019; Niedermayer, 2013), and more. As noted previously, however, it should be emphasized that most of the work has been phenomenon driven and focused more on building a basic understanding of the dynamics of platform competition and how firms within them create value, solve bottleneck problems, and maneuver themselves into better bargaining positions for capturing value. Accordingly, many of the studies either are atheoretical or emphasize “theory building” (e.g., Casadesus-Masanell & Hałaburda, 2014; Choi, 1994; Eckhardt, Ciuchta & Carpenter, 2018; Huber et al., 2017; Parker, Van Alstyne, & Jiang, 2017; Rolland, Mathiassen, & Rai, 2018; A. Srinivasan & Venkatraman, 2018; Tiwana, 2015a, 2018).

We thus did not find it plausible or particularly useful to organize the research on platform competition around theoretical foundations. Instead, we found it much more fruitful to organize the research around conceptual themes that emerged over time and to highlight the increasing sophistication—and interdisciplinarity—of inquiry into platforms.

Themes in Platform Competition Research

We identified four conceptual themes of common interest to platform competition researchers: (a) network effects and their implications; (b) platform ecosystems and corporate scope; (c) heterogeneity in platforms, complements and users; and (d) platform governance and ecosystem orchestration.³ These four themes represent both the level of analysis of the research and the temporal pattern of the shifts in focus. For example, the early research in our article set tended to focus on functional-level strategies (e.g., pricing, investments in quality) and outcomes (e.g., market share) for an individual firm or product. However, the next wave of research began to consider corporate-level strategies, like vertical integration (or disintegration) and alliances with and subsidization of complementors. Later, researchers began to shift their focus to consider a level that is simultaneously more macro (because it considers multiple firms and agents) and micro (because it examined sources of heterogeneity among different complementors and customers). Finally, the research only recently (with

Figure 4
Distribution of Themes in Platform Competition Research, by Field



a few notable exceptions) began to look at the even more macro level of analysis, the governance of an entire platform ecosystem (i.e., the strategies by which a single or few players in the ecosystem orchestrate the behavior and outcomes of the other members of the ecosystem). These four themes reflect broad research streams, which are observed in all of the disciplinary fields (see Figure 4). We next discuss each of the themes in more detail.

Theme 1: Network Externalities and Their Implications

Some of the earliest foundational work that gave rise to our understanding of platforms was research on network externalities (or, network effects) (see Table 2). In the 1980s, researchers began to study markets that had increasing returns to adoption that led to “tipping” or “lock-in” effects (e.g., Arthur, 1989; David, 1985; Farrell & Saloner, 1985, 1986; Katz & Shapiro, 1985, 1986). The primary drivers they identified for these increasing returns to adoption were learning-curve effects (i.e., where production quality and efficiency increase with the number of units produced) and network externalities (i.e., where users derive more value from a good the more users there are of the same or similar good). In markets where compatibility across a network is important (e.g., trains, phone networks, computer operating systems) or in which the availability of complementary goods drives a product’s value (e.g., movies on a streaming service, applications for a smartphone), the network externalities of a product could be a large portion of its overall value (Choi, 1994; Farrell & Saloner, 1992).

Table 2
Summary of Theme 1: Network Externalities and Their Implications

Synopsis: Network externalities create “lock-in” effects with ramifications for pricing, quality, coordination, and market structure.

Key questions:

- How do network externalities affect consumer price sensitivity?
- When will installed base be more important than product quality?
- Do network externalities create excess inertia in the market?

Typical variables:

Antecedents or moderators: Installed base, number of complementary goods, market share, product price, research and development, quality, interplatform compatibility

Outcomes: Technology adoption, sales, profits, market share, price, social welfare

Exemplar articles:

- [Economics] Katz, M. L., & Shapiro, C. 1985. Network externalities, competition, and compatibility. *American Economic Review*, 75: 424-440.
- [Information systems] Parker, G. G., & Van Alstyne, M. W. 2005. Two-sided network effects: A theory of information product design. *Management Science*, 51: 1494-1504.
- [Management and organizations] Shankar, V., & Bayus, B. L. 2003. Network effects and competition: An empirical analysis of the home video game industry. *Strategic Management Journal*, 24: 375-384.
- [Marketing] Nair, H., Chintagunta, P., Dubé, J. P. 2004. Empirical analysis of indirect network effects in the market for personal digital assistants. *Quantitative Marketing and Economics*, 2: 23-58.

Questions for future research:

- How does the strength of network externalities and the platform’s pricing strategy vary with time and other dynamic factors, such as competition?
- How can new entrants dethrone a dominant platform, especially in situations where market positions are sticky due to network externalities and lock-in effects?

Number of articles in theme: 223

This led to a variety of outcomes that initially flummoxed mainstream economists. First, it meant that the “best” technology did not always win (Arthur, 1989; David, 1985; Katz & Shapiro, 1985, 1986). A technology that got a head start in adoptions due to investment by a sponsor, for example, could rise to dominate the market even if it was considered inferior by technological standards. Furthermore, if learning-curve effects were strong, an inferior technology adopted earlier could become the superior technology through accrued improvements or cost advantages. A well-known example of an inferior technology becoming the dominant standard is the QWERTY keyboard design, which remains the de facto design to date despite the availability of purportedly superior alternatives, such as the Dvorak Simplified Keyboard design that is meant to significantly increase typing speed.

Second, and relatedly, these markets could exhibit either inadequate or excess inertia by economic standards—they just did not behave the way traditional economic models predicted they should (Arthur, 1989; De Bijl & Goyal, 1995; Farrell & Saloner, 1985, 1986; Katz & Shapiro, 1992; Shy, 1996). Economies of scale were, for example, supposed to be constant or decreasing, leading to reliable equilibria that could be determined mathematically; the increasing returns to scale that characterized markets with strong network externalities led to more volatile dynamics that were harder to compute. Furthermore, when a large portion of the value of a technology comes from its network externalities (i.e., the size of its installed base and/or the availability of complementary goods), a new technology may not be able to displace an incumbent technology even when the new technology’s benefits

over the old technology are large and well understood (Schilling, 1998; Suarez, 2004). Additionally, because both complementary goods producers and consumers make adoption decisions based on which technology they believe has (or will have) the largest installed base, signaling can be very influential. This led to firms using tactics such as preannouncements, “vaporware,” and misleading statements about installed base size and market share (Dranove & Gandal, 2003; Farrell & Saloner, 1986; Le Nagard-Assayag & Manceau, 2001; Schilling, 2003).

Third, when the value of complementary goods was an important part of the increasing returns to adoption, it created strong incentives for producers to adopt standardized interfaces and a modular production system that would enable a wide range of third-party complement developers to create complements for a common platform (e.g., Matutes & Regibeau, 1988; Schilling, 1998, 2000). Engaging third-party developers (e.g., app developers, content creators) to develop complements meant that customers would have a wider range of complements to access, allowing them to “mix and match” the platform with various heterogeneous complements, and it enabled both the platform sponsor and the individual complement producers to specialize in that part of the product system in which they were strongest. This meant that modular platform ecosystems could often outcompete vertically integrated producers because of benefits of specialization (Schilling, 1998, 2000).

Fourth, and perhaps most unsettling to the economic community, increasing returns to adoption could lead to “winner-takes-all” markets, where one or a few players have very large market power (such as Microsoft’s Windows in the market for operating systems or Google and Facebook in digital advertising). It would prove difficult to reconcile whether and when having one or a few very dominant firms created more network externalities benefits than monopoly costs (Church & Gandal, 1993; Katz, 2019; Schilling, 2019). The anti-trust case *US v. Microsoft* would prove to be a landmark example of such difficulty.⁴

The preceding led to a large range of studies on the implications of network externalities for functional-level strategies, such as pricing (e.g., Bensaid & Lesne, 1996; Brynjolfsson & Kemerer, 1996; Gallagher & Wang, 2002; Gandal, 1994; Hagiu, 2006), investments in improving the quality of a technology (e.g., Choi, 1994; Economides, 1996), product compatibility decisions (e.g., Besen & Farrell, 1994; Choi, 1994; Farrell & Saloner, 1992; Katz & Shapiro, 1994; J. Y. Kim, 2002), and outcomes like market share and social welfare (Baake & Boom, 2001; Takeyama, 1994). In particular, there was a growing awareness that markets exhibiting network externalities often required different strategies than the markets much of the traditional economic theory had been built to explain. For example, in markets with strong network externalities, getting a large installed base early could lead to a dominant position, so firms are incentivized to use penetration pricing—sometimes even below cost or offering a product free of charge—to rapidly build an installed base in the hopes of recouping profits later through secondary revenue streams (e.g., Cabral, Salant & Woroch, 1999; Csorba & Hahn, 2006; Liu, 2010; Parker & Van Alstyne, 2005; Schilling, 2003, 2019). Similarly, network externalities can significantly influence a firm’s intellectual property strategy: Firms may adopt a relatively “open” strategy, either liberally licensing their technology or forgoing enforcing their patents, if doing so speeds up the accumulation of installed base or the availability of complementary goods (Boudreau, 2010; Garud & Kumaraswamy, 1993; Karhu, Gustafsson, & Lyytinen, 2018; Parker & Van Alstyne, 2018; Schilling, 2011; West, 2003). One example in this regard is Tesla’s pledge that it will not initiate any lawsuits against external parties for

infringing a Tesla patent through activity relating to battery-charging technology and other related activities in the area of electric vehicle production.

A closely related line of research that contributed to our understanding of platforms also emerged over this time frame: two-sided markets (e.g., Argentesi & Filistrucchi, 2007; Armstrong, 2006; Bolt & Tieman, 2008; Y. Chen & Xie, 2007; Hagi, 2009; Kaiser & Wright, 2006; Lin, Li, & Whinston, 2011; Rochet & Tirole, 2002, 2003, 2006). Research on two-sided markets (and later generalized to multisided platforms) studied the situation where a firm mediated the relationship between two or more interdependent sides of a network. For example, a newspaper sells to both readers and advertisers; without readers, it cannot offer value to advertisers, but without advertisers, it would have to charge a much higher price to readers (Seamans & Zhu, 2014, 2017; Sridhar, Mantrala, Naik, & Thorson, 2011). Much of this work focused on how a firm in the role of mediator in a two-sided platform market could use different strategies across the two sides in order to achieve success for the collective network. For example, manufacturers of video game consoles typically charge very low prices for the console (subsidizing consumers) in order to attract more video game developers from whom they can collect lucrative licensing fees (Liu, 2010; Schilling, 2003). While most of the early two-sided market research focused on the situation where a firm *sells* to two different but interdependent groups of customers, later research on platform competition would generalize this dynamic to any context in which a central platform mediates any kind of relationship between two or more other interdependent members of an ecosystem (e.g., selling, licensing, standards enforcement, subsidization, knowledge sharing).

Theme 2: Platform Ecosystems and Corporate Scope

Whereas the first wave of research on network externalities and platforms tended to focus on business-level strategy, that is, the competitive strategies firms use to attract customers and complementors, a next wave of research began to examine how platforms induce changes in the nature of the firm itself (e.g., Parker et al., 2017) (see Table 3). As noted previously, in markets where customers valued a large range of complementary goods, modular products where customers could mix and match complements from a wide range of producers began to displace tightly integrated products made by vertically integrated producers (Schilling, 2000, 2002; Schilling & Steensma, 2001). One of the most widely noted examples was the deconstruction of the computer market (Jacobides & Tae, 2015), which went from being dominated by mainframe producers, such as IBM; to workstation producers, such as Digital Equipment Corporation and Sun Microsystems; then to personal computer producers, such as Dell, Acer, or Compaq, which assembled computers from components made by specialists, such as Intel, Seagate, and Microsoft (Bresnahan & Greenstein, 1999). Standardized interfaces, such as USB ports, TCP/IP protocols, and application programming interfaces, made it possible for many different specialized producers to almost seamlessly contribute to a collective product. These collective production systems were networks of symbiotic relationships between firms, much like biological ecosystems, and soon researchers started calling them “platform ecosystems” (e.g., Ceccagnoli et al., 2012; Ghazawneh & Henfridsson, 2013; Tiwana, 2015a).

Though a platform ecosystem may enable firms on average to become more specialized, individual firms in those ecosystems still have to make decisions about which products, components, or activities to produce in-house versus which to obtain from others. Choices of firm

scope have important implications for both a firm's power and influence in an ecosystem and for the success of the ecosystem overall (Jacobides, Knudsen, & Augier, 2006; Jacobides, MacDuffie, & Tae, 2016). First, to consider how scope can influence power and value capture in an ecosystem, it is useful to reflect on the example of Microsoft and Netscape. Netscape Navigator was one of the first widely successful internet browsers and ran as a Windows-compatible application under a licensing agreement with Microsoft. Much of Windows's rise can be attributed to the fact that it was aggressively licensed, encouraging other firms to develop complementary applications and hardware. However, Microsoft began to realize that Navigator could potentially become a threat to Windows itself; if end users used the Navigator browser to access files, for example, it could substitute many of the roles that Windows played and make Netscape very powerful. Microsoft thus decided to launch its own browser, Internet Explorer, and bundled it for free with all copies of Windows 95. This horizontal diversification dealt a death blow to Netscape. Microsoft was able to leverage its overwhelming dominance in operating systems to rapidly build a huge installed base for its browser, and it also gave the browser away for free. Netscape could not counterattack; it could not afford to give away its product for free because it did not have the other revenue sources that Microsoft had (Levy, 1998; Windrum, 2004; Yoffie & Cusumano, 1999). Recent examples of other firms expanding their platform's boundaries include Ticketmaster entering the resale market and Apple integrating third-party app functionality into the iOS operating system. This strategy would become known as "envelopment," that is, when one platform subsumes another platform by bundling the other platform's technology with its own (Eisenmann, Parker, & Van Alstyne, 2011).

Second, scope decisions can also be crucial for the success of the ecosystem overall. In many platform ecosystems, there are "chicken-and-egg" problems that have to be overcome for the platform to thrive (Caillaud & Jullien, 2003; Rochet & Tirole, 2003; Rysman, 2009). Video game consoles, for example, must be launched with a range of high-quality video games available or consumers will not buy them. Thus console producers that attempted to come to market without in-house games production (e.g., Philips, NEC, 3DO) all failed, while console producers that were well-established games producers before launching a console (e.g., Nintendo, Sega) or diversified into video games production or subsidization before console launch (e.g., Sony, Microsoft) survived (Rietveld, 2014; Schilling, 2003). For the same reason, Tesla diversified into owning its own charging stations, and ride-sharing services, such as Uber and Lyft, subsidize drivers when they open new markets.

A growing body of research examines when a platform will subsidize complementors (e.g., Riggins, Kriebel, & Mukhopadhyay, 1994), collaborate with complementors (e.g., Mantovani & Ruiz-Aliseda, 2016), or produce complementary goods in-house (e.g., Adner & Kapoor, 2010; Nair et al., 2004; Tanriverdi & Lee, 2008) and why these strategies change over time (Cennamo, 2018; Huber et al., 2017; O'Mahony & Karp, in press; Rietveld, Ploog, & Nieborg, 2020). Researchers have also looked at how a firm learns which complements it should produce itself (Jiang, Jerath, & Srinivasan, 2011; Zhu & Liu, 2018), how platforms that produce some of their own complements manage their relationships with complementors that may feel threatened (e.g., Hagi & Spulber, 2013; Niedermayer, 2013), how complementors and end users respond to a platform's entry into complements production (Foerderer et al., 2018; Z. Li & Agarwal, 2017; Wen & Zhu, 2019), and when platforms will wisely avoid producing their own complements (e.g., Gawer & Henderson, 2007; Hagi & Wright,

2015). Gawer and Henderson (2007), for example, provide an insightful account of why Intel chose not to enter downstream markets and the commitment devices it put in place to reassure complement developers and buyers that it would not “squeeze” them once they entered the market (also see Zhu, 2019, for an overview of this research).

Researchers also began to study (horizontal) mergers between platforms (e.g., Chandra & Collard-Wexler, 2009; Correia-da-Silva, Jullien, Lefouili, & Pinho, 2019; Jeziorski, 2014; Zou & Jiang, 2020), usually anticipating that such mergers would lead to levels of market power that had the potential to harm social welfare. Notably, however, the few studies on platform mergers have tended to find that such mergers did not result in higher prices or harm consumer welfare (contrary to typical antitrust economics predictions). This may be because platform mergers are more likely to occur when the merging parties are significantly disadvantaged relative to another competitor and merging helps to both level the competitive playing field and establish a larger ecosystem that creates more value for consumers (also see Katz, 2019).

Theme 3: Platform, Complement, and User Heterogeneity

The early research on network externalities and the rise of platform ecosystems tended to focus on how firms could increase installed base and complementary goods to exploit network effects, treating the size of the installed base or the availability of complementary goods as generic resources (e.g., the greater the installed base and/or availability of complementary goods, the greater the likelihood of success) (see Table 4). Though the quality of the platform has always been treated as an important variable (e.g., Bental & Spiegel, 1995; Mantena & Saha, 2012; Schilling, 2003; Suarez, 2004; Tellis et al., 2009), other more nuanced sources of heterogeneity were largely ignored. More recent research, however, has begun to focus on more complex interactions between differentiated platforms and complements and heterogeneous end-user demands (e.g., Armstrong & Wright, 2007; Tucker, 2008).

Some aspect of differentiation in a platform may be highly desired by a particular segment of the market, causing it to prefer the platform even though it has a smaller installed base—this was observed to be the case when Apple’s MacOS remained successful in the desktop publishing and education markets long after its installed base had been eclipsed by Windows in the mass market. Similarly, despite entering the market long after Microsoft Word, Google Docs has managed to accumulate a sizeable installed base in a relatively short period of time by offering features that make it much easier for users to collaborate and share documents in an online environment. Different platform features may thus influence the strength of same-side or cross-side network effects. For example, Basu et al. (2003) find that consumers derived greater value from CD title availability for those CD players that included changer capacity and oversampling functionality than for CD players lacking such functionality. Other scholars formally explored the implications of allowing for platform-level variation in the strength of network effects as a function of either a platform’s social media features (Dou, Niculescu, & Wu, 2013) or its degree of architectural openness (Niculescu, Wu, & Xu, 2018). Recent research has explored competitive dynamics between platforms that pursue different business model strategies. For example, J. Chen, Fan and Li (2016) compare eBay and Taobao to draw conclusions about when a brokerage model (eBay) will be more or less successful than an advertising model (Taobao). Similarly, Dushnitsky,

Piva, and Rossi-Lamastra (in press) examine strategy choices of transaction platforms in crowdfunding and observe that firms cluster around constellations of strategies (e.g., transaction fees vs. subscriptions, symmetric vs. asymmetric pricing on different sides of the platform, offering a variety of services vs. pursuing a narrow scope) that align together.

Research has also begun to focus more on the different attributes and strategies of complementors. A significant body of research has emerged, for example, showing that “superstar” or “blockbuster” complements play a disproportionate role in technology adoption (e.g., Binken & Stremersch, 2009; Hogendorn & Yuen, 2009; L. Sun, Rajiv, & Chu, 2016). In a similar vein, considerable attention has been paid to the effect of exclusive complements on the scope of network effects (Corts & Lederman, 2009; Landsman & Stremersch, 2011; R. Lee, 2013). Other research looked at the effect of complement quality on technology adoption (J. H. Kim, Prince, & Qiu, 2014) and how this effect varies over the platform life cycle (Gretz & Basuroy, 2013). Another line of research examining differentiation among complements has examined whether and when complements will invest in specialization for a platform, when they will multihome, and when these decisions result in different quality levels or technical fit of a complement across platforms and the complement’s subsequent performance (e.g., Cennamo, Ozalp, & Kretschmer, 2018; Kapoor & Agarwal, 2017; Tiwana, 2015a, 2018). Still other studies looked at the choice of complementors’ business models and the effects on performance (Benner & Waldfoegel, in press; Eckhardt et al., 2018; Rietveld, 2018).

Finally, as alluded to previously, recent research has focused on the effect of heterogeneity among users. For example, Steiner, Wiegand, Eggert, and Backhaus (2016) find that “core” users (such as hardcore or enthusiast gamers in a video game console) have very different preferences than “casual” users and should be strategically targeted in different ways. Rietveld and Eggers (2018) similarly find that early adopters of a platform will tend to buy a larger number of complements, and more novel complements, than later adopters of the platform. This leads to diverse strategic implications for complements that enter a platform at different stages of its life cycle. Social structure among platform users may also be influential (Afuah, 2013). Suarez (2005), for example, introduces the idea that rather than thinking of an installed base as being some number of N identical users, platforms should take into account the strength of ties between users; parts of the network that have “strong ties” will be more influential to technology adoption than more loosely connected users. Lee, Lee, and Lee (2006) similarly argue that the social network structure among users can sustain fragmentation in a technology market even in the presence of network externalities, because subgroups of users might interact and exchange more intensely within their subgroup than outside, and it is the installed base of this subgroup that will influence technology adoption rather than the overall installed base. More generally, research has shown that firms can target user groups with different preferences to achieve or sustain success within a market segment even when it is at an installed base disadvantage (Chao & Dardenger, 2013; Suarez & Kirtley, 2012).

Theme 4: Platform Governance and Orchestration

One of the most recent themes to emerge as a strong area of focus in platform competition research is platform governance and orchestration (see Table 5). This research examines how the rules and norms of an ecosystem are set and enforced and how key members of an ecosystem influence the behavior of other players and outcomes for the ecosystem overall. It

should be clarified that early research on how platforms made decisions on things like pricing, licensing, and compatibility was addressing governance and orchestration questions (though usually without using those terms). However, recent research has begun to focus more explicitly on how (and by whom) the overall ecosystem is governed and by what means the behaviors of its members are orchestrated by one or more powerful players in the ecosystem (e.g., Altman & Tushman, 2017; Helfat & Raubitschek, 2018; Sampler, 2018; Schmeiss, Hoelzle, & Tech, 2019; Tiwana, Konsynski, & Bush, 2010; Wareham et al., 2014).

If a platform ecosystem is organized around a powerful “hub” firm that owns or sponsors the platform, that firm has both incentive and ability to exert considerable influence to increase both the overall value created by the ecosystem and its own value capture (Hukal, Henfridsson, Shaikh, & Parker, 2020; Iansiti & Levien, 2004; Rietveld et al., 2019, 2020). In fact, failure to do so can lead to gaps in the ecosystem that seriously impair its ability to create value (Adner, 2006). For example, as noted under the corporate scope theme, in some instances, a hub firm may need to integrate into production of complements in order to ensure their availability in the early stages of the platform’s evolution (e.g., Adner & Kapoor, 2010; Schilling, 2003), and in other instances, a hub firm must be careful that integration into complements does not inhibit the participation of third-party complementors or provoke their desertion of the platform (e.g., Gawer & Henderson, 2007; Niedermayer, 2013; Tiwana, 2015b; Zhu & Liu, 2018).

A hub firm’s orchestration strategies can attract complements to the ecosystem (e.g., Gawer & Cusumano, 2008; Ghazawneh & Henfridsson, 2013; Schilling, 1998, 2002, 2003) or provoke their exit from the platform (Pierce, 2009; Tiwana, 2015b). A hub firm must make careful strategic decisions about how many and what types of complements it wants to induce to join the platform. On the one hand, greater ecosystem breadth and depth is typically considered attractive to consumers (e.g., Rietveld et al., 2019). On the other hand, a larger number of complements can also increase congestion costs that lower a complementor’s incentives to invest in quality and innovation and may result in coordination problems that actually decrease value to consumers (e.g., Boudreau, 2012, 2017; Boudreau & Jeppesen, 2015; Casadesus-Masanell & Hałaburda, 2014; Markovich & Moenius, 2009).

A platform’s strategies also influence how power is allocated across complementors or how much opportunity they have for value capture. For example, Greve and Song (2017) note that Amazon’s self-publishing platform has dramatically shifted power away from large publishers to smaller publishers and independent authors. Rietveld et al. (2019) similarly note how video game console manufacturers use selective promotion of video game titles to manipulate the success and bargaining power of individual video game developers in their ecosystems (also see Aguiar & Waldfogel, 2018; Elfenbein, Fisman, & McManus, 2015; Hui, Saeedi, Shen, & Sundaresan, 2016; Liang, Shi, & Raghu, 2019). Other research has noted how the platform’s design of recommender systems can alter the distribution of value among complementors (Brynjolfsson, Hu, & Smith, 2010; Fleder & Hosanagar, 2009). Such governance changes are typically implemented by making changes to the platform’s technological core and are manifested in the form of new platform features or design rules (Brunswick, Almirall, & Majchrzak, 2019; Ghazawneh & Henfridsson, 2013; Rietveld et al., 2020). By manipulating how much value is captured by individual complementors, a platform hub can both reward loyalty and prevent complementors from becoming so powerful that they are able to extract more value from the platform (Brandenburger, Kou, & Burnett, 1995; Rietveld et al., 2019).

A platform's governance strategies can also influence complementor pricing (e.g., Dinerstein et al., 2018; Yoffie & Kwak, 2006), investments in quality (Cennamo et al., 2018), product-market positioning strategies (Rietveld, Seamans, & Meggiorin, 2018; Tae, Luo, & Lin, 2020), the incentives and penalties for complementors to engage in bad behavior (e.g., Geva, Barzilay & Oestreicher-Singer, 2017; Sampler, 2018), the degree to which complementors cooperate with one another and share knowledge and other resources to increase innovation (e.g., Huang, Tafti, & Mithas, 2018; Perrons, 2009; Zhang, Li, & Tong, in press), and more. Finally, recent research has begun to explore how a platform ecosystem's needs, and consequently its governance strategies, evolve over time (e.g., Hannah & Eisenhardt, 2018; Huber et al., 2017; Kyprianou, 2018; O'Mahony & Karp, in press; Rietveld et al., 2020).

Future Research

Following our review of the literature, we offer a number of suggestions for future research. We begin with general suggestions for research on platform competition and then provide suggestions within each of the four themes introduced in the previous section.

General Suggestions for Future Research on Platform Competition

More interdisciplinary research

Given the overlap in research interests across the fields of management and organizations, information systems, economics, and marketing, a greater use of interdisciplinary research, and efforts to reach multiple audiences, may better leverage the advances being achieved in each discipline. It is also worth noting that in our article set, there were numerous instances of what appeared to be unintentional replication without citation (in arguments and/or conclusions) of work that had previously been done in other disciplines, suggesting that it is important that we find ways to ensure scholars are aware of the work that is being done in each of these disciplines (and likely others). Greater awareness of these areas of contiguous scholarly interest will limit unintended replication and can provide clarity about what the most pressing research questions are for platform competition scholars to pursue. It might also increase the reach and impact of work in the area.

More empirical studies pooling data from multiple industry settings

Most studies in our sample are based on single industries; more multiple-industry studies would help to develop a greater sense of external validity and generalizability (e.g., R. Srinivasan et al., 2004; Schilling, 2002; Tellis et al., 2009; Wang et al., 2010; Wang & Xie, 2011). Meta-analysis is another way scholars can assess the generalizability of platform competition research.

Greater diversity in empirical settings

A disproportionate number of studies in our article set focus on the computer, smartphone, and video game industries, followed by e-commerce and media. A large portion of that research also focused on Western economies, particularly the United States. A greater range of industries (e.g., Ciborra, 1996; Shriver, 2015) and geographic scope (e.g., Hann, Koh, & Niculescu, 2016; Lehdonvirta et al., 2019) would enhance the robustness of the platform

competition research and potentially reveal important relationships or other sector-specific dynamics that have thus far been overlooked. In particular, it might be beneficial to look at platforms that are not in industries that are commonly associated with “tech.” For example, donation platforms (e.g., Gofundme, Fundly, Snowball), crowdsourcing and online labor platforms (e.g., Flickr, 99Designs, Upwork, Crowdcube, Ourcrowd), financial payments and microfinance platforms (e.g., Kiva, PayPal, Adie, Alipay), education platforms (e.g., Udemy, Coursera, MasterClass), hiring and temporary work platforms (e.g., Kelly Services, Indeed, Buscojobs, Glassdoor, HoneyPot), and health care platforms (e.g., ZocDoc, OneMedical, DoctorOnDemand, Practo) may all offer variety that could lead to more robust theorizing and novel findings.

More in-depth case study research

Though the last two suggestions emphasized more diverse samples, it would also be good to have more in-depth case study research with the aim of developing novel theory that more richly reveals the ways that platforms compete and evolve over time (e.g., Khanagha, Ansari, Paroutis, & Oviedo, in press; Logue & Grimes, in press; Rietveld et al., 2020). In-depth qualitative analysis can uncover the mechanisms that drive large-scale empirical results and provide insight into why certain findings, for example, such as those pertaining to the effects of platforms expanding into the complementor space, have been mixed.

Forging stronger links to traditional theoretical frameworks

As we noted, many of the studies in the burgeoning body of research on platform competition are atheoretical or aim to build new theory. This is good and appropriate, given the stage at which the research is, but it is also important that researchers begin to build stronger connections between platform competition and mainstream theories, such as the resource-based view, transaction cost economics, agency theory, and others, both to explore where these theories do and do not explain platform-related phenomena and to bring platform competition research to a broader audience (e.g., Barlow, Verhaal & Angus, 2019; M. Sun & Tse, 2009). Alternatively, if these theories are too limited to be extended to these phenomena, we may need new high-level theory that explains platform dynamics in a wide range of settings.

Future Research on Network Externalities and Their Implications

Many economic models on network effects and pricing either are static, assume a monopolistic market structure, or both. Such assumptions, while reasonable from a modeling perspective, often do not reflect the empirical reality. Clements and Ohashi (2005), for example, in their study of the console video game industry, observed that video game developers launch games at a much higher rate than consumers are adopting consoles during the later stages of a console’s life cycle (an observation later echoed by Rietveld & Eggers, 2018). Song et al. (2018) similarly found that indirect network effects in the web browser market are neither symmetric nor constant across time. This suggests that the literature would benefit from a more dynamic perspective on network effects and platform pricing, in the form of either theoretical modeling or empirical analysis. Cabral (2019) has taken a first step in this direction by introducing a dynamic framework that suggests that

optimal platform pricing addresses two distinct externalities: across user groups and across time periods.

The impact of competition and external shocks—such as a disruptive new entrant—on platform strategy is another area for further investigation. While economic models typically assume the platform to either be a monopolist or a duopolist, in reality, there are often multiple competing platforms with an unequal distribution of market shares. Market structure and competition affect how platforms set prices and position themselves. In the market for sports card conventions, for example, Jin and Rysman (2015) found that prices on one side of the platform can rise as a result of increased competition (also see Seamans & Zhu, 2014). When Craigslist entered the market for classified ads, affected newspapers not only increased their prices for readers but also repositioned themselves to achieve stronger differentiation (Seamans & Zhu, 2017). Platforms' responses to changing intensities of competition are still poorly understood, and we would benefit from having more work on this topic.

While a growing body of work has highlighted conditions under which winner-takes-all dynamics occur in platform markets (e.g., Cennamo & Santalo, 2013; J. Chen, Doraszelski & Harrington, 2009; Dubé, Hitsch, & Chintagunta, 2010; Schilling, 2002), much less is known about how and why dominant platforms eventually get displaced. Research in this area is scant at best, despite scholarly and empirical relevance. Facebook disrupted Myspace in the social networking market, and iTunes dethroned Napster and LimeWire in the online music distribution market, only to itself be later dethroned by Spotify. Looking back, it is easy to argue that Facebook and Spotify simply offered superior value propositions, but at the time, they were new entrants facing dominant rivals that enjoyed strong network externalities. Preliminary evidence suggests that differentiation through enhanced customer benefits (Suarez & Kirtley, 2012) as well as (actual or perceived) technological superiority and the availability of complements (Schilling, 2003) all play a role in these “David versus Goliath”-type competitive battles. These observations still lack empirical substantiation and say little about the actual process of displacement and how this may differ from technological discontinuity or disruption dynamics observed outside the realm of platform markets (e.g., Adner, 2002; Anderson & Tushman, 1990; Rothaermel & Hill, 2005). Moreover, in some markets, the act of disrupting a dominant platform has become more difficult in recent years as a result of digital transformation. Indeed, digital technologies have facilitated the continuous updating of previously static platforms, which reduces the occurrence of marked generational breaks (Ansari & Garud, 2009; Cennamo, 2018; Ozalp, Cennamo, & Gawer, 2018). Platform sponsors can readily observe trends in their ecosystems and learn from these trends with the help of big-data analytics and machine learning to constantly improve their products (Adner, Puranam, & Zhu, 2019), making it harder for new entrants to gain a technological lead. In other words, positions of dominance have become much “stickier,” which further necessitates the need for novel insights on when and how new entrants succeed in disrupting dominant platforms.

Future Research on Platform Ecosystems and Corporate Scope

There remains considerable ambiguity around a platform's motivations to vertically integrate into the complement space as well as the consequences for third-party complementors.

Prior research focusing on the consequences for complementors found mixed results. For example, while Foerderer et al. (2018) found that Google's entry into the photo app space increased demand for third-party app developers and their incentives to innovate, Wen and Zhu (2019) found opposite effects, namely, that Google's entry into various app categories reduced third-party app developers' innovation efforts and drove up prices for mobile apps. Future research should seek to reconcile these seemingly conflicting findings and identify contingencies that undergird these mixed results. Additionally, more research is needed to better understand platform sponsors' motives for and modes of vertically integrating into the complement space and how these may shift over the platform life cycle. Put differently, the field—but also policy makers—would greatly benefit from a more holistic view on why platforms decide (not) to enter the complement space, what factors drive a platform to update its strategy regarding vertical integration, and the factors explaining cross-platform variation in strategies pertaining to platforms' entry into the complement space.

There also remains much to be understood about how horizontal differentiation and platform mergers might influence market structure and consumer welfare. Antitrust authorities are already wrestling with difficult questions about whether and how platforms should be required to enable data portability and interoperability across different platforms and how platforms may or may not be permitted to consolidate a user's data across different activities and services. Should, for example, a platform designed to provide health care and prescription delivery to consumers be able to use the data collected in those activities to market insurance, supplements, and other health-related products and services? Furthermore, is there a risk that platforms that are large and provide a wide range of services (e.g., Google, Amazon, WeChat) gain too much market power through the aggregation of data? There is considerable work to be done here that will be of use to policy makers and scholars alike.

Future Research on Platform, Complement, and User Heterogeneity

Though research has begun to emerge on differentiation among platforms and heterogeneity among complementors and users as noted already, there is considerably more work to be done in this area. We believe significant progress can be made by relaxing the assumption of market-level network effects and instead allowing for variation at the level of the product or the platform's sponsoring firm(s). A deeper understanding of how platform features drive technology adoption, for example, might help shed new light on such issues as winner-takes-all dynamics, how dominant platforms are eventually displaced, and the relative importance of complement quality, variety, and exclusivity. For example, as Alibaba and Amazon increasingly expand their reach into each other's (geographical) markets, what will determine their probability of success? Furthermore, should we expect more convergence in their supplier and complementor bases or greater effort to differentiate from one another through their features and services, business model strategies, and exclusivity arrangements?

Relatedly, there are opportunities for applying an international business perspective to research on platforms and complementors (J. Li, Chen, Yi, Mao, & Liao, 2019; Nambisan, Zahra, & Luo, 2019). Complementors that compete on platforms with an international

presence must decide if and when they wish to release their products in various national sub-markets. The timing of these international expansions and their sequence are seldom random. The decision of if and when to enter different countries is referred to as a “soft launch.” Research on complementors’ market entry decisions is still underdeveloped (for an exception, see Venkatraman & Lee, 2004), and headway can be made by looking into complementors’ soft-launching strategies. A related opportunity for future research is the effect of cross-country demand heterogeneity on complementor performance (e.g., Shaheer & Li, 2020; Shaheer, Li, & Priem, in press). Kübler, Pauwels, Yildirim, and Fandrich (2018), for example, observed cross-country variation in terms of the relative importance of app ratings and app price on the popularity of apps. In this regard, it will also be interesting to better understand how the geographical location of complementors’ headquarters affects their product and market strategies and the underlying factors driving such variation.

Future Research on Platform Governance and Orchestration

Platform governance requires addressing several interdependent tensions, including the need to balance platform openness and control, exerting influence over the quality and range of complements, managing simultaneous collaboration and competition with complementors, and creating ecosystem value while also capturing some of that value. Conceptually, prior research approached these tensions mostly from a static perspective. Empirically, prior research has mainly zoomed in on one specific type of governance change, rather than developing a more holistic appreciation of these delicate balancing acts.

The preceding offers (at least) two fruitful areas of research. First, following the notion that successfully managing a platform ecosystem is an inherently dynamic process (Gawer, 2014), future research will benefit from studying evolving governance strategies over time and as a function of other factors. Acknowledging nascent platforms’ precarious positions, some scholars started looking at governance practices in the early stages of a platform ecosystem (Hannah & Eisenhardt, 2018; Kyprianou, 2018), whereas others have developed broader accounts of how governance strategies evolve over time (e.g., Ghazawneh & Henfridsson, 2013; Huber et al., 2017; O’Mahony & Karp, in press; Rietveld et al., 2020; Saadatmand, Lindgren, & Schultze, 2019). Additional research in this area can help develop a richer understanding of how platforms’ governance strategies evolve as well as the drivers of heterogeneous governance practices both across platforms and along the platform life cycle.

Second, we invite researchers to move away from isolated governance practices and instead study platform governance and its impact from a holistic perspective. How does a platform’s menu of governance activities change over time, and how do governance practices affect complementors and users differently? In further developing insights on how platforms are managed, it will also be helpful to look into systematic differences across platforms as a function of their identity and social role (e.g., transaction platforms, social platforms, community action platforms). Do different platforms manage their complementors and users differently, and if so, what is driving these differences? Finally, when can platforms successfully rely on decentralized modes of governance (as opposed to centralized governance modes),

Table 3
Summary of Theme 2: Platform Ecosystems and Corporate Scope

Synopsis: The interaction of network externalities and platform effects with corporate-level strategy (e.g., diversification, vertical integration and dis-integration).

Key questions:

- How does platform competition influence a firm's decision to vertically integrate or dis-integrate?
- When is it beneficial for a firm to diversify into producing its own complements, and when does it crowd out other complementors?

Typical variables:

Antecedents or moderators: Subsidization of complements, production of first-party complements, quality, number of complements, vertical integration, tying (i.e., requiring platform owner's own complements or complements to be purchased with system), mergers, platform envelopment (i.e., the creation of a multiplatform bundle that subsumes a competitor platform's functionality), entry timing

Outcomes: Third-party complementor support, innovation by complements producers, prices, market share, installed base growth, complement sales growth

Exemplar articles:

- [Economics] Gawer, A., & Henderson, R. 2007. Platform owner entry and innovation in complementary markets: Evidence from Intel. *Journal of Economics & Management Strategy*, 16: 1-34.
- [Information systems] Huang, P., Ceccagnoli, M., Forman, C., & Wu, D. J. 2013. Appropriability mechanisms and the platform partnership decision: Evidence from enterprise software. *Management Science*, 59: 102-121.
- [Management and organizations] Cennamo, C., & Santalo, J. 2013. Platform competition: Strategic trade-offs in platform markets. *Strategic Management Journal*, 34: 1331-1350.
- [Marketing] Gupta, S., Jain, D. C., & Sawhney, M. S. 1999. Modeling the evolution of markets with indirect network externalities: An application to digital television. *Marketing Science*, 18: 396-416.

Questions for future research:

- What explains variation in outcomes on the complementor side (e.g., innovation incentives, performance) following vertical integration by the platform sponsor?
- What are heterogeneous motives for platform sponsors to vertically integrate into the complement space or diversify horizontally? What drives these motives?

Number of articles in theme: 43

such as those facilitated by distributed ledgers, like blockchain (Y. Chen, Pereira, & Patel, in press), and how does this affect the future viability of the platform model?

Platform sponsors have increasingly come under scrutiny for exploiting their dominant position in the ecosystem and the wider market. Market-leading platforms, such as Google, Amazon, Facebook, and Apple, have been accused of misusing their market power to stifle innovation and limit competitive entry; misappropriating end users' personal data, resulting in large-scale privacy scandals; and competing with complementors on the basis of unfair competitive advantage. Early research on platform ecosystems cautioned that hub firms operating in mature ecosystems can end up becoming "dominators" (Iansiti & Levien, 2004), and recent research pointed out that the misuse of platform power can disenfranchise ecosystem members, resulting in resentment and fear (Cusumano, Gawer, & Yoffie, 2019).

Platform governance and the hub firm's position of power are inextricably linked. Once the members of an ecosystem are locked in, the hub may shift from creating value for the ecosystem overall to (disproportionately) increasing its share of value captured. At the same

Table 4
Summary of Theme 3: Platform, Complement, and User Heterogeneity

Synopsis: There exists heterogeneity among platforms, complementors, and end users that can lead to segmented ecosystems and differential adoption and power over the platform's life cycle.

Key questions:

- How does heterogeneity of users affect the rise of a dominant platform?
- How does heterogeneity of users affect compatibility and pricing decisions?
- How much does variety of complements and/or "blockbuster" complements matter for network externality benefits or congestion costs?
- When will platforms seek interplatform compatibility versus differentiation?

Typical variables:

Antecedents or moderators: Installed base, quality, timing of entry, complement quality, "blockbuster" complements, complement exclusivity, user demand heterogeneity, user-to-platform tie strength, user-to-user tie strength, asymmetric buyer loyalty or willingness to pay, price discrimination, platform revenue model (i.e., allocation of fees across users and complements producers), complement multihoming (i.e., complements that are compatible with multiple platforms)

Outcomes: Technology adoption, profit, market share, interplatform compatibility, price

Exemplar articles:

- [Economics] Hagiu, A. 2009. Two-sided platforms: Product variety and pricing structures. *Journal of Economics & Management Strategy*, 18: 1011-1043.
- [Information systems] Bakos, Y., & Katsamakas, E. 2008. Design and ownership of two-sided networks: Implications for internet platforms. *Journal of Management Information Systems*, 25: 171-202.
- [Management and organizations] Boudreau, K. J. 2012. Let a thousand flowers bloom? An early look at large numbers of software app developers and patterns of innovation. *Organization Science*, 23: 1409-1427.
- [Marketing] Srinivasan, R., Lilien, G. L., & Rangaswamy, A. 2004. First in, first out? The effects of network externalities on pioneer survival. *Journal of Marketing*, 68: 41-58.

Questions for future research:

- What are the implications of tractable network effects (e.g., product features, firm-level factors) on platform strategy and platform competition?
- What drives heterogeneity of complementors (e.g., performance, innovation incentives, choice of business model)? How does such heterogeneity matter?
- How do complementors compete in international markets (e.g., soft-launch strategies, home country benefits, cross-country demand heterogeneity)?

Number of articles in theme: 58

time, an inequitable distribution of value that favors the hub firm may ultimately destroy the ecosystem (Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004; Parker, Van Alstyne, & Choudary, 2016). As of yet, very little is known about this "dark side" of platforms, and we encourage researchers to explore it. Potential research questions include the following: When do hub firms switch from creating value for the ecosystem and its members to capturing most of the value for themselves? What are the factors that empower platform sponsors to make this shift? What are indicators of exploitative platform hub behavior? How do complementors and end users react to a seemingly inequitable distribution of value among ecosystem members? How harmful is "bad governance" to a platform's long-term survival, and how does a platform's governance strategy affect the outcome of competitive battles between platforms?

Table 5
Summary of Theme 4: Platform Governance and Ecosystem Orchestration

Synopsis: Powerful members of the platform ecosystem can influence the behavior and outcomes of other members and the outcomes for the ecosystem overall.

Key questions:

- How do platform hubs manage the overall ecosystem to maximize value creation?
- How do platform hubs manage the boundaries of their ecosystem, including degree of openness, licensing, and exclusive contracts?
- How is platform ecosystem governance different from governance in markets or hierarchies?

Typical variables:

Antecedents or moderators: Creation and enforcement of rules by platform, “openness” of platform, platform provision of technical support, platform provision of incentives for user contributions, platform provision of incentives for complements quality, platform provision of complements reviews, bundling of complementary goods

Outcomes: Complementary goods quality, complementary goods producer profits/losses, complementary goods producer exits, social welfare

Exemplar articles:

- [Economics] Lee R. S. 2013. Vertical Integration and exclusivity in platform and two-sided markets. *American Economic Review*, 103: 2960-3000.
- [Information systems] Ghazawneh, A., & Henfridsson, O. 2013. Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal*, 23: 173-192.
- [Management and organizations] Wareham, J., Fox, P. B., & Giner, J. L. C. 2014. Technology ecosystem governance. *Organization Science*, 25: 1195-1215.
- [Marketing] Wang, Q., Xie, J. H. 2011. Will consumers be willing to pay more when your competitors adopt your technology? The impacts of the supporting-firm base in markets with network effects. *Journal of Marketing*, 75: 1-17.

Questions for future research:

- How do platforms balance seemingly conflicting tensions (e.g., openness vs. control; collaboration vs. competition with complementors, value creation vs. value capture) through the design and implementation of governance strategies?
- How do dynamic factors, such as the platform sponsor’s bargaining power vis-à-vis complementors, affect how it orchestrates and manages the ecosystem?
- What is the “dark side” of platform ecosystems? When do hub firms switch from creating value for the ecosystem to capturing value? What are the effects of “bad governance”?

Number of articles in theme: 61

Concluding Remarks

Platform ecosystems have attracted enthusiastic attention from multiple domains of research, leading to the emergence of a large and valuable body of work. The value of this work, however, has been difficult to fully leverage due to its disconnected structure: Differing terms, methods, and other isolating mechanisms tended to impede scholarly awareness and integration of work across these domains. While some amount of isolation between groups of researchers can be valuable by encouraging them to pursue different theories and avoid premature convergence (Fang, Lee, & Schilling, 2010), inadequate integration can also lead to unnecessary replication and slower progress. Given the considerable accumulation of work on platform competition and the commonality of themes that has emerged across disciplines, we believe that the topic is ripe for greater synthesis and integration. We have thus provided a systematic and interdisciplinary review of the research that tracks its evolution, identifies common themes of interest, and suggests future areas of inquiry. We hope that this review will help to provoke a more multidisciplinary conversation among scholars of platform competition that will lead to even more rapid progress in future research and practice.

Appendix A

Methods

Method of article identification

A list of scholarly publications was retrieved from Clarivate's citation indexing service, Web of Science (WOS), in January 2019. To demarcate the sample, we deployed a Boolean search query focusing on articles' titles as well as their publication outlets. To be included in the sample, an article had to have at least one of the following phrases in its title: "platform," "complementor," "two-sided market," "multisided market," "network effect," "network externalit," "system market," "winner take all," "ecosystem," or "installed base." We used wildcards (*) to include plurals and variations on these phrases (e.g., "externalities"). An inclusive approach was taken with regard to the set of publications under consideration. We started with publication outlets listed in the *Financial Times* FT50 journal list as a broad inclusion criterion of high-quality journals in management, information systems, economics, and marketing. We then added publications that are known for publishing research on platforms competition, such as the *International Journal of Industrial Organization*, the *Journal of Economics and Management Strategy*, and the *Journal of Industrial Economics*. We also added some newer journals that lack the history required for inclusion in the FT50 list. Examples of these include the *Academy of Management Perspectives* and *Strategy Science*.⁵ Conference proceedings and commentary articles were excluded from the search results. This resulted in 434 articles.

Information on the contributing authors, article title, journal title, publication date, and abstract was collected. The articles were then hand-screened for relevance. Studies on natural and entrepreneurial ecosystems, product platforming, crowdsourcing, social media, and consortia and other articles that use platforms as an empirical context (e.g., advertising platforms) but do not either draw from or contribute to the literature on platform competition were excluded from analysis. A sample of 261 articles remained.

For each of these articles, we collected additional data on the articles these studies referenced—again, using WOS as our primary data source. Data on backward citations were then used to assess whether any important studies were missing from the initial article set, either because they did not include any of the search terms in their title (e.g., Boudreau, 2010) or because they are published in journals that were not included in the WOS search query (e.g., Rochet & Tirole, 2003). Relevance was decided based on the number of times an excluded article was cited by the articles in the initial set. A minimum of 10 citations was used as the cutoff threshold, and any article surpassing this threshold that was not already included in the initial set was screened for relevance. An additional 34 articles were added to the data set following this manual check. Our initial sample thus included 295 articles. While conducting our literature review, we continued updating the data set of articles to ensure that we included the most recent research. Since retrieving the initial sample of articles, we added an additional 38 articles to our data set, bringing the final sample for analysis to 333 articles.

Collection of data from articles

We collected additional data for the 333 articles, including information on the following:

1. The field of the journal in which an article was published. We broadly distinguish between management and organizations, information systems, economics, and marketing. Studies published in *Management Science* were coded based on their editorial department.
2. The major theme or underlying question of each article. Using an inductive and iterative approach, we identified 22 concepts, ranging from “pricing strategies” and “monopoly effects” to “subsidization of complements,” “vertical integration,” “social network,” and “orchestration.” We next grouped these concepts into four overarching themes based on their level of analysis and time of emergence: (a) how network effects generate “winner-takes-all” dynamics that influence strategies such as pricing and quality; (b) how network externalities and platform strategy interact with corporate-level decisions, such as vertical integration or diversification into complementary goods; (c) how heterogeneity in the platform and its users influences platform dynamics; and (d) how the platform “hub” orchestrates value creation and capture in the overall ecosystem. These themes represent both the level of analysis of the research and the temporal pattern of these shifts in focus.
3. The method used in the research. We distinguish between modeling studies (e.g., formal models, simulations), empirical estimation (e.g., multivariate regression using large samples), studies that combine modeling and empirical estimation, conceptual papers (e.g., verbal theory, literature reviews), multiple case studies (e.g., qualitative analysis of a small number of cases), and longitudinal case studies (e.g., in-depth analysis of a single case).
4. The empirical context in which a study is based (where applicable). We note a total of 61 unique empirical contexts in our sample (e.g., mobile applications, newspapers, CD players). There are seven articles in our set that analyze multiple empirical contexts.
5. Forward citations. Using articles’ reference lists, we created a network to identify how many times and by which articles in the sample an article was cited.

The insights presented in our article are derived from a combination of both quantitative and qualitative analysis using the sample of 333 articles as starting point. For completeness, we also reference relevant articles published after 2019. The full set of references in our sample can be accessed and filtered on <http://www.platformpapers.com>.

Appendix B

Table B1
Citation Patterns Among Disciplines, by Time Period

	Start	End	Economics	IS	M & O	Marketing
Share of all citations	1986	1992	100.00%	0.00%	0.00%	0.00%
	1993	1999	99.13%	0.87%	0.00%	0.00%
	2000	2006	80.08%	6.78%	3.81%	9.32%
	2007	2013	65.55%	6.86%	13.87%	13.72%
	2014	2019	41.83%	18.46%	32.77%	6.95%
		1986	2019	55.04%	13.27%	23.16%
Share of economics citations	1986	1992	100.00%	0.00%	0.00%	0.00%
	1993	1999	100.00%	0.00%	0.00%	0.00%
	2000	2006	96.81%	2.13%	0.00%	1.06%
	2007	2013	94.44%	1.11%	2.22%	2.22%
	2014	2019	84.08%	5.19%	7.61%	3.11%
		1986	2019	91.36%	2.78%	3.81%

(Continued)

Table B1 (Continued)

	Start	End	Economics	IS	M & O	Marketing
Share of IS citations	1986	1992	100.00%	0.00%	0.00%	0.00%
	1993	1999	100.00%	0.00%	0.00%	0.00%
	2000	2006	80.56%	13.89%	2.78%	2.78%
	2007	2013	53.47%	18.81%	22.77%	4.95%
	2014	2019	30.30%	37.47%	27.27%	4.96%
	1986	2019	39.33%	31.62%	24.31%	4.74%
Share of M & O citations	1986	1992	100.00%	0.00%	0.00%	0.00%
	1993	1999	88.89%	11.11%	0.00%	0.00%
	2000	2006	79.17%	8.33%	10.42%	2.08%
	2007	2013	50.30%	9.47%	28.40%	11.83%
	2014	2019	29.34%	16.20%	50.07%	4.38%
	1986	2019	36.65%	14.44%	43.33%	5.58%
Share of marketing citations	1986	1992	—	—	—	—
	1993	1999	100.00%	0.00%	0.00%	0.00%
	2000	2006	53.45%	8.62%	5.17%	32.76%
	2007	2013	58.74%	3.88%	7.77%	29.61%
	2014	2019	45.80%	6.87%	12.98%	34.35%
	1986	2019	54.93%	5.42%	8.87%	30.79%
Share of articles	1986	1992	69.23%	7.69%	23.08%	0.00%
	1993	1999	68.75%	9.38%	15.63%	6.25%
	2000	2006	46.00%	12.00%	28.00%	14.00%
	2007	2013	34.15%	18.29%	26.83%	20.73%
	2014	2019	27.34%	24.46%	38.85%	9.35%
	1986	2019	37.97%	18.67%	31.01%	12.34%

Note: IS = information systems; M&O = management and organizations.

Appendix C

Table C1
Definitions of Key Terms Used in Platform Research

Term	Definition
Business model	How a firm creates and captures value, including identifying products or services, revenue sources, customer base, and details of financing.
Complementary goods	Products or services that enhance the functionality or desirability of another product or service, such as applications for a computer system or movies for a streaming service.
Complementary goods subsidization	When platforms invest in providing some sort of benefit (e.g., direct funding, development of tools, or other support) for complementary-goods producers to encourage their production of complements compatible with the platform.
Installed base	The number of users of a platform, typically measured as the cumulative number of adopters over time minus those that have stopped using the platform.
Multihoming	A term used to refer to when complementary goods are compatible with multiple platforms.
Network externalities/ Network effects	Positive consumption externalities that arise when users derive more benefit from using a good the more other users use the same or a similar good.
Platform	A stable core (such as a product, service, or standard) that enables and/or mediates the relationship between complementary goods (like applications or content) and prospective end users.
Platform ecosystem	The system comprising a platform and its stakeholders (users, complementary goods developers, suppliers) in which all entities have some degree of mutual dependence.
Platform sponsor	An individual, organization, or consortium that owns and/or controls and promotes a particular platform.

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Notes

1. A business model is the set of activities a firm undertakes to create and capture value, including identifying products or services, revenue sources, customer base, and details of financing. Digitization has allowed firms to (re) design and implement innovative business models based on mediating the relationship between multiple stakeholders and often leveraging network externalities (Amit & Zott, 2001). There are many variations of platform business models, including crowdfunding platforms, advertising platforms, content platforms, and more. The literature on business models is distinct from that on platform competition and focuses on its own set of topics and questions (see Massa, Tucci, & Afuah, 2017, for a review of the business model literature).

2. Ignoring studies with multiple settings, we observe a total of 61 distinct empirical contexts in our sample.

3. The research themes are not strictly exclusive, and some articles are assigned more than one theme. We observe 52 articles with two themes in our sample, while the remaining 281 articles are assigned one theme.

4. The Competition and Markets Authority in the United Kingdom recently launched a digital markets strategy with one of its main objectives to better understand the sources of market power for online platforms such as Google and Facebook and the potentially negative effects on consumers and innovation. See <https://www.gov.uk/government/news/cma-launches-digital-markets-strategy> (accessed March 2020).

5. The full list of publications under consideration includes *Strategic Management Journal*; *Strategic Entrepreneurship Journal*; *MIT Sloan Management Review*; *Research Policy*; *Quarterly Journal of Economics*; *Organization Studies*; *Organization Science*; *MIS Quarterly*; *Marketing Science*; *Management Science*; *Journal of the Academy of Marketing Science*; *Journal of Marketing Research*; *Journal of Marketing*; *Journal of Management Studies*; *Journal of Management*; *Journal of International Business Studies*; *Journal of Business Venturing*; *Information Systems Research*; *Harvard Business Review*; *Entrepreneurship Theory and Practice*; *American Economic Review*; *Academy of Management Journal*; *Academy of Management Review*; *Administrative Science Quarterly*; *Journal of Consumer Research*; *Journal of Retailing*; *Journal of Management Information Systems*; *Journal of Political Economy*; *International Journal of Industrial Organization*; *RAND Journal of Economics*; *American Economic Journal: Microeconomics*; *California Management Review*; *Journal of Product Innovation Management*; *International Journal of Research in Marketing*; *Quantitative Marketing and Economics*; *Journal of Strategic Information Systems*; *Journal of Economics Management Strategy*; *Strategy Science*; *Journal of Economic Perspectives*; *Journal of Industrial Economics*; *Academy of Management Perspectives*; *Academy of Management Discoveries*; *Journal of Marketing*; and *Journal of Marketing Research*.

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