

THE DYNAMICS OF PLATFORM BUSINESS VALUE CREATION



BY ELIANA GARCÉS-TOLON ¹



I. INTRODUCTION

In recent years, the expanding size and influence of some digital Internet platforms are generating unease among regulators around the world, in particular in the European Union. Concerns were initially raised by disrupted competitors, but regulatory scrutiny later gained traction on broader policy concerns relating to competition, privacy protection or consumer policy.

Much of the economic analysis used in regulatory discussions still relies on the same analytical framework applied to traditional offline markets. It is an economic framework built for situations where distinct products are exchanged in simple bilateral interactions, and where the dynamics of competition are determined by the availability, prices and quality of products of similar characteristics. This framework is mostly inadequate in the analysis of digital businesses due to some fundamental characteristics inherent to digital platforms: the high level of interconnectivity and variety of users; the scope for complementarities among the different activities; and the platform's resulting need to coordinate multiple agents for value creation. To better understand and analyze the evolution of Internet platforms and their impact on markets it is necessary to focus on the process of value creation in complex and uncertain environments. This requires the incorporation of concepts developed in the innovation management literature, complexity economics, evolutionary theory, contract theory and incentives mechanism design. This more sophisticated framework would allow a better assessment of regulatory responses.

Part two of this paper briefly describes the evolution of platform businesses. Part three presents the economic dynamics of digital platforms, the process of value creation and the coordination challenges that these platforms face. Part four concludes.

¹ European Commission. Senior Fellow at George Mason University, Schar School of Policy and Government. The views expressed in the article are the private views of the author and may not, under any circumstances, be interpreted as stating an official position of the European Commission.

II. PLATFORM BUSINESS MODELS: EVOLUTION OVER TIME

The Internet originated in a technology that was initially meant to improve the resilience of existing communication networks. The packet networking technology was a response to the U.S. Department of Defense's desire to build a more secure communication network than the telephone network.² The new technology soon allowed bilateral connections to become multilateral. The Internet was created, and then opened. The new communication opportunities gave rise to commercial and social exchanges.³ The Internet qualitatively changed when users started providing user-generated content, peer-to-peer exchanges, and social networking, thereby becoming direct contributors to the value creation online. Mobility added a new dimension to the kind of communications and services that could be offered. The ability to harness data, new big-data analytical capabilities and cloud computing, as well as a new approach to artificial intelligence based on machine learning further boosted the commercial value of data and online connectivity.⁴

Internet businesses evolved from the simple models focused on the online sale of goods, services or content to complex ecosystems of exchanges and collaboration that provided interlinked sets of services. These new platforms both served and engaged users, and used information in a radical new way. Amazon evolved from being an online bookstore to becoming a global market exchange, a cloud services provider, a content provider and finally a supplier of intelligent home services. Apple's mobility business evolved from a digital music provider to a communications and content provider, to a platform for services and eventually a provider of intelligent device connectivity. Google's business has long moved past the business of online search to provide online advertisement, maps and geo-location services, translation services, commercial marketplaces, cloud and management services as well as mobility services and mobile apps. The company is focused on increasingly large applications developed around artificial intelligence. Facebook's social networking site now provides advertisement, news, communication services and live content streaming. One could go on describing rapid evolutions of platforms such as LinkedIn, Booking.com, Ebay or Paypal.

Two important features have characterized successful digital platforms. First, they are evolving businesses that continuously span out into new activities. The evolution seems to be highly experimental with several instances of services and offerings that are tried out and then either developed or closed. Google tried three social network sites before Google+. Amazon tried several payment systems that it later shut down. The second characteristic is that these businesses have tended to higher or lesser degrees towards integration of their different offers into a single experience. Platforms are offering entire menus of services that increasingly rely on each other for delivery. A user will find a single interface for multi-purpose services that operate in an increasingly integrated fashion. Examples are calendars linking to mails and maps, commercial offers linked to content usage, or home devices placing orders by simple voice commands. Platform providers build their ecosystem exploiting synergies across different services. They do so in various ways using either partnerships or full integration. Digital services are becoming easier to access and simpler to use. Yet at the same time the complexity of the digital commercial world is vastly increasing.

These developments have defined the digital service markets. Users may be able to find alternative providers for a similar service but these services are rarely equivalent as the complementary offers they link to can be quite different. Similar services may be offered by platforms with different core strengths and complementary services that may vary from information processing, social networking, cloud business services, or marketplaces. The competition for users among large platforms occurs in a landscape of very differentiated suppliers that sometimes compete and sometimes complement each other. Competitive challenges may appear from a very different platform provider developing complementary services. Understanding the fundamental drivers of this complex and evolutionary environment is essential to understand its progression and distinguish desirable from non-desirable outcomes.

2 RAND "Paul Baran and the origin of Internet" <http://www.rand.org/about/history/baran.html>.

3 A good account of this process can be found in Greenstein, (2016) *How the Internet Became Commercial: Innovation, Privatization, and the Birth of a New Network*, Princeton University Press.

4 A vast literature documents the rise and evolution of platforms. See for example; Simon, *The age of the platform: How Amazon, Apple, Facebook, and Google have redefined business*. Motion Publishing, 2011.

III. THE ECONOMICS OF PLATFORMS AND PLATFORM DYNAMICS

A. What is a Digital Platform?

Platforms are diverse, and while some researchers have attempted to categorize them, others have attempted to define the underlying common elements.⁵ This paper defines platforms as coordination devices that use technology and connectivity standards to bring together a variety of functionalities and users in a way that creates value and generates a rent for the platform owner.⁶ This definition presumes and stresses the coordinating role of the platforms for value creation.⁷ The focus of this paper will be on Internet-based platforms that have evolved into providing a great variety of diverse functionalities resulting in an ecosystem of activities beyond simple market intermediation or value chain organization. This means for example that a service that would only connect passengers and taxi drivers without any payment or complementary functionality is not the subject of this paper – although the economics of platforms predicts that if this service is independently owned it would eventually evolve towards offering such complementary services. Platforms covered include for example the Apple operating system, Android OS, Amazon market place but also to more specialized platforms such as travel reservation platforms or the more sophisticated payment platforms such as Paypal. All these platforms have in common an expansion of complementarity services and functionalities although they represent different choices in the level of integration and coordination.

From a technological perspective, a platform provides some standardized functionalities that form a core on which complementary modules or functionalities can be plugged. For example, an Internet search platform provides a technology on which advertisers, geo-location services or marketplaces can plug. An operating system provides a standard interface that can be used by all those who choose to add a service or functionality. Essential functionalities such as connectivity with users or even payment systems can potentially be standardized into the platform core. Complementary “add-on” functionalities can be added, removed or replaced at little cost without undermining the stable core service, and this promotes complementary innovation and platform evolution.⁸ A platform structure is adopted as a business model when the platform owner is keen on generating investment in such complementary functionalities (or services) and when it stands to gain from their large degree of diversity.⁹ The dynamics of the platforms therefore follow an evolutionary process where the platform owner tries and tests services that create value in a variety of ways. It then proceeds to establish links of different strengths with the providers of successful complementary services.

B. Platform Value Creation

A recent literature on business models, motivated by the impact of new technologies, has focused on the coordinating role of firms in discovering and developing opportunities for value creation.¹⁰ The focus of this type of analysis is on the organization of value creation rather than on the firm strategy for competitive positioning.¹¹ The focus is on value generation rather than market share or rent appropriation. This literature emphasizes the experimental and evolutionary nature of successful business

5 For a categorization attempt see Thomas, Autio and Gann (2014) “Architectural Leverage: Putting Platforms in Context,” *Academy of Management Perspectives*, 28(2), 198–219.; For an attempt to define common characteristics see Baldwin & Woodard, (2009) “The Architecture of Platforms: A Unified View” in *Platforms, Markets and Innovation* (Paperback Ed.), Cheltenham, UK and Northampton, MA.

6 Schrieck et al. (2016) similarly attempts to bridge the gap between a technology and market based approach to platforms. See Schrieck, Wiesche & Krcmar, (2016) “Design and Governance of Platform Ecosystems-Key Concepts and Issues for Future Research,” in *ECIS* (ResearchPaper 76).

7 Bresnahan & Greenstein (1999) define a platform as “a bunch of standards components around which buyers and sellers coordinate efforts.” See Bresnahan & Greenstein, (1999) “Technological Competition and the Structure of the Computer Industry,” *The Journal of Industrial Economics*, 47(1), 1–40. This paper further extends the concept of platforms beyond simple marketplaces and presumes an active coordinating role by the platforms.

8 Baldwin & Woodard, (2009) “The Architecture of Platforms: A Unified View,” in *Platforms, Markets and Innovation* (Paperback Ed.), Cheltenham, UK and Northampton, MA.

9 Baldwin & Woodard, (2009).

10 For a review see Zott, Amit & Massa (2011) “The Business Model: Recent Developments and Future Research,” *Journal of Management*, 37(4), 1019–1042. This approach is also related to the literature on dynamic capabilities. See Teece, (2011) *Dynamic capabilities and strategic management: organizing for innovation and growth*: Oxford Univ. Press.

11 The importance of the capacity to combine and coordinate new technologies and abilities as a source of value creation is illustrated in the “dynamic capabilities” literature. See Teece, Pisano & Shuen, (1997) “Dynamic Capabilities and Strategic Management,” *Strategic Management Journal*, 18(7), 509–533.

models, and relates choices of architecture and relations with complementary actors to innovation fitness decisions.¹² It shows that the coordination of activities for the purpose of value creation typically extends beyond the formal boundaries of the firm, and also involves establishing links with independent players.¹³ The framework developed in this business model literature is relevant to the analysis of digital platforms as it sheds light into their process of value generation.

Coordination tools used to maximize platform value involve pricing and non-pricing mechanisms. Some organization and pricing decisions are certainly driven by strategic considerations relating to competitive threats, but the important point is that these considerations are not the only factor determining the design and conduct of a platform business.¹⁴

A crucial point in the analysis of platforms is that value creation on a digital platform is often triggered by two factors that are largely absent in more traditional markets: the instant large-scale interconnectivity (access to users, counterparties or complementary providers) and the large opportunities for demand and supply complementarities that are technologically made possible within the platform.¹⁵ Economies of scope may arise due to demand-side complementarities such as when the usage of a service makes the usage of another service more attractive. A platform payment service will be more valued by a user who also uses a marketplace service on the platform. But there are also supply-side synergies. The supply of a service might be made more efficient by the simultaneous supply of another service. Instant delivery services are made efficient by the simultaneous presence of geo-location and interactive map services. The observed convergence of traditional e-commerce and online content supply into a single value proposition is another example of such economies of scope in platform activity. Such convergence is visible when an online fashion retailer provides a fashion blog, a houseware retailer provides online cooking classes or an online gardening publication sells gardening tools.¹⁶

The technology for cheap interconnectivity increases the impact of network effects and economies of scale.¹⁷ But the distinctive and determinant driver of platform businesses is the sheer amount of complementarities conducive to indirect network effects and economies of scope.¹⁸ The opportunities for such demand-side and supply-side economies of scope are enhanced by the platforms' ability to interconnect very efficiently and very cheaply vast amounts of users and services. As every platform participant is immediately accessible to all counterparts, the combinatorial possibilities for transacting grow dramatically with platform size. While network effects in the provision of a given service have been treated by regulators as a factor cementing platform dominance in any one service, economies of scope are also a strong driver of platform evolution. For example, Kakao Talk, a messaging application successfully beat Facebook in Korea after it developed social network functionalities into its core communication service.¹⁹

12 See for example Doz & Kosonen (2010) "Embedding strategic agility: A leadership agenda for accelerating business model renewal," *Long Range Planning*, 43(2), 370–382.

13 This links to the concept of a business model as an "activity system" as developed in Amit & Zott (2010) and Zott & Amit (2010). Business models structure and govern a system of interdependent activities that cross the boundaries of the firm. This is a different approach than the partial optimization exercise across activities within a firm. See Amit & Zott, (2001) "Value creation in E-business," *Strategic Management Journal*, 22(6–7), 493–520; Zott & Amit, (2010) "Business Model Design: An Activity System Perspective," *Long Range Planning*, 43(2–3), 216–226.

14 Examples for pricing decisions on platforms driven by rent appropriation considerations can be found in Hagiu, (2009) "Two-Sided Platforms: Product Variety and Pricing Structures," *Journal of Economics & Management Strategy*, 18(4), 1011–1043.

15 Shapiro & Varian, (1998) offer an early but still valid account on how companies can exploit economies of scale and scope in digital services. See Shapiro & Varian, (1998) *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business Press.

16 Berger & Hess, (2015) "The Convergence of Content and Commerce: Exploring a New Type of Business Model," *AMCIS 2015 Proceedings*.

17 The mechanisms of network effects on platforms when they are matching buyers and sellers or producers and users are described in Katz & Shapiro, (1994) "Systems Competition and Network Effects," *The Journal of Economic Perspectives*, 8(2), 93–115.; Evans, (2003) "The Antitrust Economics of Multi-Sided Platform Markets," *Yale Journal on Regulation*, 20(2); and Rochet & Tirole, (2003) "Platform competition in two-sided markets," *Journal of the European Economic Association*, 1(4), 990–1029.

18 Amit & Zott, (2001) presents a theoretical framework to explain value creation in e-businesses that also identifies these features. See Amit & Zott, (2001) "Value creation in E-business," *Strategic Management Journal*, 22(6–7), 493–520.

19 "Despite its Android Dominance Facebook fails to Tower over Kakao in Korea," July 13, 2017 Business Korea <http://www.businesskorea.co.kr/english/news/ict/18645-despite-its-android-dominance-facebook-fails-tower-over-kakao-korea>.

Data has greatly increased the complementary nature of many services as the data collected in one service can be used to improve another.²⁰ Platform users not only purchase goods or services but also provide useful information on behavior, demand and usage. The management literature is awash with predictions on the importance of Big Data analytics for the successful businesses of tomorrow, but the exploitation of Big Data is already a reality for the large online platforms.²¹ Big Data analytics is used to improve existing services by targeting offers and possibly elaborate new ones. It is used to forecast behavior, and its utility spans beyond the market on which it is collected as observed patterns in one market can improve forecasts in another. Big Data is also essential for the development of businesses relying on artificial intelligence. Data is easy to collect in digital platforms, and new techniques are increasingly facilitating the type of processing that renders the data actionable for platforms capable of the necessary technological investment. The collection and exploitation of data are an increasingly important factor in platform value creation.

C. Elements of Platform Coordination

In order to properly generate and maximize the value made possible by the platform, the platform owner ends up having to coordinate a wide variety of diverse elements interacting on it. As mentioned above, one aspect of the platform coordination is the provision of a set of standard technology to be relied upon by all other complementary services. But platform coordination extends beyond the joint development or provision of standard technology, and also concerns the value creation process. It includes the set up rules, incentive mechanisms and payment structures that elicit particular behaviors on the part of all users involved in co-creation.²² Such coordination tools include for example the design of the interface and rules of participation that prompt buyers and sellers to join an intermediation service platform, allow them to meet in relevant ways, and potentially incentivize them to improve the service.

Coordination mechanisms in market intermediation services that link two or more sets of users wanting to interact have been extensively studied in the multi-sided market literature.²³ This literature thoroughly analyzes the impact of behavioral complementarities (how the behavior of one type of users affect the behavior of the rest of the group or of other types of users) on a coordinating platform's contractual decisions. The focus of that literature has tended to be on the impact of these complementarities on price structures to incentivize market participation and growth.²⁴ But this interdependence needs also to be managed in order to unlock new forms of value generation.²⁵

When coordinating the value generating activities it supports, a platform will attempt to optimize the total value generation process. It will set the rules of the platform to coordinate all possible types of valuable contributions by all the participants in order to maximize total value. In doing so, the platform must be sure to generate enough value to each user to

20 Visconti et al. (2017) describe the Big Data value chain and the value created by "data fusion." They also highlight the complexity and technical challenges involved hence illustrating the benefits of coordination. Visconti, Larocca & Marconi, (2017) *Big Data-Driven Value Chains and Digital Platforms: From Value Co-Creation to Monetization* (SSRN Scholarly Paper No. ID 2903799). Rochester, NY: Social Science Research Network.

21 McAfee & Brynjolfsson, "Big data: the management revolution," *Harvard Business Review* 90.10 (2012): 60-68; Davenport, (2014) "How strategists use 'big data' to support internal business decisions, discovery and production," *Strategy & Leadership*, 42(4), 45-50. The data generated and collected in the platform can also be monetized in more classic ways and the sale of non-identifiable personal data is already a competing revenue stream with advertising on online services. This fact is mentioned in Roma & Ragaglia, (2016) "Revenue models, in-app purchase, and the app performance: Evidence from Apple's App Store and Google Play," *Electronic Commerce Research and Applications*, 17, 173-190. Data monetization is also described in Visconti et al. (2017).

22 Hagiu, (2014) "Strategic Decisions for Multisided Platforms," *MIT Sloan Management Review*, 55(2), 71-80; Parker, Alstyne (2014) *Platform Strategy* (SSRN Scholarly Paper No. ID 2439323). Rochester, NY: Social Science Research Network.

23 A non-technical explanation of the functioning of multisided markets can be found in Evans & Schmalensee, *Matchmakers: The New Economics of Multisided Platforms*, Harvard Business Review Press, 2016.

24 Rochet & Tirole, (2003) "Platform competition in two-sided markets. *Journal of the European Economic Association*," 1(4), 990-1029; Evans & Schmalensee, (2005) *The industrial organization of markets with two-sided platforms* (No. w11603), National Bureau of Economic Research; Rysman, (2009) "The economics of two-sided markets," *The Journal of Economic Perspectives*, 23(3), 125-143.

25 In their analysis of platform ecosystems, Shrieck et al. (2016) note the lack of integration of the technology based literature that emphasize value creation and the market based approach that emphasizes pricing and revenue generation. McIntyre & Srinivasan (2017) summarize both strands of literature and also calls for a needed integration. See Schrieck, Wiesche & Krcmar, (2016) "Design and Governance of Platform Ecosystems-Key Concepts and Issues for Future Research," in *ECIS* (ResearchPaper 76); McIntyre & Srinivasan, (2017) "Networks, platforms, and strategy: Emerging views and next steps," *Strategic Management Journal*, 38(1), 141-160.

incite their participation. Because of the large number of potential interdependences across users and services, the incentive mechanisms set by a platform will differ from a situation of distinct providers of these same services.

Coordinating across users and suppliers of complementary services will be particularly important when the platform is intent on technological or business model innovation. Such innovation may require an adaptation by users and suppliers; a platform can affect their ability and willingness to undertake that adaptation by establishing the right relationship.²⁶ The platform may also want to maximize the production of and access to actionable information actively or passively provided by users in their various interactions. For this, the platform may design behavioral incentives for different users to increase their provision of data. Finally, the platform owner will need to take into account the positive or negative impact that any participant's behavior has on other participants in order to enhance positive complementarities and avoid negative feedback effects across users.²⁷ Such negative feedback effects occur for example when a platform allows fraudulent operators to co-exist with legitimate ones causing users to drop out. Negative externalities explain why platforms often have an incentive to regulate against fraud, low-quality services, excessive user risk or other undesirable outcomes.

All these value-generating considerations will be relevant to the platform when it determines the final rules of participation to its participants. The drive to provide value to individual users, the opportunities to extract and use data and information, as well as the prevention of outcomes that could undermine the dynamics of the platform all play an important role in platform governance and incentive mechanisms.²⁸ The multi-sided market literature has extensively described the coordination issues involved in scaling and pricing correctly such as to bring on board two sides of a same market.²⁹ Coordination through pricing can also extend to behavior outside of the platform. For example, it has been argued that the price parity clause that hotel booking sites impose on hotels, which prevents them from selling rooms at a cheaper rate on their own websites, is meant to eliminate incentives for users to use the hotel search service on the platform without using the booking service. As it is efficient for a booking platform offering both search and booking services not to charge for the traffic generating search, and only to charge the hotel for the booking, eliminating the booking step on the platform may undermine the whole process of synergies and value creation for the platform business. This example also illustrates the tensions that often arise between platform value optimization and optimization by a single user.³⁰

Rules and coordination mechanisms may extend beyond pricing, and may involve access rules, bouncer rights, restrictions on behavior, investment requirements or asset and risk sharing.³¹ All these rules imposed on users may be motivated by the need to address the externalities that arise on the platform in order to increase or protect the value of the platform ecosystem.³² An approach that considers the impact of platform rules on one particular service, functionality, or user type in isolation runs the risk of missing a value generating purpose of the rule. Technological complementarities, behavioral externalities and economies of scope on the platform need to be well understood in order to assess the rationale of platform rules.

26 Yoffie & Kwak, (2006) "With Friends Like These," *Harvard Business Review*, 84(9), 88–98.

27 Hagiu, (2014) "Strategic Decisions for Multisided Platforms," *MIT Sloan Management Review*, 55(2), 71–80.

28 Iansiti & Levien, (2004) describe the strategic interest of businesses that rely on complementary suppliers in actively promoting "healthy" ecosystems. Iansiti & Levien, (2004) "Strategy as ecology," *Harvard Business Review*, 82(3), 68–81.

29 Katz & Shapiro, (1994) "Systems Competition and Network Effects," *The Journal of Economic Perspectives*, 8(2), 93–115; Evans, (2003) "The Antitrust Economics of Multi-Sided Platform Markets," *Yale Journal on Regulation*, 20(2); Rochet & Tirole, (2003) "Platform competition in two-sided markets," *Journal of the European Economic Association*, 1(4), 990–1029.

30 Yoffie & Kwak, (2006) "With Friends Like These," *Harvard Business Review*, 84(9), 88–98.

31 Boudreau & Hagiu, (2008) discuss the necessary regulator role of platforms. Boudreau & Hagiu, (2008) "Platform rules: Multi-sided platforms as regulators." Parker & Van Alstyne, (2014) also provide examples of efficient platform non price coordination. Parker, Alstyne (2014) *Platform Strategy* (SSRN Scholarly Paper No. ID 2439323). Rochester, NY: Social Science Research Network.

32 Kapoor & Lee, (2013) argue that market based mechanisms coordinating only around prices may not promote innovation in new technologies under circumstances of complexity and uncertainty. Kapoor & Lee, (2013) "Coordinating and competing in ecosystems: How organizational forms shape new technology investments," *Strategic Management Journal*, 34(3), 274–296.

D. Integration Decisions

The difficulty of establishing and maintaining the right incentives in support for maximum value creation will sometimes motivate platforms to take control of complementary services integrating them into the platform core. Economic theory predicts that a platform will not have an incentive to integrate a complementary service if it has an alternative way of internalizing the rent generated by the complementarity.³³ This appropriation could take the form of a higher fee charged to platform users, rent transfers from the complementary service provider or even higher platform traffic. But if realizing these complementarity efficiencies requires coordination then bargaining problems may occur that may push the platform towards integration.

Incentives for vertical integration due to the costs of writing and enforcing complete contracts have been described in the transaction costs economics literature.³⁴ Transaction costs are likely to be high when the contracting assets need to undertake specific investments for the joint value creation.³⁵ The link between the need to develop co-specialization and the level of integration has also been described in the literature of dynamic capabilities and the more recent literature on business models has also approached modularity as a mechanism for innovation and adaptation.³⁶ Under these frameworks, services that are integrated will be the ones that exhibit the highest and more complex complementarities within the platform and therefore offer the most gains from coordination in either supply or usage. For example, access to functionalities such as Google maps, Google Drive or Google Wallet is offered to any app developer that joins Google Play on the Android platform – although they remain distinct services.³⁷ Amazon has fully integrated payment systems into their marketplace platform. Although such integration decisions may be motivated by competitive strategy, the standardization of functionalities on the platform promotes value and often enhances coordination in a way that facilitates the realization of economies of scope.

Increasing difficulties in contracting access to data for the exploitation of possible synergies may, in this sense, point to less modular platforms in the future. Similarly, the technological coordination that is needed to facilitate the fusion of unstructured datasets also fosters cooperation and, absent coordinated solutions, integration.

E. Appropriation Mechanisms

The design of the business model by a platform must not only coordinate to create value but also include revenue appropriation mechanisms. These will also take a variety of forms across activities: access fees, transaction fees, direct sale of premium services or licensing. The collection of information can also ultimately be revenue generating. The design of mechanisms to appropriate platform benefits will need to be coherent with incentive mechanisms for value generation. As already described in the multi-sided market literature, who pays for what will be strongly affected by the role and externalities generated by the different platform users in the process of value creation.

Finding mechanisms to appropriate and protect the rents of innovation will also affect the architectural design of the platform. In order to avoid easy replication and an erosion of rent, platforms will promote the differentiation of the platform eco-system. The joint supply of diverse specialized services building on a core technological strength is an example of such possible differentiation. The need to protect rent appropriation mechanisms against competitive pressure will also determine

33 Farrell & Weiser, (2003) develop this concept of internalization of complementary efficiencies and discuss some exceptions to this rule. Farrell & Weiser, (2003) "Modularity, vertical integration, and open access policies: towards a convergence of antitrust and regulation in the internet age," *Harv. JL & Tech.*, 17, 85.

34 Starting with Williamson, (1971) "The Vertical Integration of Production: Market Failure Considerations," *The American Economic Review*, 61(2), 112–123.

35 Riordan & Williamson, (1985) "Asset specificity and economic organization," *International Journal of Industrial Organization*, 3(4), 365–378; Williamson, (1989) "Transaction cost economics," *Handbook of industrial organization*, 1, 135-182.

36 Teece, Pisano & Shuen, (1997) "Dynamic Capabilities and Strategic Management," *Strategic Management Journal*, 18(7), 509–533. For the role of capabilities development in the vertical structure of an industry see Jacobides & Winter, (2005) "The co-evolution of capabilities and transaction costs: explaining the institutional structure of production," *Strategic Management Journal*, 26(5), 395–413. For a description of choices of modularity as a mechanisms for innovation see Aversa, Haefliger, Rossi & Baden-Fuller, (2015) "From Business Model to Business Modelling: Modularity and Manipulation," in *Business Models and Modelling* (Vol. 33, pp. 151–185). Emerald Group Publishing Limited.

37 "Integrated Google Play Services on Android" <https://code.tutsplus.com/tutorials/integrating-google-play-services-on-android--cms-19828>.

the modules or functionalities that will be internalized or kept open.³⁸ For example, retaining control of or integrating those functionalities that are not easy to replicate will contribute to rent appropriation and protect from platform replication.³⁹ But a platform might also invest in a complementary asset that is valuable in generating further complementary opportunities and may even encourage imitations of this function if this subsequently increases the value of that asset.⁴⁰ The appropriation of a new functionality may therefore result in closure or additional openness depending on its role in the overall platform value generation and in its appropriation mechanisms.

Rent appropriation mechanisms are necessary for the business platform to be viable and innovative. As long as what is appropriated is a share of the value generated by the business, the welfare effect is positive. This contrasts with cases where strategies are put in place to increase rent extraction from the market as a whole at the expense of overall welfare and innovation capabilities.

IV. CONCLUSION

Platforms generate value by exploiting the benefits of large-scale interconnectivity and the opportunities of an exceptional range of possible economies of scope. Recent economic and management literature has illustrated how the incentives to invest in new technologies and the ability to organize and appropriate rent from the resulting innovation rely on complex relations with customers, suppliers and complementary providers.

This paper has presented the argument that the co-creation activity and coordination mechanisms for joint development of new products are as much a driver in the dynamics of platform governance as are the platform's strategic imperatives of competition. Rules of participation and pricing decisions will often work as incentive mechanisms and coordination tools in addition to their more traditional role of market positioning mechanisms. Yet production-oriented objectives have been mostly ignored in policy makers' analysis of platform markets. Traditional models of firm behavior generally used in less evolutionary and more disconnected environments are likely to be inadequate in explaining platform behavior and the dynamics of platform based businesses. This is particular the case when these models are used in a partial analysis of the overall platform activity.

38 Several articles also illustrate the link between platform architecture and competitive strategy. See for example Woodard, (2008) "Platform Competition in Digital Systems: Architectural Control and Value Migration," 1–38.

39 Teece, (1986) "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," *Research Policy*, 15(6), 285–305.

40 Jacobides, Knudsen & Augier, (2006) "Benefiting from innovation: Value creation, value appropriation and the role of industry architectures," *Research Policy*, 35(8), 1200–1221.