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A Review of Platform Business Models

Markéta Mlčúchová

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Research Centre
Faculty of Business and Economics
Mendel University in Brno
Zemědělská 1, 613 00 Brno
Czech Republic
http://vyzc.pef.mendelu.cz/en
+420 545 132 605

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Abstract

Markéta Mlčúchová: **A Review of Platform Business Models**

The paper focuses on platform business models as ubiquitous features of the digital economy whose economic importance is continuously increasing. Considering their varying definitions and diverse typology, this review of platform business models aims to discuss and evaluate the current heterogeneous literature. In line with fulfilling the aim of the paper, the following research question is addressed: 'What are the main attributes of platform business models?' Based on a vast literature review, the paper coins a unified definition and devises a novel typology, distinguishing four main types of platform business models: transaction, innovation, integrated and investment. Furthermore, the importance of both digital data and network effects as the main identified attributes is highlighted. Additionally, the paper devises a novel typology of network effects, amplifying users' value-creating activities and interconnected relationships. The novel typology of network effects is distinguishing direct, indirect (cross-sided, cross-network or two-sided), data, positive and negative network effects.

Key words

Digital economy, business model, platform business model, digital data, network effects

JEL: F23, L86

Contacts

Markéta Mlčúchová, Department of Finance, Faculty of Business and Economics, Mendel university in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: xmlcucho@mendelu.cz.

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Introduction

As one of the most important and recent economic and social developments, platform business models are widely considered to be the prevailing new business configuration, enabled by digitalisation[1]. The new vanguard companies of the twenty-first century (e.g. Uber, Amazon, Alphabet/Google, Facebook, Microsoft, Airbnb, eBay and dozens more) represent a new type of platform business model that builds on the developments of the 1980s and 1990s and combines them with new features (Rahman and Thelen, 2019). Even though platform business models employ just a tiny fraction of traditional value-creating assets, they significantly disrupt and dominate traditional industries (Schenker, 2019; Parker, Alstyne and Choudary, 2016). Platform business models are ubiquitous features of the digital economy with increasing economic importance. They embody the leading edge of emerging business models and increasingly set the terms of markets they enter (Rahman and Thelen, 2019; Brynjolfsson and McAfee, 2017; Parker and Alstyne, 2008).

While vast research has been conducted into the emergence of platform business models, there has been a lack of both discussion regarding a unified definition of such models and understanding of new value chain configurations and their specific attributes that have been enabled by digitalisation. This paper aims to discuss and evaluate the current heterogeneous literature on platform business models by conducting an extensive literature review.

In line with fulfilling the aim of this paper, the following research question is addressed: 'What are the main attributes of platform business models?' This paper proceeds as follows: Section 2 presents the definition of the platform business model, elaborates on the typology, attributes and market capitalisation of various platform business models and presents descriptive statistics; Section 3 is focused on digital data as one of the main attributes of platform business models; Section 4 discusses the definition, typology and measurement of network effects and Section 5 presents the conclusion.

[1] Digitalisation as a global trend and growth factor of the modern economy is part of the most important engines of global innovation, competitiveness and economic growth (e.g. Afonasova et al., 2019; Olbert and Spengel, 2019 and 2017; Kenney and Zysman, 2016).

1 Platform business models

One of the main features of the digital economy is the spread of new business models, in particular platform-based business models. Platform business models are ubiquitous and represent the leading edge of emerging business models, increasingly setting the terms of markets they enter. According to Rahman and Thelen (2019), traditional business models often only survive because they emulate the main attributes of platform business models. Moreover, platform business models transform a range of other economic and social areas, such as healthcare, education or government (Parker, Alstyne and Choudary, 2016). The authors admit that traditional business models still exist; however, when the platform business model enters the same marketplace, it almost always wins over the traditional one (*ibid*.).[2] This section elaborates on the general definitions of the business model and the platform and concludes with the sole concept of the platform business model, its characteristics, attributes, typology and increasing overall market capitalisation, listing particular examples of various types of platform business models. The paper follows up by elaborating on the main identified characteristics of platform business models, network effects and digital data.

1.1 Definition of platform business models

This section begins with a focus on understanding the platform business model, followed by a brief explanation of both business models and platforms. Subsequently, the paper coins a unified definition of the platform business model. Hereafter, in order to gain a holistic understanding of the business model concept, Teece's (2010) definition is followed. According to Teece (2010), the concept of a business model defines the manner by which a business delivers value to customers, attracts customers to pay for the delivered value and transforms those payments into a profit. Teece (2010) refers to three dimensions of business model: value creation, value delivery and value capture.

Business models are not changeless. With changing markets, legal environments and technological innovations[3], business models must also change. Digitalisation encompasses a growing number of

[2] Later in the text, the evolving dominance of platform business models over traditional business models is demonstrated by platform-based companies prevailing to become the largest companies worldwide, according to market capitalisation (see Graph 1).

[3] Based on Schumpeter (1942), innovations, or technological changes, are the key elements of a dynamic process. In other words, the process of development starts when innovations (or economic, social or political changes) occur in the economy and the stationary equilibrium is displaced. The author describes the creative destruction as '*the process of industrial mutation that incessantly revolutionizes the economic structure from*

digitally enabled activities in business, politics and social interactions. A detailed review of the existing literature revealed a rich body of theory proving that digitalisation and coherent technological innovation is undoubtedly one of the main driving forces behind the creation of new business models (e.g. Foss and Saebi, 2017; Baden-Fuller and Haefliger, 2013; Chesbrough, 2010; Teece, 2010). For instance, Lane (1999) argues that digitalisation is a direct driver of changes in business structures and operations. Moreover, the author identifies digitalisation as a driving force in the widespread growth of electronic commerce, new competitive strategies and changes in organisational structures, business processes and models (*ibid.)*. Similarly, Dahlman, Mealy and Wermelinger (2016) note that the growing intensity of data usage[4], new automation and robotics technologies are reshaping existing consumer behaviours, business interactions and, most importantly, business models. Additionally, Elding and Morris (2018) claim that digital technologies are changing the ways in which companies do business and interact with both their customers and suppliers. In the same vein, Amit and Zott (2001) point out that digitalisation supports the emergence of virtual communities and commercial arrangements that disregard the traditional boundaries between companies along the value chain. In a nutshell, the current succession of new digital technologies has recently been followed by new digital business models, such as cloud computing, digital services and platform business models.

Regarding the emergence of platform-based business models, the paper proceeds with the sole definition of the platform. Following Kenney and Zysman's (2016) definition, the platform can be understood as both an intermediary and infrastructure. Evans and Gawer (2016) understand the platform as a technology, product or service. Technically, the platform means a set of shared techniques, technologies and interfaces that are open to all kinds of users. The technical definition of the platform has been extended by Kenney and Zysman (2016), who define it as a set of digital frameworks for social and marketplace interactions. This view is supported by Parker and Alstyne (2014), who understand the platform as an environment that enables participants to interact and exchange information. Recently, the definition of the platform was coined in the Council Directive (EU) 2021/514 of 22 March 2021 amending Directive 2011/16/EU on administrative cooperation in

within, incessantly destroying the old one, incessantly creating a new one' (*ibid.).* In the context of digitalisation, creative destruction refers to changing the structure of business models to create new business configurations – platform business models.

[4] In particular big data, data analytics and algorithmic decision making (Dahlman, Mealy and Wermelinger, 2016).

the field of taxation, '*Platform means any software, including a website or a part thereof and applications, including mobile applications, accessible by users and allowing sellers to be connected to other users for the purpose of carrying out the relevant activity*[5]*, directly or indirectly, to such users. It also includes any arrangement for the collection and payment of a consideration in respect of relevant activity*'. Therefore, throughout the paper, the platform is understood not only as a complicated mixture of software, hardware, operations and networks but more importantly as a set of online digital arrangements whose algorithms serve to organise and structure economic and social activities and interactions; in other words, as a technological environment that enables participants to interact and exchange information.

Following the above-stated definitions of the business model and the platform, the paper formulates the definition of the consolidated platform business model. It is evident that platform business models have become a ubiquitous feature of the digital economy, with increasing economic importance (Parker and Alstyne, 2008). Some authors refer to two-sided markets[6], some to multi-sided markets, some to platform operators[7] and some to the network of contracts model[8] or demand-side economies of scale; these terms are used interchangeably in this paper. Even though the research on platform business models has a relatively short history, several studies have expanded the definition of the platform business model (e.g. Rahman and Thelen, 2019; Brynjolfsson and McAfee, 2017; Devereux and Vella, 2017; Kenney and Zysman, 2016; Parker, Alstyne and Choudary, 2016; Parker and Alstyne, 2014). It was noted that the suggested definitions vary, and a terminological confusion was apparent. This section lists some of the current definitions and understandings of platform business models and concludes with the working definition used in this paper.

[5] Such as a) the rental of immovable property, including both residential and commercial property, as well as any other immovable property and parking spaces; b) personal services; c) sale of goods; d) rental of any mode of transport (Annex of the Council Directive (EU) 2021/514 of 22 March 2021 amending Directive 2011/16/EU on administrative cooperation in the field of taxation).

[6] Rochet and Tirole (2006) further highlight that it is useful to ringfence the scope of two-sided (or multi-sided) markets because all markets involve transactions between two (or more) parties and are therefore potentially two-sided markets.

[7] Council Directive (EU) 2021/514 of 22 March 2021 amending Directive 2011/16/EU on administrative cooperation in the field of taxation.

[8] For example, Davis (2009).

According to Brynjolfsson and McAfee (2017); Devereux and Vella (2017) and Parker and Alstyne (2014), the platform business model is an infrastructure that facilitates interactions among users. The authors also state that it connects independent actors[9], from both the demand and supply sides, via the platform that interact with each other to realise commercial transactions facilitated by the platform (*ibid.).* Similarly, according to Kenney and Zysman (2016), the platform business model sets the rules of mutual interactions between participants and is an environment in which social and economic interactions are mediated online. In the same vein, Rahman and Thelen (2019) describe the platform business model as a nexus of reciprocal relationships[10] between the company and its internal and external participants. Thus, the authors often refer to the network of contracts model (*ibid.).* Brynjolfsson and McAfee (2017) explain the platform business model as a business model using software interfaces. According to Papadopoulos (2019); UNCTAD[11] (2019); Parker, Alstyne and Choudary (2016) platform business models are based on enabling value-creating interactions between third-party (external) participants. These interactions take place within the framework of rules set by the platform, with the objective of enabling value creation by facilitating the exchange of goods or services. Congruently, Rochet and Tirole (2006)[12] roughly define two-sided (or multi-sided) markets as markets in which one or several platforms enable interactions between end-users and attempt to get the two (or multiple) sides 'on board'. According to Parker and Alstyne (2014), platform business models do not produce or trade goods or services themselves; instead, the value is created by the interactions between external participants. Similarly, Täuscher and Laudien (2018) claim that by connecting previously unmatched demand-side and supply-side participants, platform business models generate an innovative form of creation and delivery of economic value. Lee and Kim (2019) highlight that platform business models – along with being the infrastructure and intermediary for the network of external participants – also create trust and help participants to discover an acceptable price for transactions by providing reputational and feedback mechanisms, transaction histories and opportunities for advertising and marketing. Additionally, following Kenney

[9] Referred actors can be understood as either individuals or organisations. Parker and Alstyne (2014) further specify that actors can participate in the market on both (supply and demand) sides. Therefore, they do not necessarily represent different groups of participants.

[10] Rahman and Thelen (2019) follow Anderson (2015), who defines the model mid-century industrial company as the embodiment of the nexus of reciprocal relationships between the company and its internal and external stakeholders.

[11] Nations Conference on Trade and Development.

[12] Additionally, Rochet and Tirole (2006) demonstrate the failure of the Coase theorem in platform business models.

and Zysman (2016), all platform business models are based on mobilising human beings to contribute; thus, they are generally subject to the so-called network effects[13]. Finally, Parker, Alstyne and Choudary (2016) define the platform business model as '*a new business model that uses technology to connect people, organizations, and resources in an interactive ecosystem in which amazing amounts of value can be created and exchanged'.*

This section follows up with a brief emphasis on the disparities between traditional and platform business models. In traditional industries, the value chain follows a linear path as companies purchase inputs, transform them to add value, assemble components and subsystems into complete products and then sell the output. The traditional value chain can be simplified into production, distribution, marketing and sales. Parker, Alstyne and Choudary (2016) use the term pipeline to describe the step-by-step arrangement for creating and transferring value, with producers at one end and consumers at the other. It is evident that increasing numbers of businesses are shifting from a linear value chain to the new structure of platform business models. Eisenmann, Parker and Alstyne (2009) state that in platform business models, external participants first affiliate with the platform, then they connect or trade with other platform participants using platform resources. Mesenbourg (2001) explains that demand-side participants use platform business models to identify sellers, evaluate products and services, compare prices and exert market leverage, while supply-side participants use it even more extensively to conduct and re-engineer production processes, streamline procurement processes, reach new customers and manage internal operations.

Before moving on to the unified definition used in the paper, a few examples of platform business models, along with their brief characteristics[14], are presented. For instance, platform business models such as Uber[15] or Upwork[16] provide a link between requesters and providers of services; Amazon connects buyers and sellers of all kinds; information platform business models such as Google and Facebook[17] connect end-users to sources of information and media through searches, news, feeds, etc.; Airbnb performs both search and matching algorithms and enables renters and

[13] Network effects are in detail elaborated further in the text.

[14] A detailed list of examples and characterisation of different types of platform business models is provided in the upcoming sections.

[15] Uber offers services such as ride-hailing, food delivery (Uber Eats), package delivery, couriers, freight transportation, and, through a partnership with Lime, electric bicycle and motorised scooter rental.

[16] Freelancing platform where enterprises and individuals connect in order to conduct business.

[17] In particular, Facebook connects users, advertisers, developers, companies and others.

hosts to transact between each other, enter into contractual agreements, transfer payments and manage their reputations to facilitate future transactions (Parker and Alstyne, 2014).

To conclude, while a variety of definitions of the platform business model have been suggested, in accordance with Koskinen, Bonina and Eaton (2018); Brynjolfsson and McAfee (2017); Devereux and Vella (2017); Parker, Alstyne and Choudary (2016); Evans and Gawer (2016); Gawer (2014); Parker and Alstyne (2014); Basole and Karla (2011); Armstrong (2006); Rochet and Tirole (2006); and Mesenbourg (2001), in this paper, the platform business model is simply defined as a technology-driven business model based on platforms that create value and provide an institutional and regulatory framework enabling interactions between the previously unmatched demand-side and supply-side participants. This definition is deliberately broad. Platform business models include a variety of types, such as electronic payments, crowdfunding, social media or an immense group of e-commerce platform business models. Moreover, according to Rahman and Thelen (2019), their main attributes are often emulated by traditional business models, extending the currently wide spectrum of platform business models. The following section further explains the typology of platform business models identified in the literature, concluding with a unified typology.

1.2 Typology of platform business models

In general, platform business models include a wide range of e-commerce, app store, online advertising, cloud computing and participative networking platforms, as well as high-speed trading and online payment services. Moreover, it is evident that platform business models often serve more than one purpose, and that ringfencing them into specific sectors would be short sighted. Table 1, based on research conducted by Parker, Alstyne and Choudary (2016), illustrates the wide spectrum and diversity of platform business models. To exhibit the discussed diversity, particular examples of platform business models in different industries are listed.

Table 1: Examples of platform business models in various industries

Industry	**Examples**
Agriculture	John Deere, Intuit Fasal
Communication and Networking	LinkedIn, Facebook, Twitter, Tinder, Instagram, Snapchat, WeChat
Consumer Goods	Philips, McCormick Foods FlavorPrint
Education	Udemy, Skillshare, Coursera, edX, Duolingo
Energy and Heavy Industry	Nest, Tesla Powerwall, General Electric, EnerNOC

Finance	Bitcoin, Lending Club, Kickstarter
Health Care	Cohealo, SimplyInsured, Kaiser Permanente
Gaming	Xbox, Nintendo, PlayStation
Labor and Professional Services	Upwork, Fiverr, 99designs, Sittercity, LegalZoom
Local Services	Yelp, Foursquare, Groupon, Angie's List
Logistics and Delivery	Munchery, Foodpanda, Haier Group
Media	Medium, Viki, YouTube, Wikipedia, Huffington Post, Kindle Publishing
Travel	Airbnb, TripAdvisor
Operating Systems	iOS, Android, MacOS, Microsoft Windows
Retail	Amazon, Alibaba, Walgreens, Burberry, Shopkick
Transportation	Uber, Waze, BlaBlaCar, GrabTaxi, Ola Cabs

Source: Parker, Alstyne and Choudary (2016)

This section aims to elaborate on the heterogeneous typology of platform business models used in the literature. Koskinen, Bonina and Eaton (2018); Evans and Gawer (2016); Parker, Alstyne and Choudary (2016); Gawer (2014); Basole and Karla (2011); Armstrong (2006); Rochet and Tirole (2006) and distinguish between transaction and innovation platforms based on their underlying operations. In accordance with Koskinen, Bonina and Eaton (2018), these represent the vast majority of all existing platform business models.

Transaction platforms are often referred to as two-sided (multi-sided) platforms, two-sided (multi-sided) markets or exchange platforms that facilitate transactions, interactions or exchanges between the platform's external users, e.g. buyers or suppliers. Examples of transaction platforms include Uber, Google Search, Amazon, Alibaba, Airbnb, Didi Chuxing[18], Facebook and eBay. Furthermore, Koskinen, Bonina and Eaton (2018) divide transaction platforms into subsections, including the gig/sharing economy (e.g. Upwork), social media (e.g. Facebook) and e-commerce (e.g. Mercado Libre).

Innovation platforms[19] are often referred to as engineering or technology platforms that create an environment for code or content producers to develop applications and software. Innovation

[18] Didi Chuxing is a Chinese company that provides app-based transportation services, including taxi-hailing, private car-hailing, social ride-sharing, and bike sharing.

[19] Koskinen, Bonina and Eaton (2018) further differentiate between internal (closed) and external (opened) innovation platforms.

platforms can be understood as the foundation for developing complementary technologies, products or services for other participants, loosely organised into an innovative ecosystem. They consist of the technological building blocks that are used as a foundation on top of which a large number of innovators can develop their services or products, for instance, iPhone – which has a significant number of applications developed by innovators using Apple technology (APIs) – operating systems (e.g. Android, Linux and iOS), technology standards (e.g. MPEG video) or SAP[20]. Additional examples of innovation platform business models are Oracle Corporation, which sells database software and technology, cloud engineered systems and enterprise software products, and Salesforce.com, which creates and supports customer relationship management software.

Innovation platforms can sometimes overlap with transaction platforms. Evans and Gawer (2016) describe the combination of a transaction and innovation platform as an integrated platform. For example, Google's leadership in the Android operating system has resulted in a set of intersecting innovation platforms (Android, core smartphone designs) and transaction platforms (Google Play Store, Google Search). Another example of a company with an integrated platform business model is Apple, which has matching platforms (e.g. App Store) and a large third-party developer ecosystem that supports content creation on the platform.

Additionally, while the vast majority of all existing platform business models can be classified as transaction or innovation platforms – or integrated platforms – Evans and Gawer (2016) have also identified the existence of investment platforms in companies that have developed a platform portfolio strategy and act as a holding company, active platform investor or both. Examples of investment platform business models are companies such as Priceline Group, Softbank, Naspers, IAC Interactive and Rocket Internet. Even though it can be argued that these companies are not platforms as such, Evans and Gawer (2016) claim that they invest in platform business models at an early stage[21] and act as holding companies.

[20] System Application and Product in Processing.

[21] For example, the Priceline Group includes Booking.com, Priceline.com, Kayak.com, rentalcars.com, and OpenTable.

Furthermore, based on a cluster analysis, Täuscher and Laudien (2018) have identified six fundamentally distinct types of platform business models[22]: efficient product transactions, digital product communities, product aficionados, on-demand offline services, online services and peer-to-peer offline services. Appendix A summarises the classifications by Stobierski (2020); UNCTAD (2019); Rochet and Tirole (2006) and that differentiate platform business models into two main categories: non-profit (subcategories include exchange, donation, free services and the true sharing economy) and profit-oriented (subcategories include electronic payments, crowdfunding, social media and e-commerce). Additionally, Appendix B illustrates the most downloaded platforms, divided into subcategories including communication, entertainment and education. Finally, based on their underlying business models, Li, Nirei and Yamana (2018) have classified platforms into eight major types: e-commerce online platforms, online resource sharing platforms, e-financial service online platforms, online social network service platforms, online auction/matching platforms, online competitive crowdsourcing platforms, online non-competitive crowdsourcing platforms and online search platforms.

To conclude, based on the rich theoretical body of literature, a unified novel typology of platform business models was devised. In accordance with Evans and Gawer (2016); Basole and Karla (2011); Gawer (2014); Koskinen, Bonina and Eaton (2018); Armstrong (2006); Rochet and Tirole (2006); and Parker, Alstyne and Choudary (2016), this paper suggests differentiating between transaction, innovation, integrated and investment platform business models. The main types of platform business model identified are summarised in Table 2.

Table 2: Typology of platform business models

Type	**Definition**	**Examples**
Transaction	Intermediaries facilitating exchanges, interactions or transactions between external users.	Uber; Upwork; Google Search; Amazon; Airbnb; Didi Chuxing; eBay; Mercado Libre; Yahoo; Netflix; Uber; LinkedIn; Tencent; PayPal.
Innovation	Foundation for producers of code or content to develop complementary technologies, products or services for other users (such as	Oracle; Intel; Microsoft; System Application and Product in Processing (SAP); Apple technology; operating systems (e.g.

[22] Täuscher and Laudien (2018) thereby provide a novel typology of platform business models. Authors further highlight the platform business model of peer-to-peer offline services and the digital product community as highly aligned with business model characteristics associated with the so-called sharing economy (*ibid*.).

	applications and software).	Android, Linux); technology standards (e.g. MPEG video).
Integrated	Combination of transaction and innovation platforms.	Apple; Google; Facebook; Amazon; Alibaba (operates e.g. Taobao.com, Tmall.com, Aliyun.com and Cainiao); Google (primarily searches, subsequently targeting advertising and home automation/energy demand response with its acquisition of Nest Labs).
Investment	Business model in companies that have developed a platform portfolio strategy and act as a holding company, active platform investor or both.	Priceline Group (includes Booking.com, Priceline.com, Kayak.com, rentalcars.com, and OpenTable); Softbank; Naspers; IAC Interactive; Rocket Internet.

Sources: Koskinen, Bonina and Eaton (2018); Evans and Gawer (2016); Parker, Alstyne and Choudary (2016); Gawer (2014); Basole and Karla (2011); Armstrong (2006); Rochet and Tirole (2006).

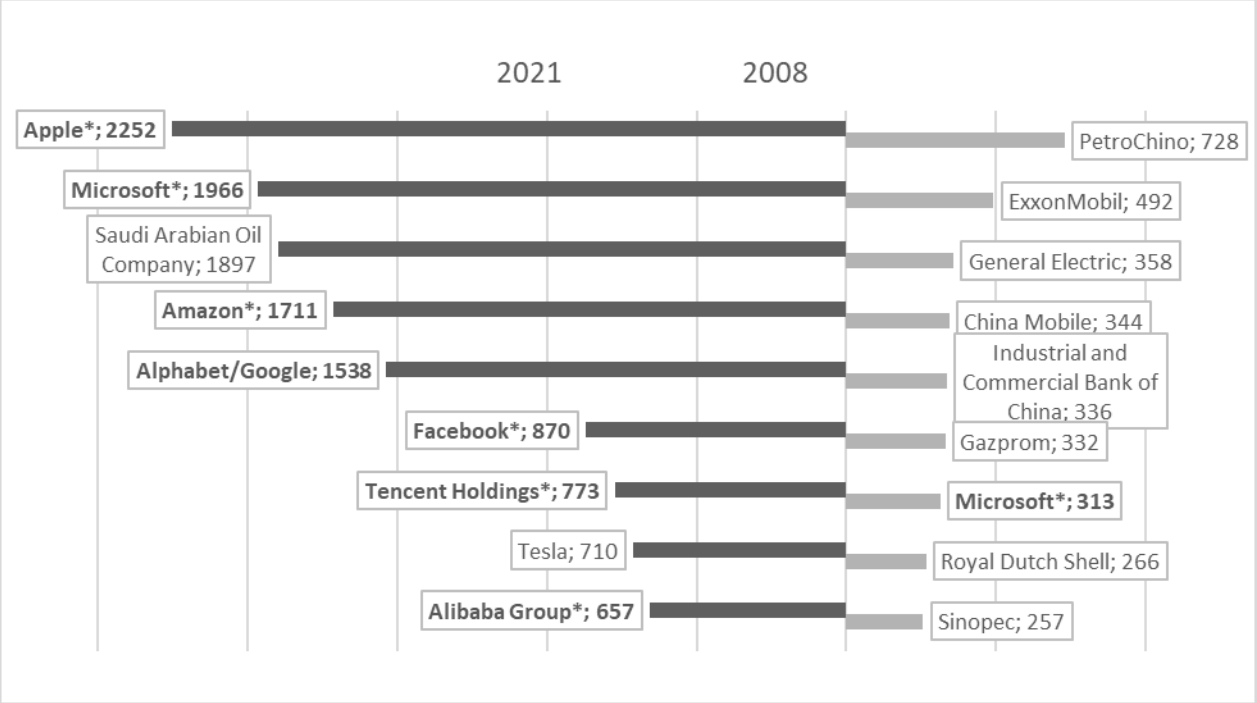
1.3 Market capitalisation of platform business models

The vast majority of the previous research in the field of platform business models has focused on theoretical foundations and case studies; however, no comprehensive empirical dataset had been built. Evans and Gawer (2016) conducted a survey to fill this gap, building a database that covered platform business models from both all regions of the world and all sectors in which platforms are active. The authors identified 176 companies that exceeded the set threshold of a 1 billion USD market capitalisation. Based on the survey, the total value of these companies exceeded 4,3 trillion USD in 2016 (*ibid*.). According to UNCTAD (2019), the market capitalisation of the 15 biggest public platform companies was 2,6 trillion USD.

It is evident that platform business models represent a fast-increasing proportion of the overall total market capitalisation and are the prevailing new business configuration, enabled by digitalisation. Chu and Manchanda (2016) claim that platform business models have become a major engine of growth, especially in e-commerce. Parker, Alstyne and Choudary (2016) add that the fastest-growing global brands are increasingly dominated by platform business models and that the rise of platforms is a crucial driver of transformation in almost every economic sector. The authors add that platform business models can grow much faster than traditional ones as they derive value from resources they neither own nor control (*ibid*.). The significance of platform business models is reflected in the fact that seven of the world's top nine companies – based on market capitalisation – use platform

business models. Graph 1 compares the largest global companies based on market capitalisation in 2021 vs 2008. The graph shows that in 2008, only one of the largest companies was platform-based. However, over the years, platform business models have seized control of the market and currently dominate among the largest companies worldwide.

Graph 1: Comparison of the largest companies (according to market capitalisation) in 2021 and 2008 (billion USD)



***** Denotes platform business model

Sources: Statista, 2021; Schenker, 2019.

Additionally, focusing on platform business models, the emergence of micro multinational corporations (mMNCs) can be observed. Traditionally, the biggest companies operated internationally, while smaller companies tended to be domestic. This has changed with both digitalisation and globalisation. Dimitratos et al. (2003) define mMNCs as 'small and medium-sized companies (SMEs) that control and manage value-added activities through constellation and investment modes in more than one country'. To conclude, due to digitalisation, even SMEs can now operate globally and they are using MNCs digital platform business models to connect with customers and suppliers across the world.

1.4 Characteristics and attributes of platform business models

Whenever a business enterprise is established, it either explicitly or implicitly employs a particular business model that can be described by specific attributes. At first glance, considering the rapidly growing number of types of platform business models, it seems far-fetched to assume that companies such as Twitter, eBay, TripAdvisor, John Deere or Facebook all have particular attributes in common. This section aims to identify the main characteristics and attributes that are relevant to all types of platform business models, regardless of the particular specialisation of a given business. A growing body of literature is investigating the characteristics and attributes of platform business models (e.g. Liu, Brynjolfsson and Dowlatabadi, 2018; Täuscher and Laudien, 2018; Parker, Alstyne and Choudary, 2016; Amit and Zott, 2001).

Amit and Zott (2001) characterise platform business models by high connectivity, focus on transactions, importance of information goods and networks and high reach and richness of information. The reach[23] of information refers to the number of users and products that are reachable quickly and cheaply in virtual markets. The so-called richness of information refers to the depth and detail of information that can be accumulated, offered and exchanged between platform participants (*ibid.*). According to Parker and Alstyne (2014), one of the main characteristics of platform business models is that independent participants co-create value through networking activities. Furthermore, Parker and Alstyne (2014) describe the platform business model as the nexus of rules and infrastructure that facilitates interactions between networks' users. To manage and motivate these external relations and networking interactions, platform business models must offer a set of rules to support these interactions.

Liu, Brynjolfsson and Dowlatabadi (2018) contend that platform business models are often designed to mitigate information asymmetry problems through the use of new technologies and incentive systems[24]. Moreover, the authors claim that platform business models enhance market transparency and mitigate moral hazard via referred incentive systems and new technologies (*ibid.*). According to Lee and Kim (2019), platform business models also create trust and improve the provision of

[23] Amit and Zott (2001) state that platform business models have unprecedented reach because they are characterised by a near total lack of geographical boundaries. Business processes can be shared among companies from different industries, even without any awareness of end-customers, as more information on products and services has become instantly available.

[24] Incentive systems are described by Liu, Brynjolfsson and Dowlatabadi (2018) as ratings of buyers and sellers, real-time monitoring and low-cost complaint channels.

information. The authors claim that information becomes more symmetric as consumers can access a broader range of goods and services and the networking framework provides quality control through user-based reviews and ratings systems (*ibid.*). The attributes of platform business models, such as key activity, key revenue stream or revenue source are explained in detail by Täuscher and Laudien (2018). Their main findings are summarised in Table 3.

Table 3: Attributes of platform business models

Attributes	**Specification**
Platform type	Web-based; Mobile app
Key activity	Data services; Community building; Content creation
Price discovery	Fixed prices; Set by sellers; Set by buyers; Auction; Negotiation
Review system	User reviews; Review by platform; None
Key value proposition	Price/Cost/Efficiency; Emotional value; Social value
Transaction content	Product; Service
Transaction type	Online; Offline
Industry scope	Vertical; Horizontal
Platform participants	C2C; B2C; B2B
Geographic scope	Global; Regional; Local
Key revenue stream	Commissions; Subscriptions; Advertising; Service/Sales
Pricing mechanism	Fixed pricing; Market pricing; Differentiated pricing
Price discrimination	Feature based; Location based; Quantity based; None / other
Revenue source	Seller; Buyer; Third party; None / other

Sources: Täuscher and Laudien (2018)

Finally, Rahman and Thelen (2019) compare today's platform business models to the monopolists of yesteryear, stating that, in many ways, platform business models exercise deeper control due to digital data and algorithms. Through their capacity to extract and harness immense amounts of data, platform business models operate as critical intermediaries and market makers (*ibid*.). In the same vein, according to Olbert and Spengel (2019), digital data is progressively becoming more important in the value creation process and all platform business models rely on its collection and use. In conclusion, digital data has become the strategic asset of platform business models and a new economic resource for creating and capturing value. The following section focuses on the role of digital data, presenting the hard-to-value intangible strategic assets of platform business models and value-creating human activities, as well as the interconnected relationships between users, which are amplified by network effects.

2 Digital data

Most policy discussions around digital data tend to focus on privacy issues[25] and, increasingly, on data as an economic resource. DeCovny (2018) claims strategic assets are unique in nature and are often particular to a specific company in terms of how it can extract value from them. Moreover, the author points out that during the last few decades, the ratio of intangible to tangible asset value in public and private companies has grown significantly, a trend which is likely to continue (*ibid*.). Based on Olbert and Spengel's (2019) recent findings regarding value creation in platform business models, data is progressively becoming more important in the value creation process and all digital business models rely on its collection and use. The growth of platform business models is directly linked to their capacity to collect, analyse and, most importantly, monetise digital data.

Digital data can be understood as machine-readable information (unfiltered symbols or signals) generated from the digital footprints of various personal, social and business activities taking place on digital platforms (UNCTAD, 2019). Digital data is part of a hierarchy, linked to information and knowledge (*ibid*.).

It can be classified according to its type, format, acquisition and sensitivity; types of data include personal, non-personal or corporate data or technical or merchant data; based on its format, it can be identified as non-structured[26], semi-structured[27] or structured data[28]; based on how it is acquired, it can be divided into volunteered, observed or inferred data; and based on its sensitivity, as sensitive or non-sensitive data. Different categories overlap, for instance, Olbert and Spengel (2019) highlight that many of Alphabet/Google's products rely directly on the data mining process. This process does not necessarily involve the use of personal user data exclusively but involves every form of digital data that is generated through the use of Alphabet/Google's products and services.

[25] The digital economy has imposed new regulatory challenges, such as the protection of security and the privacy of data. The is reflected, for example, in Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, the repealing of Directive 95/46/EC (General Data Protection Regulation) and currently in the Proposal for a Regulation of the European Parliament and of The Council, which lays down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amends certain Union legislative acts (COM (2021) 206 final).

[26] According to Prasad and Acharya (2016), unstructured data represents approximately 80–90% of digital data. It is usually not human-readable or indexable. Examples of unstructured data are source code, documents and binaries.

[27] For example, emails, XML and languages such as HTML (Prasad and Acharya, 2016).

[28] Usually human-readable digital data that can be indexed, for example, database objects, spreadsheets, SQL and OLTP systems.

In addition to the previously mentioned characteristics, digital data is non-rival in nature[29]; thus, it can be globally and simultaneously used, replicated and reused multiple times without being exhausted. This has significant implications in terms of value creation as, together with network effects, it can lead to economies of scale and scope. Digital data is an increasingly valuable economic resource, but only once it has been transformed into digital intelligence that can be monetised.

Previously, the value of digital data was sometimes compared to the value of the natural resource; however, recent research has shown that digital data is a source of value only when it is tied to a particular problem domain and solves problems for customers and companies. In other words, raw digital data needs to be transformed by businesses that aim to create value. Digital data can be transformed through a range of processes – such as filtering, aggregating or ordering – into information that can be then used to support people's experiences, skills or thinking models, which contributes to knowledge.

Olbert and Spengel (2019) discuss the different ways that digital data contributes to value creation, concluding that data mining can be considered the main part of a business model that creates value. Considering the various definitions of data mining in the literature, this paper follows Kayaalp and Başarslan (2018), who define digital data mining as the process of gaining meaningful information from raw digital data. The raw data is obtained by various collection methods and further processed by applying several methods of digital data mining in order to extract hidden information. Value creation arises once digital data is collected, stored, analysed and transformed into digital intelligence, which is then monetised through commercial use (UNCTAD, 2019). This can be referred to as the data value chain (*ibid.*).

Data monetisation appears in various forms depending on the platform business model. For example, Google and Facebook sell targeted online advertising; Amazon, Alibaba, Uber and Airbnb operate e-commerce platforms; Mobike and Rolls Royce transform traditional goods into rentable services; Amazon, Web Services, Tencent[30] and MyJohnDeere rent out cloud services. In summary, platforms need a volume of data available to enable them to form the required matches between consumers and producers (Parker, Alstyne and Choudary, 2016).

[29] The use of digital data by a particular economic subject does not limit its use by other economic subjects.

[30] Technology company that markets services and products, including entertainment, artificial intelligence and other technology. It is one of the main video game publishers globally.

3 Network effects

As previously mentioned, all platform business models are based on mobilising human beings to contribute; thus, they are generally subject to network effects, which are often referred to as network externalities (e.g. Farrell and Saloner, 1986; Katz and Shapiro, 1985). The combined impacts of the internet, digital technologies and platforms trigger network effects between the demand-side and supply-side of the economy. According to Shapiro and Varian (1999), the traditional industrial economy was driven by economies of scale, while the new digital economy is driven by the economics of networks. The authors also refer to an economic shift from the supply-side to the demand-side economies of scale, generated by network effects, which are identified as the main differences between traditional and digital economies (*ibid.*). Schrage (2016) states that companies such as Google, Apple, Facebook, Uber, Amazon, Airbnb and LinkedIn relentlessly disrupt and redefine traditional industries. It is evident that network effects have become the source for success, increasingly determining innovation opportunity, value creation and growth (*ibid*.).

Initial studies on network effects (e.g. Lane, 1999; Farrell and Saloner, 1986; Katz and Shapiro, 1985) have recognised new networking activities – enabled by digitalisation – that are neither markets nor hierarchies, but are based on relationships. Katz and Shapiro (1985) acknowledge there are many products for which the user's utility from the consumption of goods increases with the number of other users consuming the same goods. The authors illustrate the network effects on communications technologies (such as a telephone) and differentiate between direct and indirect network effects. Katz and Shapiro (1985) have developed a simple equilibrium model that confirms the importance of consumers' expectations in markets with the presence of network effects. In Farrell and Saloner's (1986) discussions on the inhibition of innovation caused by network effects, they focused on the effects of installed base on the likelihood of innovations and new technology incentives.

Recently, there has been a rapid rise in research focused on network effects as the main attribute of the fast-growing number of platform business models. Multiple authors (e.g. Currier et al., 2020; Puerta, 2018; Devereux and Vella, 2017; Alstyne, Parker and Choudary, 2016; Parker, Alstyne and Choudary, 2016; Chu and Manchanda, 2016; Evans and Gawer, 2016; Schrage, 2016; Parker and Alstyne, 2014; Gawer, 2014; Rochet and Tirole, 2006) have elaborated on the definition and typology

of network effects. The following section summarises the existing literature, delivering a comprehensive overview and devising a unified typology of network effects.

As highlighted earlier, one of the main characteristics and a crucial defensibility feature of platform business models is the networking activities of independent participants (Currier et al., 2020; Puerta, 2018; Parker and Alstyne, 2014;). Furthermore, the networking activities of platform business models are the core factor for value creation. According to Park (2004), network effects are positive consumption externalities, while Schrage (2016) states that network effects determine value creation in platform business models, turn users into assets and empower users to both directly and indirectly create new value. The author further states that network effects do not merely create more value for more users, they make users more valuable to both the company and to each other (*ibid*.). For instance, Currier et al. (2020) claim that network effects are responsible for 70% of the total value that has been created in the digital economy since 1994.

Devereux and Vella (2017) argue that a common element of platform business models is that the greater the number of participants operating on one side of the platform, the more attractive it is for participants on the other side.[31] Congruently, Evans and Gawer (2016) claim that network effects mean that more users beget more users and the platform becomes more valuable as it is used by more participants. In other words, the more users engage with the platform, the more attractive it becomes to potential new users. The authors further elaborate that it triggers a self-reinforcing cycle of growth (ibid.). Similarly, Parker, Alstyne and Choudary (2016) define network effects simply as the impact of the number of users of a platform on the value created for each user. Shapiro and Varian (1999) state that the key challenge is to obtain critical mass. Once network effects lead to a large enough customer base, the market will build itself. Alstyne, Parker and Choudary (2016) understand network effects as benefits that accrue for users of a platform from additional users joining. According to Evans and Gawer (2016), network effects exist when two user groups – typically producer and consumer – generate network value for each other, resulting in mutual benefits that drive the demand-side economies of scale.

[31] For example, individuals seeking to sell goods or services would find it beneficial if the platform had many potential buyers. Similarly, buyers would find the platform more advantageous if there were many sellers.

According to Schrage (2016), network effects exist when the value of a product or service to users increases as the number of users grows; however, how the framework for networking activities is used is just as important as how many users are participating.[32]

Lee and Kim (2019) state that platform business models are also creating trust and improving the provision of information. The authors claim that information becomes more symmetric as consumers have access to a broader range of goods and services and that the networking framework provides quality control through user-based reviews and ratings systems. These qualitative insights – such as recommendations, suggestions and customer reviews – have a quantitative impact for both the company and its customers. It is not only the quantity of users but also the quality of use, with regards to users, that is an important factor in value creation (*ibid.*).

Additionally, Koskinen, Bonina and Eaton (2018); Parker, Alstyne and Choudary (2016) and Gawer (2014) point out the problem of decreasing competition between platform business models. As previously described in this section, the larger the user base, the more successful the company has been in applying its platform business model. According to the authors, this may lead to winner-takes-all scenarios[33] among platform business models (*ibid*.).

In conclusion, network effects refer to any situation in which the value of a product, service or platform in general depends on the number of users by whom it is leveraged. The greater the number of external participants of the platform, the greater the network effect, the greater the value created, the more valuable it becomes to each user and, finally, the more attractive the framework becomes to potential new users. It is not merely the quantity but also the quality of both the use and the participants that plays a significant role in the consequent value creation. The more users participate – and the more innovatively they engage – the more value, valuable digital data and experiences generated. In general, network effects represent a new genre of productivity. Overall, the main finding is that network effects are amplifying the co-creating interactions between users of

[32] Schrage (2016) provides an exploratory example based on Amazon's business model. Amazon has hundreds of millions of customers shopping for goods on its site. These customers both actively browse through recommendations, suggestions and customer reviews and write comments and reviews. In doing so, they contribute enormously to the company's value. Amazon's network facilitates the creation and capture of data that proffers qualitative insights into both customers and products, which have a quantitative impact for both Amazon and its customers.

[33] Only one competitor survives; also referred to as the 'winner takes all dynamic' by Turck (2016).

platform business models. The next section focuses on the classification and the methods for the measurement of network effects identified in literature, devising a unified typology of network effects.

3.1 Typology of network effects

Multiple authors have identified different types of network effects. One stream of authors (e.g. Stobierski, 2020; Koskinen, Bonina and Eaton, 2018; Park, 2004; Shankar and Bayus, 2003; Ohashi, 2003; Katz and Shapiro, 1994 and 1985) have focused on direct network effects. Direct network effects occur when the value of a product, service or platform increases because the number of users increases; in other words, when more users beget more users (Stobierski, 2020). This is best illustrated by social media platforms, such as Facebook, Twitter, Instagram, LinkedIn, Snapchat or Pinterest, the value of which grows as a direct result of attracting more users. Another example is Apple, as the preferential treatment of messages sent from an iPhone to another Apple device (through iMessage) has helped the company expand its moat in the market (*ibid.).* Koskinen, Bonina and Eaton (2018) summarise that direct network effects are evident in the type of platform business model where the size of the pool of users from the same group is beneficial for a given individual as there are more users with whom they can interact.

Indirect network effects – also referred to as cross-sided, two-sided[34] or cross-network effects – occur when a platform or service depends on two or more user groups[35]. As more users from one group join the platform, the other group receives a greater amount of the value. According to Rochet and Tirole (2006) and Chu and Manchanda (2016)[36], indirect network effects are found where the expansion of one side of the market increases the value for another group. Koskinen, Bonina and Eaton (2018) claim that the decision to join a platform from the point of view of a user belonging to a given user group (e.g. buyers) depends on the number of users in a given complementary group (e.g. seller). In other words, more users on one side of the platform attracts more users to the other side of the platform. E-commerce and ride-sharing platforms, such as Uber or Upwork, can be considered

[34] Parker, Alstyne and Choudary (2016)

[35] Such as producers and consumers, buyers and sellers or users and developers.

[36] Chu and Manchanda (2016) explain that the growth in the number of buyers is driven primarily by the seller's installed base and product variety, and the growth in the number of sellers is driven by the buyer's installed base and buyer quality. The authors highlight the relationship between the product price and the increasing importance of buyer quality.

as explanatory examples. To further highlight the two-sided base of indirect network effects, Table 4 – based on research conducted by Eisenmann, Parker and Alstyne (2006) – presents the platform business models identified as utilising two-sided network effects. The original table presented by Eisenmann, Parker and Alstyne in 2006 was adjusted and complemented with new, currently emerging platform business models.

Table 4: Examples of platform business models employing indirect (two-sided) network effects

Market	**Side 1**	**Side 2**	**Example of platform business model**
PC operating systems	Consumers	Application developers*	Microsoft Windows; Apple macOS; Linux; Android and Apple's iOS
Online recruitment	Job seekers*	Employers	Monster, CareerBuilder; Indeed; Dice; CityJobs; eFinancial Careers; Adzuna; Guardian Jobs
Web searches	Searchers*	Advertisers	Google; Bing; Yahoo; Baidu; Ask.com; AOL.com; DuckDuckGo
Health maintenance organisations[37]	Patients*	Doctors	Kaiser; WellPoint
Video games	Players*	Developers	PlayStation; Xbox
E-commerce	Shoppers*	Retailers	Amazon; Wish; Mercado Libre; eBay; BigCommerce; Shopify; AliExpress; Wix; Shift4Shop; WooCommerce; Volusion; Prestashop; Weebly
Wi-Fi equipment	Laptop users	Access points	Linksys; Cisco; Dell
DVD	Consumers	Studios	Sony; Toshiba; Samsung
Gasoline-powered engines	Auto owners	Fuelling stations	GM; Toyota; Exxon; Shell

* Denotes network's subsidy side

Sources: Eisenmann, Parker and Alstyne (2006)

Gregory et al. (2021) and Turck (2016) highlight the new category emerging from advances in artificial intelligence (AI) and the growing availability of digital data. Data network effects are exhibited by the platform if the more the platform learns from the digital data it collects on users, the more valuable it becomes to each user. They can be understood as a positive direct relationship between the AI capability of a platform and its value perceived by its users. According to Gregory et al. (2021), this relationship is moderated by platform legitimation, digital data stewardship and user-centric design. According to Turck (2016), data network effects occur when the product, service or platform in general is powered by machine learning and becomes smarter as it obtains more data from its users, for example, personalisation in the case of Facebook or recommendations in the case of Airbnb, eBay or Amazon. In the context of data network effects, another example is Google. In

[37] Health maintenance organisations provide health insurance coverage.

simple terms, the more users search, the more data they provide, the more Google is enabled to constantly refine and improve its core performance, as well as personalise the user experience (Turck, 2016).

Papadopoulos (2019) and Parker, Alstyne and Choudary (2016) argue that network effects can be either positive or negative. According to the authors, positive network effects produce significant value for each user of the platform, while negative network effects occur when the platform is poorly managed and increasing numbers of users of a platform causes a reduction in the value for each user.[38] Shankar and Bayus (2003) state that positive network effects arise when the consumer's utility from using a product or service increases with the number of users of that product or service.

Another category identified by Gawer (2014) is lock-in effects. This type of network effect describes the setting where actors are more likely to remain on a platform rather than migrate to competing ones. Moreover, Shankar and Bayus (2003) have identified interactive network effects[39], which operate through the customer base's interactions with one or more marketing mix variables, such as price and advertising. The combination of interactive and direct network effects is defined by the authors as network strength[40] (*ibid*.). Additionally, Currier et al. (2020) has identified 13 different types of network effects, distinguishing between physical (e.g. landline telephones), protocol (e.g. ethernet), personal utility (e.g. iMessage, WhatsApp), personal (e.g. Facebook), market network (e.g. HoneyBook, AngelList), marketplace (e.g. eBay, Craigslist), platform (e.g. Windows, iOS, Android), asymptotic marketplace (e.g. Uber, Lyft), data (e.g. Waze, Yelp!), tech performance (e.g. Bittorrent, Skype), language (e.g. Google, Xerox), belief (currencies, religions) and bandwagon (e.g. Slack, Apple).

To conclude, network effects as the key value driver in platform business models' configurations have received much attention by researchers, classifying them into diversified categories. This section elaborated on the classifications discussed by various authors, with Table 5 summarising the

[38] The example of Uber is used to demonstrate these positive and negative network effects. The more drivers join the network, the more options riders have. The growing number of participants reduces waiting times for both riders and drivers, which allows Uber to drop fares as drivers can earn an equivalent amount of revenue in the same time period, which in turn attracts more riders to the platform.

[39] Following Shankar and Bayus (2003), these interactive network effects have an impact on the firm's marketing mix decisions; thus, it is important to consider them in the overall business strategy.

[40] More details on network strength will be provided in the following section.

main findings. This section mainly focused on direct and indirect network effects, data network effects and also briefly listed alternative types of network effects.

Table 5: Typology of network effects

Type	Authors	Description
Direct network effects	Shankar and Bayus, 2003; Ohashi, 2003; Park, 2004; Stobierski, 2020; Katz and Shapiro, 1985, 1994; Koskinen, Bonina and Eaton, 2018.	When the size of the user base from the same group is beneficial for a given individual of the group as there are more users to interact with.
Indirect/two-sided network effects (cross-sided or cross-network effects)	Rochet and Tirole, 2006; Chu and Manchanda, 2016; Koskinen, Bonina and Eaton, 2018; Katz and Shapiro, 1985, 1994; Eisenmann, Parker and Alstyne (2006).	When the expansion of one side of the platform increases the value for another group, therefore, for a given individual from a different group of the platform's users.
Data network effects	Gregory et al., 2021.	When the more the platform learns from the data it collects on users, the more valuable the platform becomes to each user.
Positive network effects	Shankar and Bayus, 2003; Papadopoulos, 2019; Parker, Alstyne and Choudary, 2016	When the user's utility of using a product or service increases with the number of users of that product or service.
Negative network effects	Shankar and Bayus, 2003; Papadopoulos, 2019; Parker, Alstyne and Choudary, 2016.	When an increasing amount of platform users causes a decrease of the value for each user.

Sources: Gregory et al. (2021); Stobierski (2020); Papadopoulos (2019); Koskinen, Bonina and Eaton (2018); Chu and Manchanda (2016); Parker, Alstyne and Choudary (2016); Rochet and Tirole (2006); Eisenmann, Parker and Alstyne (2006); Park (2004); Shankar and Bayus (2003); Ohashi (2003); Katz and Shapiro (1994 and 1985).

3.2 Measuring network effects

This section focuses on the body of literature on measuring the network effects identified in platform business models (e.g. Park, 2004; Chu and Manchanda, 2016; Gawer, 2014; Koskinen, Bonina and Eaton, 2018). Network effects are undisputedly the main driver of value creation in the digital

economy; thus, multiple authors have focused on the feasibility of measuring network effects' size, strength or benefit. Park (2004) denotes the number of users as network size (platform business model's user base) and the user's utility from the network size as a network benefit. Shankar and Bayus (2003) focus not only on the network size – defining it as equivalent to the platform business model's user base – but also network strength. Network strength is explained by the authors as the marginal impact of a unit increase in network size on demand (*ibid*.).

For instance, in Park's (2004) quantitative analysis of network effects in competing technologies, a dynamic structural model of consumers' choices and producers' pricing was applied to empirically analyse the VHS format in the US market[41] from 1981–1988. The results reveal that network effects explain from 70.3% to 86.8% of (the logarithm of) relative sales in each year *(ibid.)*.

The significance of network effects was examined in Chu and Manchanda's (2016) case study on Alibaba Group's Taobao. Quantifying indirect and direct network effects, the authors concluded that the relative contribution of the different factors that affect the growth of external participants (buyers and sellers in particular) on the platform does not play a significant role in the platform's overall growth. The authors detected a relatively small positive direct network effect on buyers' growth and no direct network effect on sellers' growth (*ibid*.). However, a significant, large and positive indirect effect on both sides of the platform was identified. In other words, the installed user base of either side of the platform propelled the growth of the other side, thus the overall growth. Chu and Manchanda (2016) point out that, interestingly, the indirect effect was asymmetric, with the installed base of sellers having a much larger effect on the growth of buyers than vice versa. Furthermore, in investigating the nature of indirect network effects over time, Chu and Manchanda (2016) reveal that while the indirect effect of sellers on buyers increases and then decreases to reach a stable level, the indirect effect of buyers on sellers is relatively stable.

Moreover, network size was described as the number of users of a platform. There are various indicators to enumerate network size, such as the number of active users per day (daily active users), per month (monthly active users [MAUs]) or volume of downloads. The indicator MAUs refers to the number of external participants who interact with the platform's framework within a given month and is considered to be the key performance indicator for measuring online user engagement. The

[41] The de facto standardisation of the VHS format in the US market.

ability to both attract new users and retain existing ones is to some extent described by MAUs. Moreover, a significant change in MAUs can affect the stock price of a company. However, the definition of MAUs differs slightly among companies as there are inherent challenges in measuring the usage of products and services across different economic sectors. For instance, Alibaba defines MAUs as the number of unique mobile devices used to visit or access certain of its mobile applications at least once during a particular month. Furthermore, it includes a performance indicator based on annual active consumers, referred to as the amount of annual active buyers.

4 Conclusion

Researching the growing body of literature defining the emerging platform business models (e.g. Rahman and Thelen, 2019; Papadopoulos, 2019; Lee and Kim, 2019; Brynjolfsson and McAfee, 2017; Devereux and Vella, 2017; Kenney and Zysman, 2016; Parker, Alstyne and Choudary, 2016; Parker and Alstyne, 2014 and 2008; Mesenbourg, 2001), platform business models were identified as the prevailing new business configuration enabled by digitalisation. Based on the findings, a unified definition of the platform business model was defined; it is a technology-driven business model based on platforms that create value and provide an institutional and regulatory framework enabling interactions between the previously unmatched demand-side and supply-side participants. Furthermore, surveying the existing literature, revealed that there are a variety of platform business models, including electronic payments, crowdfunding, social media and an immense group of e-commerce platform business models. Based on the vast literature survey, a novel typology of platform business models was devised that distinguishes four main types of platform business models: transaction, innovation, integrated and investment platform business models. Moreover, this paper also highlighted that platform business models represent a rapidly increasing proportion of the overall total market capitalisation.

Furthermore, the paper investigated the main attributes and characteristics of platform business models, confirming that the growth of platform business models is directly linked to their capacity to collect, analyse and, most importantly, monetise digital data, value-creating human activities and interconnected relationships between users, which are amplified by network effects. This paper further elaborated on these network effects, which refer to any situation in which the value of a product, service or platform in general depends on the number of users by whom it is leveraged. Based on Gregory et al. (2021); Stobierski (2020); Papadopoulos (2019); Koskinen, Bonina and Eaton

(2018); Chu and Manchanda (2016); Gawer (2014); Rochet and Tirole (2006); Shankar and Bayus (2003); Ohashi (2003); Park (2004) and Katz and Shapiro (1994 and 1985) the paper devised the following main types of network effects: direct, indirect (cross-sided, cross-network or two-sided), data, positive and negative. Taken together, the findings highlight the role of digital data and network effects as the main attributes of platform business models. To further this research, the future focus will be on how platform business models create, deliver and capture value through their business model configurations, taking a closer look at the role of network effects and digital data as the identified main attributes of platform business models.

References

AFONASOVA, M. A. et al. (2019). Digitalization in economy and innovation: the effect on social and economic processes. Polish journal of management studies, 19 (2), 22-32. https://pjms.zim.pcz.pl/resources/html/article/details?id=190160

Alstyne, V. M. W., PARKER, G. G., CHOUDARY, S. P. (2016). Pipelines, Platforms, and the New Rules of Strategy. *Harvard Business Review*. 94(4).

AMIT, R., ZOTT, C. (2001). Value creation in e-business. *Strategic Management Journal*. 22: 493–520. https://doi.org/10.1002/smj.187

ANDERSON, E. (2015). The Business Enterprise as an Ethical Agent. Subramanian Rangan, ed., Performance and Progress: Essays on Capitalism, Business, and Society. Oxford: Oxford University Press, 2015), 185. https://doi.org/10.1093/acprof:oso/9780198744283.001.0001

ARMSTRONG, M. (2006). Competition in Two-Sided Markets. *The RAND Journal of Economics* Vol. 37, No. 3 (Autumn, 2006), 668-691. Published by: Wiley. https://www.jstor.org/stable/25046266

BADEN-FULLER, C., HAEFLIGER, S. (2013). Business Models and Technological Innovation. Long Range Planning 46 (2013): 419-426. https://doi.org/10.1016/J.LRP.2013.08.023

BASOLE, R. C., KARLA, J. (2011). On the Evolution of Mobile Platform Ecosystem Structure and Strategy. Business & Information Systems Engineering 5/11. https://doi.org/10.1007/s12599-011-0174-4

BRYNJOLFSSON, E., MCAFEE, A. (2017). Machine, Platform, Crowd: Harnessing Our Digital Future. New York: W.W. Norton & Company. ISBN: 9780393254303

CHESBROUGH, H. W. (2010). Business Model Innovation: Opportunities and Barriers. Long Range Planning 43 (2010): 354-363. https://doi.org/10.1016/j.lrp.2009.07.010

CHU, J., MANCHANDA, P. (2016). Quantifying Cross and Direct Network Effects in Online Consumer to Consumer Platforms. Marketing Science 35(6). https://doi.org/10.1287/mksc.2016.0976

Council Directive (EU) 2021/514 of 22 March 2021 amending Directive 2011/16/EU on administrative cooperation in the field of taxation. Published in: Official Journal of the European Union.

CURRIER, J. et al. (2020). The Network Effects Bible. Nfx

DAHLMAN, C., MEALY, S., WERMELINGER, M. (2016). Harnessing the digital economy for developing countries. Working Paper No. 334. OECD Development Centre. Paris. http://www.oecd-ilibrary.org/docserver/download/4adffb24-en.pdf

DAVIS, G. F. (2009). Managed by the Markets. How Finance Reshape America. Oxford: Oxford University Press, 2009. ISBN 978–0–19–921661–1

DECOVNY, S. (2018). Assessing Value in the Digital Economy. CFA Institute. https://blogs.cfainstitute.org/investor/2018/04/18/assessing-value-in-the-digital-economy/

DEVEREUX, M. P., VELLA, J. (2017). Implications of Digitalization for International Corporate Tax Reform. Oxford University Centre for Business Taxation. https://oxfordtax.web.ox.ac.uk/files/wp17-07pdf

DIMITRATOS, P. et al. (2003). Micromultinationals: New Types of Firms for the Global Competitive Landscape. European Management Journal, Volume 21, Issue 2, 2003, Pages 164-174, ISSN 0263-2373. https://doi.org/10.1016/S0263-2373(03)00011-2

EISENMANN, T. R., PARKER, G., ALSTYNE, V. M. (2006). Strategies for TwoSided Markets. Harvard Business Review. 84, no. 10 (2006): 92–101.

EISENMANN, T. R., PARKER, G., ALSTYNE, V. M. (2009). Opening platforms: How, when and why? In Platforms, markets, and innovations, ed. A. Gawer. Cheltenham: Edward Elgar. Harvard Business school. Working Paper 09-030

ELDING, C., MORRIS, R. (2018). Digitalisation and its impact on the economy: insights from a survey of large companies. ECB Economic Bulletin, Issue 7/2018. https://www.ecb.europa.eu/pub/economic-bulletin/focus/2018/html/ecb.ebbox201807_04.en.html

EVANS, P. C., GAWER, A. (2016). The Rise of the Platform Enterprise: A Global Survey. The Emerging Platform Economy Series No. 1. The Center for Global Enterprise. https://www.thecge.net/wp-content/uploads/2016/01/PDF-WEB-Platform-Survey_01_12.pdf

FARRELL, J., SALONER, G. (1986). Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation. The American Economic Review, Vol. 76, No. 5 (Dec., 1986), 940-955. American Economic Association. https://www.jstor.org/stable/1816461

FOSS, N. J., SAEBI, T. (2017). Fifteen Years of Research on Business Model Innovation. Journal of Management 43 (2017): 200 - 227. https://doi.org/10.1177/0149206316675927

GAWER, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. Research Policy, Volume 43, Issue 7, 1239-1249. ISSN 0048-7333. https://doi.org/10.1016/j.respol.2014.03.006

GREGORY, R. W. et al. (2021). The Role of Artificial Intelligence and Data Network Effects for Creating User Value. Academy of Management Review VOL. 46, NO. 3. https://doi.org/10.5465/amr.2019.0178

KATZ, M. L., SHAPIRO, C. (1985). Network Externalities, Competition, and Compatibility. The American Economic Review, Vol. 75, No. 3 (Jun., 1985), pp. 424- 440. American Economic Association. https://www.jstor.org/stable/1814809

KATZ, M. L., SHAPIRO, C. (1994). Systems Competition and Network Effects. *Journal of Economic Perspectives*, Volume 8, Number 2, 1994, 93–115. https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.8.2.93

KAYAALP, F., BAŞARSLAN, M. S. (2018). Open Source Data Mining Programs: A Case Study on R. Düzce University Journal of Science & Technology, 6. 455-468. https://www.researchgate.net/publication/324171539

KENNEY, M.; ZYSMAN, J. (2016). The Rise of the Platform Economy. Issues in Science and Technology 32, no. 3. https://issues.org/rise-platform-economy-big-data-work/

KOSKINEN, K.; BONINA, C.; EATON, B. (2018). Digital Platforms in the Global South: Foundations and Research Agenda. Development Implications of Digital Economies. Centre for Development Informatics. https://diode.network/publications/

LANE, N. (1999). Advancing the Digital Economy into the 21st Century. Information Systems Frontiers 1:3, 317–320. Kluwer Academic Publishers, Boston. https://doi.org/10.1023/A:1010010630396

LEE, K., KIM, D. (2019). A peer-to-peer (P2P) platform business model: the case of Airbnb. Serv Bus 13, 647–669. https://doi.org/10.1007/s11628-019-00399-0

LI, C. Y., NIREI, M., YAMANA, K. (2018). Value of Data: There's No Such Thing as A Free Lunch in the Digital Economy Wendy. https://www.oecd.org/site/stipatents/programme/ipsdm-2018-5-2-li-nirei-yamana.pdf

LIU, M., BRYNJOLFSSON, E., DOWLATABADI, J. (2018). Do Digital Platforms Reduce Moral Hazard? The Case of Uber and Taxis. No 25015, NBER Working Papers, National Bureau of Economic Research, Inc. http://www.nber.org/papers/w25015

MESENBOURG, T. L. (2001). Measuring the Digital Economy. US Bureau of the Census, Suitland, MD. https://www.census.gov/content/dam/Census/library/workingpapers/2001/econ/umdigital.pdf

OHASHI, H. (2003). The Role of Network Effects in the US VCR Market, 1978–1986. https://doi.org/10.1111/j.1430-9134.2003.00447.x

OLBERT, M., SPENGEL, C. (2017). International taxation in the digital economy: challenge accepted. *World tax journal*, 9(1), 3-46.

OLBERT, M.; SPENGEL, C. (2019). Taxation in the Digital Economy – Recent Policy Developments and the Question of Value Creation. ZEW - Centre for European Economic Research Discussion Paper No. 19-010, http://dx.doi.org/10.2139/ssrn.3368092

PAPADOPOULOS, A. (2019). The power of platform businesses: How to enable value creation. Integrated Management Systems. https://www.imanagesystems.com/digital-marketing/power-platforms-enable-value-creation/

PARK, S. (2004). Quantitative Analysis of Network Externalities in Competing Technologies: The VCR Case. The Review of Economics and Statistics 2004; 86(4): 937–945. https://doi.org/10.1162/0034653043125275

PARKER, G. G., ALSTYNE, W. M. V., CHOUDARY, S. P. (2016). Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You. W. W. Norton & Company, New York, NY.

PARKER, G., ALSTYNE, M. V. (2008). Managing Platform Ecosystems. ICIS 2008 Proceedings - Twenty Ninth International Conference on Information Systems. 53. http://aisel.aisnet.org/icis2008/53

PARKER, G., ALSTYNE, W. V. M. (2014). Platform Strategy. The Palgrave Encyclopedia of Strategic Management. http://dx.doi.org/10.2139/ssrn.2439323

PRASAD, RN, ACHARYA, S. (2016). Fundamentals of Business Analytics. Wiley India Pvt. Ltd. ISBN: 8126563796

Proposal for a Regulation of the European Parliament and of The Council laying down harmonized rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union legislative Acts (COM (2021) 206 final). https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0206&from=CS

PUERTA, J. B. (2018). Defensibility in digital platforms: The main driver of long-term value creation. Samaipata. https://medium.com/samaipata-ventures/defensibility-in-digital-marketplaces-discussion-at-samaipata-london-event-125b5144754

RAHMAN, K. S., THELEN, K. (2019). The Rise of the Platform Business Model and the Transformation of Twenty-First-Century Capitalism. *Politics & Society*, 47(2), 177 - 204. http://dx.doi.org/10.1177/0032329219838932.

Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

ROCHET, J., TIROLE, J. (2006). Two-sided markets: a progress report. *The RAND Journal of Economics*. Vol. 37. No. 3, pp 645-667. Wiley. https://www.jstor.org/stable/25046265

SCHENKER, J. L. (2019). The Platform Economy. Largest global companies in 2018 vs 2008. The Innovator news. https://innovator.news/the-platform-economy-3c09439b56

SCHRAGE, M. (2016). Rethinking the Value of Customers in a Digital Economy. MIT Sloan Management Review.

SCHUMPETER, J. A. (1942). Capitalism, Socialism, and Democracy. Harper: New York.

Shankar, V., Bayus, B. L. (2003). Network effects and competition: an empirical analysis of the home video game industry. *Strategic Management Journal*, 2003, vol. 24, issue 4, 375-384. https://doi.org/10.1002/smj.296

SHAPIRO, C., VARIAN H. R. (1999). Information Rules: A Strategic Guide to the Network Economy. Boston, Massachusetts: Harvard Business School Press. ISBN 0-87584-863-X

STATISTA. (2021). The 100 largest companies in the world by market capitalization in 2021. https://www.statista.com/statistics/263264/top-companies-in-the-world-by-market-capitalization/

STOBIERSKI, T. (2020). What are network effects? Harvard Business School Online. https://online.hbs.edu/blog/post/what-are-network-effects

TÄUSCHER, K.; LAUDIEN, S. M. (2018). Understanding Platform Business Models: A Mixed Methods Study of Marketplaces. *European Management Journal*. https://doi.org/10.1016/j.emj.2017.06.005

TEECE, D. J. (2010). Business Models, Business Strategy and Innovation. Long Range Planning, Volume 43, Issues 2–3, April–June 2010, 172-194. https://doi.org/10.1016/j.lrp.2009.07.003

TURCK, M. (2016). The Power of Data Network Effects. https://mattturck.com/the-power-of-data-network-effects/

UNCTAD. (2019). Digital economy report. Value creation and capture: Implications for developing countries. United Nations Publication. ISBN 978-92-1-112955-7. https://unctad.org/system/files/official-document/der2019_en.pdf

Appendix A: Classification of platform business models
Sources: Stobierski, 2020; UNCTAD, 2019; Rochet and Tirole, 2006.

Non-profit oriented platform business models				
Exchange	HomeExchange.com			
Donation	Freecycle, Nolotiro.org			
Free services	Couchsurfing			
Other "true" sharing economy	Goteo, Wikipedia			
Profit oriented platform business models				
Electronic payments	Alipay, Paypal, M-Pesa, bKash, Visa, Mastercard			
Crowdfunding	Catarse, Costeame, Getmefund, Kickstarter			
Social media	Facebook, Twitter, Instagram, LinkedIn, Snapchat, Pinterest			
E-commerce	Incumbent companies	Caterpillar, Ikea, Zara, UBS (e-banking)		
	Third party	Goods	Amazon, Marketplace, Alibaba, eBay, Jumia, Lazada, MercadoLibre, Souq, Etsy, AliExpress	
		Services	Transportation	99, Didi Chuxing, Grab, Lyft, Safemotos, Uber
			Ticket exchange	StubHub, Ticketmaster, SeatGeek
			Delivery	Deliveroo, Glovo, iFood, Pedidos Ya, Rappi, Grubhub, DoorDash, Uber Eats, Instacart, Postmates
			Tourism	Agoda, Airbnb, Booking.com, Despegar, Hotels.ng
			Financial services (lending)	Afluenta, KiaKia, Lending Club, Prestadero, Prosper, RateSetter, Zopa
			Entertainment	iTunes, iROKO, Netflix, Spotify, Shutterstock
			Video games	Nintendo, Sega, Sony Play Station, Microsoft X-Box
			Media	AllAfrica.com, Bloomberg, Devex, Google News, Globo, Reuters
			Advertising	Baidu, Facebook, Google, Gumtree, Kenshoo, OLX
			Search	Baidu, Bing, DuckDuckGo, Google Search, Yahoo
			Information / reviews	Tenderbazar.com, Tradekey, iCow, Yelp, Tripadvisor, Kudobuzz
			Learning	Coursera, edX, Lynda.com, Udacity, XuetangX
			Health	Doctor.com, MDLive, 1DocWay
			Digital labour	Gig work (location bound): Airbnb, Fiverr, Grab, Helpling, TaskRabbit, Uber
				Cloud work: Amazon MTurk, Samasource, Upwork
			Apps Markets	AppStore, GooglePlay
			Cloud Services	Alibaba Cloud, Amazon Web Services, América Móvil, Microsoft Azure, Salesforce, Tencent

Appendix B: Most downloaded platforms

All categories	Dwn	Games	Dwn	Social	Dwn	Communication	Dwn	Entertainment	Dwn	Music & Audio	Dwn
TikTok	850	Among Us	285	TikTok	850	WhatsApp	600	Netflix	233	Spotify	211
WhatsApp	600	Subway Surfers	227	Facebook	540	Zoom	477	YouTube	170	YouTube Music	138
Facebook	540	Garena Free Fire	218	Instagram	503	Messenger	403	Amazon Prime Video	130	Shazam	77
Instagram	503	PUBG Mobile	175	Snapchat	281	Telegram	256	Disney+	102	SoundCloud	57
Zoom	477	Gardenscapes	171	Pinterest	179	Google Meet	254	YouTube Kids	94	StarMaker	53
Messenger	404	Roblox	158	Twitter	119	Microsoft Teams	153	MX Player	82	Amazon Music	51
Snapchat	281	Hunter Assassin	155	BIGO Live	89	Discord	141	Reface	75	DrumPad Machine	47
Telegram	256	Tiles Hop	151	MX TakaTak	65	WhatsApp Business	113	Hotstar	62	GroovePad	41
Google Meet	254	Join Clash	149	Josh Videos	58	WeChat	87	ZEDGE Wallpapers	60	Gaana Music	38
Netflix	223	Brain Test	138	Moj	55	Imo	70	iQiyi	51	Amazon Alexa	37

Shopping	Dwn	Food & Drink	Dwn	Travel	Dwn	Education	Dwn	Dating	Dwn	Health & Fitness	Dwn
Amazon	169	Uber Eats	82	Uber	95	Google Classroom	128	Tinder	74	Mi Fit	41
Shopee	139	McDonalds	82	Google Maps	88	Duolingo	61	Badoo	44	Home Workout	40
Wish	138	DoorDash	44	Google Earth	61	Photomath	48	Tantan	21	Lose weight for Wmn	36
Shein	122	Foodpanda	35	Booking.com	50	Brainly	42	Bumble	19	Calm	33
Pinduoduo	90	Just Eat Takeaway	32	Airbnb	42	Cake	36	MeetMe	17	Flo	32
AliExpress	79	Starbucks	28	Grab	32	Kahoot!	25	WHO	16	Six Pack in 30 Days	28
Flipkart	72	iFood	22	AutoNavi Maps	31	U-Dictionary	23	Grindr	15	Lose weight for Men	27
Lazada	69	Zomato	20	inDriver	27	Simply Piano	23	Happn	13	Strava	25
Mercado Libre	56	Deliveroo	17	Lyft	24	PictureThis	22	Plenty of Fish	12	Muscle Booster	24
eBay	51	Grubhub	16	Hello Travel	23	Qanda	16	Hily	11	MyFitnessPal	23

Sources: Curry (2021)