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A Review of Platform Business Models

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Abstract

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, the aim of this paper is to coin a unified definition and identify the main attributes of platform business models. 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.

Keywords

Digital Economy, Business Model, Platform Business Model, Digital Data, Network Effects

JEL Classification

F23, L86

Introduction

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. 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 digitalisation¹. 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 (Kenney, Bearson and Zysman, 2021; Kenney and Zysman, 2020; 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 (Kenney, Bearson and Zysman, 2021; Rahman and Thelen, 2019; Brynjolfsson and McAfee, 2017; Parker and Alstyne, 2008).

The aim of this paper is to coin a unified definition and identify the main attributes of platform business models. In line with fulfilling the aim, the following research question is addressed: 'What are the main attributes of platform business models?'. Synthesizing the existing knowledge along with consolidating concepts across various research efforts, attempting to resolve competing definitions, the paper provides an exhaustive summary of the literature relevant and stimulate further research.

This paper represents an integrative literature review summarizing, examining, and synthesizing the existing research already done on platform business models such that unified definition of the platform business model is generated, and the main attributes are identified. Relevant literature to be included in the paper was collected from

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. Afonsova, Panfilova, Galichkina and Ślusarczyk, 2019; Olbert and Spengel, 2019 and 2017; Kenney and Zysman, 2016).

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citation databases including but not limited to Web of Science, Oxford Journals, JSTOR, Scopus, Science Direct, EBSCO, SpringerLink and Google Scholar. In addition, working papers database, such as the U.S. National Bureau of Economic Research, the Census Bureau Library, Harvard Business School Working Paper Series or OECD Development Centre Working Papers were included with the purpose of accessing the most recent studies and developments. The review was supplemented by relevant studies, cited in the collected literature. Keywords used in the search strategy included “Platform business models”, “Platforms”, “Platform-based business models”, “Business models based on platforms”, “Two-sided markets”, “Multi-sided markets”, “Platform operators”, “Network of contracts model” and “Demand-side economies of scale”, and combinations thereof. With regards to the planned scrutiny and the purpose and topic of the review, the selected literature was reviewed by a complete reading of each piece of literature.

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, Section 5 discusses the results and practical implications and Section 6 presents the conclusion.

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 (Agyeman, Ma, Li and Sampene, 2021; Kenney, Bearson and Zysman, 2021; Biglaiser and Cr emer, 2020). 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.

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 innovations³, business models must also change. Digitalisation encompasses a growing number of 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. Bican and Brem, 2020; Foss and Saebi, 2017; DaSilva and Trkman, 2014; 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, Bican and Brem (2020), Grabher and Tuijl (2020) and Dahlman, Mealy and Wermelinger (2016) note that the growing intensity of data usage⁴, 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, Bican and Brem (2020) and Amit and Zott (2001) point out that digitalisation supports

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 Figure 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 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 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 (2020, 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 (2020, 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 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 activity⁵, 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 markets⁶, some to multi-sided markets, some to platform operators⁷ and some to the network of contracts model⁸ 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.

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 actors⁹, 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, Adachi and Tremblay (2020) and Rahman and Thelen (2019) describe the platform business model as a nexus of reciprocal relationships¹⁰ 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); UNCTAD¹¹ (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

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 Adachi and Tremblay (2020) and 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).

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.

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 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 effects¹³. 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 characteristics¹⁴, are presented. For instance, platform business models such as Uber¹⁵ or Upwork¹⁶ 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 Facebook¹⁷ 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 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.

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. Given the fast-growing number of platform business models across industries the original examples listed by Parker, Alstyne and Choudary (2016) were updated with the current platform business models (e.g. Curry, 2021; Stobierski, 2020; UNCTAD, 2019; Parker, Alstyne and Choudary, 2016).

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

¹⁴ A detailed list of examples and characteristics 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.

Table 1. Examples of platform business models in various industries.

Industry	Examples
Agriculture	DigiFarm, Twiga, Jumia, John Deere, Intuit Fasal, Digisoko
Communication and Networking	LinkedIn, Facebook (Meta), Twitter, Tinder, Snapchat, WhatsApp
Education	Duolingo, Google Classroom, Kahoot, Brainly, Udemy, Skillshare, Coursera
Energy and Heavy Industry	Nest, Tesla Powerwall, General Electric, EnerNOC
Finance	Bitcoin, Lending Club, Kickstarter, Afluenta, KiaKia, Lending Club
Health Care	Doctor.com, MDLive, Cohealo, SimplyInsured, Kaiser Permanente
Gaming	Nintendo, Sega, Xbox, Nintendo, PlayStation
Labor and Professional Services	Upwork, Fiverr, 99designs, Sittercity, LegalZoom, Gig work
Local Services	Yelp, Foursquare, Groupon, Angie's List
Logistics and Delivery	Deliveroo, Glovo, iFood, Pedidos Ya, Munchery, Foodpanda, Haier Group
Media	Medium, Viki, YouTube, Wikipedia, Huffington Post, Kindle Publishing, Bloomberg, Google News, Reuters
Travel	Airbnb, TripAdvisor
Operating Systems	iOS, Android, MacOS, Microsoft Windows
Retail	Amazon, Alibaba, Walgreens, Burberry, Shopkick
Transportation	Uber, Waze, BlaBlaCar, GrabTaxi, Ola Cabs, Lyft, DidiChuxing

Source: Own elaboration based on Curry (2021); Stobierski (2020); UNCTAD (2019); Parker, Alstynne 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, Alstynne 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 Chuxing¹⁸, 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 platforms¹⁹ are often referred to as engineering or technology platforms that create an environment for code or content producers to develop applications and software. Innovation 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 SAP²⁰. 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

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

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

²⁰ System Application and Product in Processing.

are not platforms as such, Evans and Gawer (2016) claim that they invest in platform business models at an early stage²¹ and act as holding companies.

Furthermore, based on a cluster analysis, Täuscher and Laudien (2018) have identified six fundamentally distinct types of platform business models²²: efficient product transactions, digital product communities, product aficionados, on-demand offline services, online services and peer-to-peer offline services. 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 applications and software).	Oracle; Intel; Microsoft; System Application and Product in Processing (SAP); Apple technology; operating systems (e.g. 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: Curry (2021); Stobierski (2020); UNCTAD (2019); 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).

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 (Kenney, Bearson and Zysman, 2021; Bican and Brem, 2020). 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. Figure 1 compares the largest global companies based on market capitalisation in 2021 vs 2008. The Figure 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

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

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.*).

currently dominate among the largest companies worldwide.

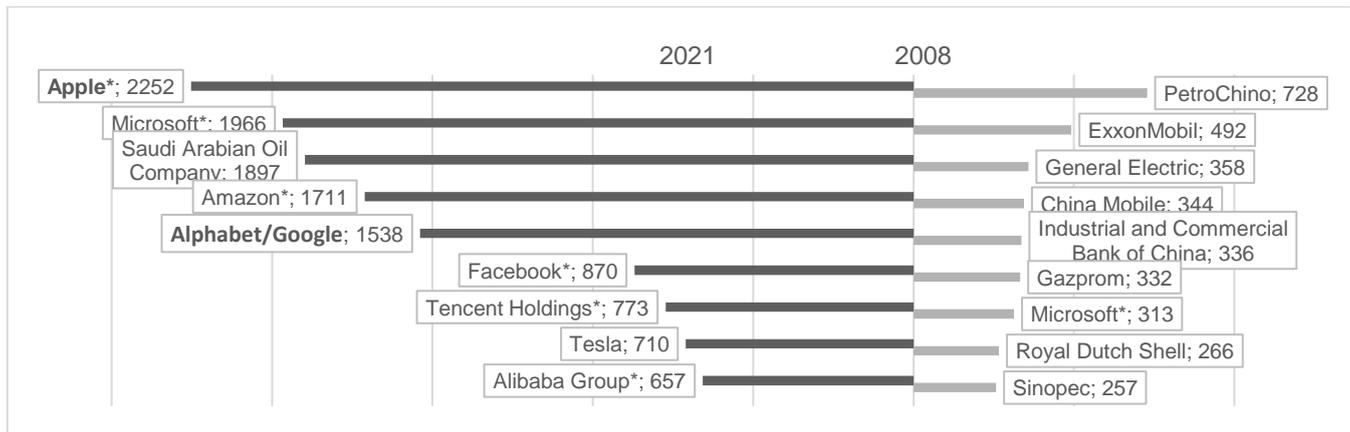


Fig. 1. Comparison of the largest companies (according to market capitalisation) in 2021 and 2008 (billion USD).

Note: * Denotes platform business model

Sources: Own elaboration based on 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, Johnson, Slow and Young (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.

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. Eisape, 2020; 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 reach²³ 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 systems²⁴. 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 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.

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.

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	Customer-to-customer (C2C); Business-to-consumer (B2C); Business-to-business (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.

Digital Data

Most policy discussions around digital data tend to focus on privacy issues 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. Hagiu and Wright (2020) focus on companies improving their products through learning from customer data and the extent of data accumulation. Authors model competition between platform business models, explore the implications of the model for competitive dynamics and efficiency and analyse factors affecting an incumbent's competitive advantage (*ibid.*). 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, semi-structured or structured data; 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.

In addition to the previously mentioned characteristics, digital data is non-rival in nature; 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.

Kenney and Zysman (2020), Hagiu and Wright (2020) and 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 (Kenney and Zysman, 2020; Hagiu and Wright, 2020; 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 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).

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. Biglaiser and Crémer, 2020; Halaburda, Jullien and Yehezkel, 2020; Currier, 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 (Halaburda, Jullien and Yehezkel, 2020; Currier, 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 (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.²⁵ 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, Alstynne 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. Alstynne, 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.

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.²⁶

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, Alstynne 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 scenarios²⁷ 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 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.

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-sided²⁸ or cross-network effects – occur when a platform or service depends on two or more user groups²⁹. 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

²⁵ 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.

²⁶ 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.

²⁷ Only one competitor survives; also referred to as the 'winner takes all dynamic' by Turck (2016).

²⁸ Parker, Alstynne and Choudary (2016)

²⁹ Such as producers and consumers, buyers and sellers or users and developers.

Manchanda (2016)³⁰, 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 as explanatory examples (Grabher and Tuijl, 2020). 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 (e.g. Curry, 2021; Stobierski, 2020; UNCTAD, 2019).

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	Upwork; Monster, CareerBuilder; Indeed; Dice; CityJobs; eFinancial Careers; Adzuna; Guardian Jobs
Web searches	Searchers*	Advertisers	Google; Bing; Yahoo; Baidu; Ask.com; AOL.com; DuckDuckGo; Bing
Health maintenance organisations ³¹	Patients*	Doctors	Doctor.com; MDLive; 1DocWay; Kaiser; WellPoint
Video games	Players*	Developers	PlayStation; Xbox; Nintendo; Sega
E-commerce	Shoppers*	Retailers	Amazon; Wish; Mercado Libre; eBay; BigCommerce; Shopify; AliExpress; Wix; Shift4Shop; WooCommerce; Volusion; Prestashop; Weebly; Marketplace; Alibaba
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

Note: * Denotes network's subsidy side

Sources: Curry (2021); Stobierski (2020); UNCTAD (2019); Eisenmann, Parker and Alstyne (2006)

Gregory, Henfridsson, Kaganer and Kyriakou (2021); Iansiti (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, Henfridsson, Kaganer and Kyriakou (2021), this relationship is moderated by platform legitimization, 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 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.³² 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 effects³³, which operate through the customer base's

³⁰ 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.

³¹ Health maintenance organisations provide health insurance coverage.

³² 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, which in turn attracts more riders to the platform.

³³ 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.

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 strength³⁴ (*ibid.*). Additionally, Currier(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 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	Stobierski, 2020; Koskinen, Bonina and Eaton, 2018; Shankar and Bayus, 2003; Ohashi, 2003; Park, 2004; Katz and Shapiro, 1985, 1994.	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, Henfridsson, Kaganer and Kyriakou, 2021; Iansiti, 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	Papadopoulos, 2019; Parker, Alstyne and Choudary, 2016; Shankar and Bayus, 2003.	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	Papadopoulos, 2019; Parker, Alstyne and Choudary, 2016; Shankar and Bayus, 2003.	When an increasing amount of platform users causes a decrease of the value for each user.

Sources: Gregory, Henfridsson, Kaganer and Kyriakou (2021); Iansiti (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).

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 market³⁵ 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

³⁴ More details on network strength will be provided in the following section.

³⁵ The de facto standardisation of the VHS format in the US market.

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 ability to both attracts 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.

Discussion

The paper explored the utmost dynamic literature on platform business models, which have not benefited, from a comprehensive review up to now. Furthermore, it improves conceptual definitions of the original constructs and stimulate further research. Building on the theoretical foundations of the business model (e.g. DaSilva and Trkman, 2014; Teece, 2010) and technical understanding of platform (e.g. Evans and Gawer, 2016), the platform business model has been 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. The coined definition has been concluded based on Kenney, Bearson and Zysman, 2021; Eisape, 2020; Kenney and Zysman, 2020; 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).

However, the latest legislative proposals³⁶ by the European Commission, reflecting the emergence of platform business models as such, tend to narrow the scope of platform business models to online intermediation services, online search engines, online social networking services, video-sharing platform services, cloud computing services and advertising services. Referred legislative proposals aim to regulate providers of core platform services having a significant impact on the internal market of the European Union and thus the narrow scope of platform business models is appropriate. Earlier in the text, it was acknowledged that, platform business models often serve more than one purpose, and that ringfencing them into specific sectors would be short sighted. Nevertheless, the emerging platform business models are unregulated from various perspective and the relevant scope and notion can thus differ respectively.

This paper highlighted specific attributes that have been enabled by digitalisation and embodied by platform business models. The digitalisation as a global trend and growth factor of the modern economy has however imposed new challenges, such as the protection of security, privacy of users' digital data and brought various challenges to the international business tax framework (Afonasova, Panfilova, Galichkina and Ślusarczyk, 2019; Olbert and Spengel, 2019 and 2017; Auerbach, Devereux, Keen and Vella, 2017; Kenney and Zysman, 2016). From the tax perspective, the current worldwide taxation system is widely considered to not correspond with the global, modern, and digitalized context (e.g. Olbert and Spengel, 2019; Auerbach, Devereux, Keen and Vella, 2017; Devereux and Vella, 2017). The critical way for most countries to capture value in the digital economy is through taxation, thus rules designed for the traditional economy may need to be reviewed considering new digital business models, such as platform business models. New value chain configurations and specific attributes, as identified in the paper, are the core elements to be focused on when updating the tax rules in the digitalized context. Even though the tax perspective is beyond the scope of this paper, the presented review provides a solid starting point for further research in platform business models from a tax perspective.

Conclusion

Researching the growing body of literature defining the emerging platform business models (e.g. Kenney, Bearson and Zysman, 2021; Eisape, 2020; Kenney and Zysman, 2020; Hagi and Wright, 2020; 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

³⁶ For instance, the Proposal for a Regulation of the European Parliament and of the Council on contestable and fair markets in the digital sector (Digital Markets Act) (COM/2020/842 final); Proposal for a Regulation of the European Parliament and of the Council on a Single Market for Digital Services (Digital Services Act) and amending Directive 2000/31/EC (COM/2020/825 final).

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, Henfridsson, Kaganer and Kyriakou (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.

The paper has certain limitations to be acknowledged. The topic of this paper is utmost dynamic and experience rapid growth in literature. As demonstrated earlier in the text, platform business models are fast-increasing proportion of the overall total market capitalisation, present across various industries and moreover, take different forms. The continuously evolving, and increasing, heterogeneity of platform business models entails a risk of shift to new main attributes, differing from those detected in this review. Regarding the search strategy, the inclusion of working papers databases, with the purpose to access the most recent research developments, imports a risk of absent peer-review of research results included. Furthermore, regarding methodological related limitations, potentially not a comprehensive list of keywords applied within the search strategy resulting in possibly undetected relevant literature is acknowledge. Application of advanced text mining tools such as analytical techniques and deep learning algorithms may result in dissimilar list of keywords.

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. Stated will establish a solid starting point for further research in platform business models from the tax perspective, since the current worldwide taxation system is widely considered to not correspond with the global, modern a digitalized context.

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