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Competition Economics of Digital Ecosystems – Note by Georgios Petropoulos

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Competition Economics of Digital Ecosystems[1]

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1. Introduction

1. Digital ecosystems can be described as digital resources that enable efficient interactions between producers, content providers, developers, consumers and other users that lead to value creation from (online or even offline) trade. Digital ecosystems can facilitate, for example, the production, distribution, marketing, sale or delivery of products and services by electronic means, the sale and/or shipment by traditional means of digital goods (products and services) as well as the transmission or storage of information as a service in its own right.

2. Competition concerns in digital ecosystems typically involve a star network structure: Every user is connected to a hub, one or more platforms in the center of the ecosystem. The platform provides the infrastructure and facilitates interactions between users. To do that, platforms i) adopt open digital infrastructures that allow multiple stakeholders to orchestrate their service and content needs; ii) establish governance rules and invest in governance enforcement mechanisms that seek to balance platform control with the necessary incentives for platform participants to engage with the platform and generate value for one another; iii) set an effective and fair dispute resolution system that corrects trade distortions in a timely manner.

3. Broadly we can distinguish between two groups of platforms:

- Aggregators are platforms that provide some valuable service to their users in addition to their interaction with third party producers or providers that they facilitate. For example, search engines like Google and Microsoft's Bing allow their users to reach a vast quantity of information. To do so, they invest in the effort of "crawling" the Internet in order to catalog and organize information resources. Users who patronize these search engines also see external producers' (e.g., advertisers) products and services. In most cases, online search is provided through such platforms at zero price and the search platforms monetize their operations by charging advertisers a price per user interaction that is realized through a generalized price auction per search keyword. Social media platforms like Facebook and Twitter are another example of this category. Users receive value through non-monetary interactions with their friends and influencers but, at the same time, they are invited to get in touch with advertisers through the personalized promoted content these platforms project to their users.
- Marketplaces are platforms that have as a primary objective to create efficient matches between consumers and suppliers of goods. Online marketplaces of goods and services such as eBay, Uber and Booking.com facilitate the matching between third parties in an efficient way through data collection, analytics, and techniques that reveal their users' preferences. In this category, there are also platforms that

[1] This contribution is based on my joint research work with Geoffrey Parker and Marshall Van Alstyne and the series of papers we are currently working on. See references for more details.

manufacture and sell their own products and services. Amazon Marketplace, Apple iTunes, and Google Play are examples of this subcategory.

4. Key characteristics of digital ecosystems can give rise to economic forces that result to an increased control of the ecosystem by platforms and a market tipping behavior:

5. Multi-sidedness: The one side of the market can derive an added value from its interaction with the other side of the market. This value can be either symmetric between the two sides (e.g., in the case of a marketplace where the primary objective is the trade of goods) or it may be the case that the one side derives more value from the interaction with the other (e.g., in an aggregator where users place greater value on the platform's content and advertisers place higher value on interaction with users). A platform may decide to subsidize one side of the market when its presence on the platform is very valuable to the other side. In aggregator platforms, advertising is the main source of business revenue. Since advertisers are attracted by the consumer users of the platform, platforms will often provide content for a very low price, or even for free, to consumers in order to attract them. By attracting potential consumers on the one side, platforms can get higher benefit from advertising. CMA (2020) illustrates the high concentration of advertising revenues in platforms such as Google and Facebook.

6. Economies of scale: Digital goods and services are typically produced at a significant fixed cost but no or little variable cost (Varian, Farrell and Shapiro, 2004). In other words, the cost of production is much less than proportional to the number of customers served. Hence, once established, digital firms can grow quickly by expanding their operations to new users at minimum cost.

7. Data-driven economies of scope: Machine learning and artificial intelligence has vastly improved the value of data for firms. By collecting, analyzing and aggregating large amounts of data, firms can improve product quality and expand their activities into new areas. Because machine learning yields better insights when it is trained on larger datasets, firms with access to large amounts of data can raise the quality of their services in ways that firms with restricted access to data cannot. Martens (2020) illustrates this by describing the economies of scope in data aggregation: Merging two complementary datasets can generate more insights and economic value compared to keeping them in separate data silos. Hence, when two datasets are complementary and not entirely separable, applying data analytics to the merged set will yield more insights and be more productive than applying it to each set separately, especially when the marginal cost of applying analytics to a more complex dataset is relatively small.

8. Network effects: The user's value from participating in the platform can increase with the participation of other users in the platform. Network effects can be direct or indirect. Direct network effects are, for example, observed in social network platforms such as Facebook where the value users derive from the platform increases with the number of friends using it. Indirect network effects are, for example, observed in aggregators where the aggregation of data from additional users help the platform to improve its product quality for all its participants. Network effects can go both directions. For example, in the Android ecosystem, the more users there are, the more attractive the platform for app developers and advertisers will be. This implies a greater variety and quality of products and services offered to the users. So, the platform becomes even more valuable and more users wish to join which in turn attracts more developers in a virtuous cycle.

9. The interaction between these forces can lead to the ecosystem's increased economic dependence on the platform that facilitates the majority of interactions between different users. It also increases the first mover advantage. The platform that first reaches a critical mass of users can dominate the ecosystem. In other words, these forces that are

met in digital ecosystems can impact competition in a structural way: Instead for competition within the market, we observe competition for the market.

2. The important role of data

10. The data as an asset and input in the algorithmic systems employed by platforms to provide their services can have an important role in this process of dominance. Machine learning and artificial intelligence (AI) has vastly improved the value of data for firms. By collecting, analyzing and aggregating large amounts of data, firms can improve product quality (data-driven economies of scope) and expand their activities into new areas.

11. When users join platforms, they *volunteer* some personal information which typically remain constant over time (e.g., name, age, location). During their engagement with the platform and their interactions with other users as well as content, their actions and behavior are *observed*. These actions may change over time as platform content is usually updated in a dynamic way. This observation of user behavior allows platform to follow closely their users' preferences over time. Platforms combine data that is volunteered with data that is observed, and use them as an input to their algorithmic system whose objective is to infer users' preferences. While volunteered data is non-rival, observed data is only collected by the platform on which users interact. This exclusive access can generate significant benefits and a comparative advantage against competitors that do not have the ability to observe users' actions in the ecosystem.

12. The value created from data and the information it incorporates is reinforced through the data feedback loop which is enabled through machine learning and AI technologies. AI algorithms improve their performance with the quality and quantity of data they use as an input, data improves value creation through two channels.

1. More and better data help algorithms of a given quality to make better predictions which in turn leads to better products and services
2. More and better data help to improve the quality of an algorithm through learning by doing. In other words, data also serves as a training function for algorithmic systems to become better at the tasks assigned to them.

13. A resulting positive data feedback loop can, under the presence of strong network effects, be powerful. As firms improve the quality of products and services through these two data-driven channels, more individuals will consume their goods which implies that more data will be available for these firms to further improve their services and products, generating higher value than entrants which, because of lack of data, are unable to reach similar levels of service/product quality.

14. Note that data can also be re-purposed, thereby generating additional value. For example, in cases where firms wish to train algorithms to capture consumer preferences that shift frequently, the size of the data sample can be helpful in identifying quickly such shifts and adjusting digital services accordingly. Moreover, the data sample in one market, when it is sufficiently large, can be helpful when entering a closely adjacent market (Condorelli and Padilla, 2019). Overall, when data is only used in algorithmic systems with a specific task, it is likely to exhibit diminishing returns to scale (Arnold et al., 2018). But, when data are used in additional applications or for capturing dynamic trends, there can be increasing returns to scale (Posner and Weyl, 2018).

15. The Furman et al. (2019) report concluded that concentration is particularly prominent in the following digital markets: i) online search, which is dominated by Google, with some competition from Microsoft Bing; ii) social media, dominated by Facebook and

the services its owns, with some competition from Twitter and Snapchat; iii) digital advertising, dominated by Google and Facebook; iv) mobile app downloads, which is a duopoly between Apple and Google; v) commerce through online marketplaces, where Amazon is a dominant platform, with some competition from eBay.

16. It is important to note that market concentration and dominance do not violate competition law if they are reached through the efficiency channel, without the employment of anticompetitive strategies: If a platform offers better services than its competitors and attract more users, then the above-mentioned economic forces can lead to a competitive equilibrium in which the platform is dominant. Dominance in this case is the outcome of healthy competition and can be beneficial for consumers. However, increased market power should come with special responsibilities that restrict the ability of the platform to use its advantageous position in the ecosystem to its own benefit.

3. Information asymmetries and potential anticompetitive strategies

17. Concerns and theories of harm have been developed for big platforms that exert great control on the ecosystem they operate, the so-called gatekeepers. One important characteristic of these ecosystems is the high information asymmetries. The great information advantage of the gatekeepers allows them to control the ecosystem and generate significant value for their intermediation services. Consumers and external producers need to rely on platforms' ranking and matching algorithms in order to interact efficiently. At the same time, competition authorities, without access to vital information for the operation of these ecosystems find difficult to evaluate potential anticompetitive strategies in a timely manner.

18. Particular concerns arise due to vertical integration. Platforms in addition to their intermediation services supply their own products and services in the upstream level competing directly with external producers. When the platform acts as a gatekeeper and consumers have limited options to reach suppliers through other means, then, in the case that platforms develop strategies like self-preferencing (i.e., promotion of platform's upstream subsidiary to the downstream market), they can effectively drive demand to platform's own supplier to the expense of its competitors in the upstream market. The crucial question is whether platform's own supplier provides the best quality product or more specifically it is the best match for a consumer. If yes, the self-preferencing promotes efficient transactions and maximize the generated value. If not, then, the value of the transaction declines and efficient competitors may be foreclosed. This is a typical example of how leveraging market power at the intermediary level can distort market competition in the upstream market and reduce consumer surplus.

19. Gatekeeper platforms have control over framing consumer choices, policies for goods supplied through the platform, and technical standards. In many cases, they keep complete control over the user relationship as well as platform access rules. They therefore have incentives to avoid the threat of entry and disintermediation. Problems arise when third-party sellers need to comply with specific conditions that do not apply to the upstream platform's subsidiary. These conditions involve excessive access and transaction fees (that are collected by the platform), exclusive dealing (i.e., prevention of third-party sellers from promoting their offers outside of the gatekeeper's platform), a biased dispute resolution mechanism that does not allow third-party sellers to complain about the ecosystem conditions.

20. Moreover, the data-driven channel can have important implications with respect to vertical relationships. The gatekeeper platform collects data from third-party sellers that

participate in its ecosystem. It can then use such collected data to gain a competitive advantage when competing directly with those sellers in the upstream market. Knowing product characteristics and selling strategies, the platform can better design its own products and strategies in the upstream market.

21. At the same time, gatekeeper platforms may not share critical information with their trading partners that could potentially lead to the threat of disintermediation, but this can also lead to forgone production efficiency gains. In some cases, this implies that trading partners are forced to operate without clarity over market conditions.

22. An important aspect in digital ecosystems is whether greater competition at the level of the gatekeeper intermediary can increase product and process innovation. There is no consensus between endogenous growth models, agency models, and empirical evidence on whether market power reinforces or discourages innovation. Literature has focused on the impact of competition on firms' innovation incentives, defined as the difference in the profits a firm earns when it innovates and when it does not. This "incentive-effect" of competition can be either positive or negative. On the one hand, firms that operate in a competitive market have incentives to innovate to escape from competition and enjoy higher market shares (the "escape-competition" effect following Aghion et al. (2005), which is a slightly modified version of the "replacement effect" of Arrow 1962). On the other hand, firms that enjoy monopoly rents have higher incentives to innovate to protect their market position and discourage entry by potential competitors (the Schumpeterian effect, based on the notion of "creative destruction" introduced by Schumpeter, 1934). Most of the theoretical contributions have focused on the interaction between these two opposing forces for different market structures and characteristics of innovation.

23. In the case of gatekeeper platforms, the theory of harm in investments on innovation focuses on the fact that once the competition for the market phase has been completed and the winner has emerged, the latter has incentives to engage in anticompetitive practices to limit the threat for successful entry and innovation. But, by raising entry barriers, incentives for innovation decrease. Since innovation is a way to improve a firm’s market position against its competitors, if the probability of entry by competitors is reduced through other practices that rely on market power, then innovation is less necessary to protect a market position.

24. But the story does not stop here. According to this theory of harm, incentives for innovation by small firms are also hurt. It is difficult for start-ups to find funds and convince investors to trust them in order to innovate if they compete (or try to enter) in a market with very established platform or if they compete in a platform’s trading partner market but all the trading surplus is appropriated by the platform. A venture capital firm will not want to invest in a start-up that directly competes with a tech giant. It will also not want to invest in a start-up operating in a vertical market whose surplus is appropriated by the platform.

25. Last but not least, mergers and acquisitions (M&As) is an important dimension related to the activities of big digital platforms. Parker et al. (2020a) report approximately 1000 M&As in which Amazon, Apple, Facebook, Google and Microsoft have been involved since the beginning of their operation. From these M&As, only a very small number has been investigated by the authorities, since the majority of these mergers involve small and medium digital firms that do not exceed the threshold for further investigation.

26. However, when a platform identifies a small entrant that is quite innovative and may threaten its market position in the future, it may be inclined to acquire it, not because of the extra value it will bring in the business, but because they want to avoid potential competition in the future. In digital markets, especially the ones dominated by a big platform, merger activity is quite intense. Big platforms frequently acquire smaller firms in

the same or closely adjacent markets. Since one of the merged entities is small and without significant market power, such mergers in the most of cases escape the scrutiny of competition authorities. Such acquisitions can also have detrimental effects for the whole digital ecosystem in terms of investments and innovation.

27. The so-called killer acquisitions (Cunningham et al. 2020) refer to the case when firms acquire innovative targets solely to discontinue the target's innovation projects and preempt future competition. However, preemption may take place in other forms. In the digital space, one possible form of preemption is given by the so-called "killer zone" effect. Specifically, Kamepalli et al. (2020) and Koski et al. (2020) suggest that acquisitions by tech giants tend to decrease the entry of new firms and venture capital investments in product markets where the acquisitions took place.

4. A Proposal: Ex-ante regulation of gatekeepers followed by an update of ex-post competition policy enforcement

28. A proper response to the market competition concerns of digital ecosystems requires an ex-ante regulatory intervention which i) deals with the great information asymmetry that leads to market failures; ii) imposes fair access rules that restore transparency and the level playing field between third-party sellers and platform's own upstream subsidiary; iii) removes any unjustified barriers that prevent users to multihome.

29. The scope of regulatory intervention should satisfy the following three criteria:

1. Value creation from the operation of platforms does not decrease because of the policy intervention; in particular, interventions should not reduce network effects.
2. Allocative efficiency is based on distributing the value created in a fair way among market participants. Fair and transparent rules must govern the platform ecosystem.
3. Dynamic efficiency and competition ensures that incentives for market misconduct and anticompetitive strategies such as artificial entry barriers are eliminated.

30. A key theme in our proposal is that value should be redistributed in a fair way among all platforms markets participants. The most effective way is through a regulatory intervention that should define the rules related to users' data flow and analysis and facilitates information sharing mechanisms, such that data will confer value not only to market leaders but also to their competitors and other firms of the ecosystem to the benefit of consumers. Competition policy should be updated to apply on the top of that regulatory framework to ensure that rules have a proper function in the digital markets.

31. The starting point is to observe that information related to the efficient market operations relies on the interactions between consumers and sellers. Platforms withhold this information to their own benefit. Parker et al. (2020b) develop a proposal for *in situ* exchanges that can lead to a more symmetric access to information by gatekeepers and the other actors of the digital ecosystem. This requires a new regulation that obliges platforms to open their data infrastructures to their competitors while keeping their governance model separated. Raw (volunteered and observed) data is always used at the location it is collected. Instead of transferring data to a competitor's online interface where it is used as an input in its algorithmic exercises (as data portability dictates), it is the competitor's algorithms that are transferred to the platform's infrastructure where the data is located, in order to perform its data analysis.

32. *In situ* offers incorporate the benefits of data portability but they confer added advantages of allowing third parties to add value on behalf of a consumer in the context of

the infrastructure where it resides. Absent access to the infrastructure, certain benefits could not be created. The new regulation should ensure that there are not impediments for such information sharing and that information exchange interoperability as well as some minimum compatibility standards are adopted over how information will be accessed and shared. The new regulation should also ensure that such information sharing mechanism is fully in line with the data privacy rules.

33. Allowing third-party sellers as well as other smaller platforms to get access to gatekeeper's information over the ecosystem's demand conditions can help third-parties to develop better quality products and services that are tailored to the preferences of consumers. That in turn can increase the competitive pressure exerted on the gatekeeper which will have more incentives to innovate in order to "escape" from the increased competition. Consumers can be benefitted by the additional high-quality available options of products and services.

34. Information sharing will also maximize the value generated through network effects. It should be possible to build a large network where users can transfer the information they generate in one platform to another with multiple derived benefits from the better personalization of services as well as the value per interaction with other users. A user of big platforms like Google, Amazon and Facebook for example will be able through the *in situ* mechanism to use its Google search engine activities to improve her search in the Amazon marketplace. At the same time, the user can use the information from her online activities in the Amazon marketplace in order to improve her contacts and favorite pages in Facebook (e.g., pages of retailers). So, the *in situ* mechanism facilitates a more information symmetric ecosystem where both firms can overcome data barriers and become more competitive but also consumers can be better off from information sharing.

35. More symmetric information will endogenously impose firm boundaries limiting the ability of big platforms to extent their operation to new markets through M&As by leveraging on their data advantage. As incumbents in these markets can benefit from the information sharing mechanism to provide more efficient and competitive products and services, big platforms will not be able to easily expand their operation beyond their core markets.

36. More symmetric information can also reduce entry barriers since the first mover advantage does not rely on the collected data. Potential entrants will be able to access important information that can help their venture to be more successful.

37. With respect to vertical integration, since gatekeepers are usually open infrastructures on which upstream firms provide their goods and services, what we need to ensure is that the platforms do not affect competition in the upstream level favoring their own subsidiaries. The following mechanism cab be helpful with this respect:

1. Platforms should be obliged to publish the criteria under which upstream providers get access to their infrastructure as well as the criteria they match them through their algorithm with the users at the demand side (e.g., what the criteria for ranking of alternative upstream firms are). These criteria should be non-discriminatory.
2. The regulator should be in the position to verify if these criteria are satisfied and whether there exists algorithmic bias in the matching process that promotes platform's own upstream subsidiaries to the expense of their competitors. This can be done through the use of application programming interfaces (APIs): The

regulator does not get access to the neural network algorithmic system itself[2] but through open APIs, it can submit test data sets to then see what the matching outcome or ranking will be. The submitted data could either be collected by the regulator (in the Google shopping algorithmic bias case, the European Commission collected 5.2 terabytes of actual search results to evaluate Google's search algorithm). Alternatively, the regulator can select a random sample over platform's data to run its tests. Note that this way allows the platform to have some proprietary trade secrets over its algorithmic system and design. It is not the algorithmic code that is shared with the regulator, but instead, the regulator can test the algorithmic system without viewing its code. It just tests empirically whether the published criteria are satisfied. Some secrecy over the algorithm is socially beneficial as it makes more difficult for external actors to manipulate the algorithm to their benefit, to the expense of other users (e.g., black-hat search engine optimization).

3. In case the published criteria are found to be misleading, then a significant penalty should be imposed.

38. This approach will require the close interaction between the regulator and the platform and thus poses a potential risk for some form of regulatory capture by the platform. To avoid this risk, it will be essential to keep multiple layers of regulatory intervention, where the one layer supervises the other. The further a regulatory layer is from the platform, the lower the risk for such regulatory bias will be.

39. With respect to M&As and the risk to be used as strategic instruments that eliminate potential future competition, authorities should certainly investigate more merger cases in digital ecosystems than the ones they investigate under the current regime. Each of such investigations will not only be relevant for the particular case under investigation, but will help authorities to better understand how digital ecosystems work, how the economic forces interact with each other and what the valuable lessons will be helpful in future potential cases. Of course, the extent of this exercise highly depends on the resource constraints of each authority. One way to proceed forward is to define a group of gatekeepers for which the threshold of M&A investigations become significantly lower. During the investigation, authorities should develop a more forward-looking perspective, especially for cases that raise the suspicion of a killer acquisition, namely, an acquisition that targets in eliminating a potential future competitor. To do that, they need to assess what the potential competition effect is if the merger is not allowed. If indeed the merger restricts potential future competition, it may decrease consumer welfare because it restricts potential competition that could lead to lower prices and higher quality and therefore be prevented. But, in practice, it is very challenging to assess potential competition.

40. One avenue that can be helpful with this respect could be to measure the substitutability of platforms' services during the merger evaluation. Typically, gatekeepers involve a side that they charge zero price and a side they charge a positive price (e.g., in the form of access or transaction fee). Regarding the former, Brynjolfsson et al. (2019) provide a new methodology on how to assess the substitutability of free goods and services, in an incentive compatible way. They use digital survey techniques to run massive online choice experiments examining the preferences of hundreds of thousands of consumers. In a similar way, authorities, through the employment of surveys and online questionnaires and experiments can ask users about what platforms would attract their attention if a specific platform was no longer available. For the impact of the merger on concentration in the other side of the market where positive prices are used to clear the market, traditional

[2] In many cases, it is very difficult to figure out how a machine "thinks", as the intermediate layers of the neural network are viewed as a black box, even for the engineers that work with them.

tools in merger simulation can be applied. Hence, in this way we can assess the impact of a proposed merger. Closely substitutable platform services can potentially lead to a future competitive equilibrium with direct welfare implications for the merger case. Besides, platforms have developed marketing strategies to monitor the development of firms that may be a future threat to their market position.

41. Regardless of the specific merger cases that are being evaluated, the option of well targeted market surveys at different points of time could be very useful. They could provide a better understanding of the substitutability between alternative options and how they evolve over time, even if they do not operate in the same markets.

42. Mergers between the gatekeepers and firms that offer complementary goods also deserve some scrutiny. While on the one side, economies of scale and network effects can lead to substantial efficiency gains, on the other side, they made increase the incentives of the merged entities to be engaged in anticompetitive strategies (e.g., tying or bundling of the complementary goods). The imposition of well-designed remedies, in this case, can eliminate such competition risks.

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