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ABSTRACT

Digital Entrepreneurship Research: A Concise Introduction

In the past few decades, technological progress has led to the digitization and digitalization of economies into what one could now call digital economies.The COVID-19 pandemic will accelerate the development of the digital economy. In a digital economy, digital entrepreneurs pursue opportunities to produce and trade in digital artifacts on digital artifact stores or platforms, and/or to create these digital artifact stores or platforms themselves. There is a well-recognized need for more research on digital entrepreneurship. As such, this paper provides an overview of the central research questions currently being pursued in this field. These include questions such as: What is digital entrepreneurship? What is different in the digital economy from an entrepreneurial perspective? What is the impact of digitalization - and big data - on business models and entrepreneurship? How can digital entrepreneurship be supported and regulated? The paper identifies areas of neglect, and makes proposals for future research.

JEL Classification: L26, D21, M13, O33

Keywords: digital entrepreneurship, digital artifacts, network effects, digital platforms, gig economy, digital entrepreneurial ecosystems

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1 Introduction

Whilst the digitization[1] of the economy started in earnest following advances in computing during and after the Second World War, and was given impetus by the commercialization of the personal computer[2] in the 1980s and the invention of the World Wide Web in the 1990s, it was only around 2007 that the deep disruptive potential of the digital revolution became topical. As Friedman (2016, p.19) asked, "What the hell happened in 2007?"

This digital revolution resulted in technologies such as ubiquitous computing, internet connectivity, digital devices, big data, artificial intelligence (AI), and digital platforms (Cavallo et al., 2019; Coyle, 2017). Consequently, the digital revolution has also made new forms of entrepreneurship possible, has accelerated the creation and scaling up of new businesses, and has changed the contours of competition. According to Recker and Von Briel (2019, p.4), "through the infusion of digital technologies into entrepreneurship, entrepreneurial processes become more fluid and porous [...]and entrepreneurial outcomes become increasingly malleable, extendable, and modifiable."

The infusion of digital technologies into entrepreneurship has resulted in what is known as digital entrepreneurship. Digital entrepreneurship research includes "those studies exploring and (possibly) theorizing on entrepreneurial processes, out-comes and agency transformed by digitization, or by rephrasing it as digital transformation of entrepreneurial processes, outcomes, and agency" (Cavallo et al., 2019, p.24). Digital entrepreneurship research is in its infancy. There is a well-recognized need for more research on digital entrepreneurship (Nambisan et al., 2019; Sussan and Acs, 2017). The acceleration of the digitalization of the world economy as a result of the COVID-19 pandemic (Bloom et al., 2020; Schrage, 2020) gives more urgency to this need. In this light, this paper provides an overview of the central research questions currently being pursued, comment on areas of neglect, and identifies avenues for future research.

The central research questions currently being pursued under the topic of digital entrepreneurship are the following: What is digital entrepreneurship? What is different in the digital economy from an entrepreneurial perspective? What is the impact of digitalization – and big data – on business models and entrepreneurship? How can digital entrepreneurship be supported and regulated? These main research questions and the secondary questions they

[1] "Digitization is the technical process, whereas digitalization is a socio-technological process of applying digitization techniques" (Sussan and Acs, 2017, p.58).

[2] The Apple II was the world's first "mainstream" personal computer, introduced in 1977 (Zittrain, 2009, p.18).

encompass will be discussed in sections 2 to 5 of this paper. Then, section 6 provides a brief summary of the most important conclusions we can draw at this point, including recommendations for addressing issues that are hitherto neglected, and hence, should be addressed in future research.

2 What is Digital Entrepreneurship?

Recognizing who is a digital entrepreneur and who is not, is not so straightforward. The digitalization of the economy may be changing the very concept of entrepreneurship. For example, Sussan and Acs (2017, p.56) ask "what about Uber drivers and AirBnB renters? Are they digital entrepreneurs?"

In a sense, one can argue that almost all entrepreneurship now is digital or data-driven to the extent that it involves in one way or another computing and a computer. As Varian (2010, p.2) puts it, "sometimes the computer takes the form of a smart cash register, sometimes it is part of a sophisticated point of sale system, and sometimes it is a web site." As a consequence, virtually all entrepreneurial transactions in the economy are now tracked and stored digitally – as digital artifacts, and trade on digital artifact stores.

To try and further narrow down an answer the question what digital entrepreneurship is, and recognise better who a digital entrepreneur is, it is perhaps best to start off with one of the most widely accepted definitions of the field of entrepreneurship, that of Shane and Venkataraman (2000). They defined the field as studying "how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited" (Ibid, p. 218).

To stay close to this definition, digital entrepreneurship should firstly include opportunity recognition and exploitation within the digital economy[3]. Then, digital entrepreneurship is then the "pursuit of opportunities based on the use of digital media and other information and communication technologies"(Davidson and Vaast, 2010, p.2). Secondly, digital entrepreneurship should explicitly include the "digital" dimensions of opportunities. As Von Briel et al. (2018, p.279) point out, "one clear implication of Shane and Ventakaram's (2000) framework is that characteristics of 'that on which they act' (the opportunity) should influence the venture creation process". In other words, digital entrepreneurship is distinct

[3]The term "digital economy" is ascribed to Tapscott (1995).

from traditional entrepreneurship in that the digital nature of the opportunity influences the process of entrepreneurship.

To make clear how an opportunity in the digital economy influences the entrepreneurship process, the concept of a digital artifact is important. Digital artifacts are "man-made purposeful objects embodied in information and communication technology components of software and hardware" (Von Briel et al., 2018, p.292). Digital artifacts can be recombined, edited, and distributed, which can lead to new venture ideas, to changes in prices, and the nature of competition and strategy, in effect leading to what has been described as the "increasingly malleable, extendable, and modifiable" characteristics of entrepreneurial processes (Recker and Von Briel, 2019, p.4). Because digital artifacts can be recombined, they offer unlimited scope for new artifact creation. A digital entrepreneur can for example offer a new set of services and or products by recombining existing digital artifacts, such as application programming interfaces (APIs) in a novel manner or introduce it in a new context.

Based on the above, digital entrepreneurs can therefore be defined as entrepreneurs who pursue opportunities to produce and trade in digital artifacts on digital artifact stores or platforms and/or create these digital artifact stores or platforms (see also Cavallo et al. (2019)). The most common forms of digital entrepreneurship thus include the creation and commercialization of new digital infrastructure, such as platforms, or the creation of value within existing digital platforms (Sussan and Acs, 2017).

As such, *Uber* drivers and *AirBnB* hostesses are not digital entrepreneurs. The owner of a mobile phone repair shop is likewise not a digital entrepreneur. Nor are millions of entrepreneurs who sell non-digital goods online. Thus, participation on digital platforms or digital marketplaces are not sufficient to classify an entrepreneur as a digital entrepreneur (as for instance Sundarajan (2014) does), nor are using digital technologies (e.g. 3D-printing or mobile money) in a business. Digital entrepreneurship is recognized by the centrality of digital artifacts and the influence of these artifacts on the nature of the entrepreneurship process. Von Briel et al. (2018) label the ventures started by digital entrepreneurs as "digital ventures" and point out that some of the world's most valuable companies, including *Apple*, *Google*, *Microsoft* and *Facebook* started out as digital ventures whose offering consisted of a digital artifact.

As far as the consistent measurement of digital entrepreneurship is concerned, satisfactory cross-country measures are unfortunately still lacking (Ojanperä et al., 2019). However, a

number of initiatives in recent years that have made some progress in this direction include the World Bank's Digital Indicators that provides comparable measures across countries of digital infrastructure such as broadband connectivity, digital payment facilities, data privacy and security and logistics (Chen, 2019). Other initiatives include the World Bank's *Knowledge Economy Index*, the *Digitalization Readiness Index* of UNIDO (UNIDO, 2019), and the *Digital Knowledge Economy Index* (DKEI) by Ojanperä et al. (2019). The latter reflects more on digital entrepreneurship by including measures of content creation through digital platforms such as *GitHub* (a code-sharing platform) and *Wikipedia* (a crowd-sourced encyclopedia). As more and more scholars in entrepreneurship explore the uses of big data, it is to be expected that there will be a multiplication of novel approaches to measure and track digital entrepreneurship. It is a fertile area for research.

3 What is Different in the Digital Economy?

A second question that is explored in the current literature on digital entrepreneurship is: what is different in the digital economy from an entrepreneurial perspective? This includes asking sub-questions such as: How do digitization and digital artifacts affect the nature of business and of new venture creation? What is the implication for entrepreneurship of the nature of the digital economy?

3.1 How do digitization and digital artifacts affect the nature of business and of new venture creation?

In the previous section it was pointed out that virtually all entrepreneurial transactions in the economy are now tracked and stored digitally – as digital artifacts, and trade on digital artifact stores. This "mediation" of transactions by digitization impacts on entrepreneurship in many different ways – both digital entrepreneurship as defined, but also more traditional, non-digital entrepreneurship.[4]

Varian (2010, p.2) discusses four broad types of impact. One is that digital technologies allows for the creation of new forms of contract. For example, revenue-sharing contracts, which are central in most digital platform business models, are possible because of the

[4]For instance, the combination of new contracts and customization creates opportunities for traditional to benefit from the outsourcing of labor to online labor platforms, e.g. UpWork (Chen, 2019).

enhanced ability to monitor revenues in digital space.

A second broad type of impact of the digitization of the economy on entrepreneurship is that it generates data for storage and analysis. The analysis of data is central in many models used by digital ventures and digital platforms to model and influence consumers' behavior.

A third impact of the digitization of the economy on entrepreneurship is that digital space makes experimentation, production and diffusion faster, easier and less costly. This is helpful for the startup of digital ventures, where the fundamental problem has always been that traditional planning methods such as business planning based on "waterfall" product development and past performance are not appropriate (Bortolini et al., 2018). Easier experimentation has allowed new practical approaches towards entrepreneurial startups, such as Lean Startup Approaches (LSA)[5] (Blank, 2013; Ries, 2011) to become widely used by digital new ventures (Cavallo et al., 2019). Digital ventures can also engage in much faster product development, making even better use of agile development (AD) practices[6] than traditional firms. It also changes the role and function of management, away from the importance on opinions,[7] towards rational and decentralized decision-making based on experiment (Varian, 2010).

A fourth impact of the digitization of the economy on entrepreneurship is that digitization and ubiquitous computing enables (hyper) personalization and mass customization. Differential pricing and consumer recommender systems are all based on digitization. Production and services can be developed based on concepts of a digital twin. The advent of personalization and recommendation systems, *inter alia* using methods of deep learning, has led to huge gains in consumer surplus. For instance, Brynjolfsson et al. (2003) calculated that consumers are benefiting significantly from online retail through paying lower prices (due to greater competition) as well as through the increased variety that are offered to them online – and of which they are made aware through recommendation systems. Already back in 2003, the consumer surplus gained from the increased variety of books offered of Amazon was between 7 and 10 times larger than the consumer surplus for lower prices (Brynjolfsson et al., 2003).

[5]The LSA is "a scientific, hypothesis-driven approach to entrepreneurship, where entrepreneurs translate their vision – i.e. business idea – into falsifiable hypotheses which are embedded in a first version of a business model. These hypotheses are then tested through a series of minimum viable products (MVPs), which are the smallest set of activities needed to disprove a hypothesis." (Ghezzi and Cavallo, 2018, p.3)

[6]Agile development (AD) practices refer to "practices for software development based on the centrality of individuals and interaction, incremental delivery of working software, collaboration with customers and response to change" (Ghezzi and Cavallo, 2018, pp.1-2).

[7]This has been framed as the HIPPO tendency – to make business decisions following the Highest Paid Person's Opinion (HIPPO).

A fifth effect that be added to the above is the ability to crowdsource inputs and solutions. In the context of the Internet crowdsourcing refers to the sourcing of "digital and material contributions from an on-demand workforce" (Howcroft and Bergvall-Kareborn, 2018, p.21). Platforms that are based on crowdsourcing include platforms that source capital (crowdfunding), ideas (crowdsolving), polling and voting (crowdvoting) and labor[8] (crowdwork) (Howcroft and Bergvall-Kareborn, 2018). Crowdsourcing also underpins the so-called sharing economy, where digital platforms leverage unutilized assets of users. The use of crowdfunding for entrepreneurial startups broadly (and not only of digital ventures) has already generated a fairly large literature (Cavallo et al., 2019; Nambisan et al., 2019).

A sixth impact of digitization on entrepreneurship, that is in part related to the rise of crowdsourcing, is in the way that it is changing entrepreneurial agency. One way is as Cavallo et al. (2019, p.24) argue, that there is in the digital economy a gradual shift to be seen, away from the lone entrepreneur, towards the community. Tapscott (2012), who coined the term the digital economy, has referred to this as "capitalism 2.0", where "we're all collaborating as never before and in business the hottest concepts are social – collective intelligence, mass collaboration, crowd sourcing and collaborative innovation". A second way that it is changing entrepreneurial agency, or at least has been argued to have the potential to do, is by facilitating female entrepreneurship, see e.g. McAdam et al. (2019). This is an important area for further research, as it is still the case that "little is known on the role played by digital technologies in driving changes in female entrepreneurship" (Ughetto et al., 2020, p.305).

3.2 What are the implications for entrepreneurship of the nature of the digital economy?

In order to answer the question, what is different in the digital economy from an entrepreneurial perspective, it is also necessary to consider the broader context of the digital economy. Here, there are two aspects that are most crucial. The first is the presence of (indirect) network effects (Rysman, 2009), and the second is the implications for business models when "certain costs fall substantially and perhaps approach zero," due to digitaliza-

[8] An example is Amazon Mechanical Turk, which explains on its website that ""Amazon Mechanical Turk (MTurk) is a crowdsourcing marketplace that makes it easier for individuals and businesses to outsource their processes and jobs to a distributed workforce who can perform these tasks virtually. This could include anything from conducting simple data validation and research to more subjective tasks like survey participation, content moderation, and more" (see `https://www.mturk.com`).

tion (Goldfarb and Tucker, 2019, p.3).

Network effects arise when the number of participants in a market affects the value then everyone obtain on that market. There are both direct and indirect network effects, and they can be either positive or negative (Rysman, 2009). The most familiar example of a (positive) direct network effect is possible of a telephone network, where it becomes more valuable to own a telephone the more people are connected to the network. Indirect network effects refer to network economies where the value to the network increases for one side of the market (or platform, as will be discussed below) if there are more users on the other side of the market /platform. For instance, the value of the ride-hailing platform *Uber*, increases for taxi drivers if there are more rider users on the platform (and vice versa).

With indirect networks effects important, demand-economies of scale (as opposed to supply-economies of scale such as in traditional markets) tend to determine how a market or platform will develop – as described by Parker et al. (2016, p.20) "demand economies of scale are the fundamental source of positive network effects, and thus the chief drivers of economic value in today's world."

Digital entrepreneurs therefore tend to put more attention and effort into harnessing positive networks effects. This in turn tends to make intangible capital and communities, including assets that the entrepreneur does not own (as in the case of *Uber* taxis or *AirBnB* apartments) a more critical focus for digital entrepreneurs than more traditional entrepreneurs.

The network effects and digital economy features described above have the consequence of raising the uncertainty and risk of entrepreneurship. Indeed, the environmental in which digital entrepreneurs operates tend to subject to greater uncertainty than most traditional forms of entrepreneurship. One manifestation of this is that digital startups tend at earlier stages to go through fast change and innovation due to the dynamic and uncertain context they face (Ghezzi and Cavallo, 2018). Another manifestation is that due to the unpredictable growth of new digital ventures, there has been an evolution in equity funding - such as the rise of Angel groups of investors (Cavallo et al., 2019). Such investors usually invest their own money – often obtained from one or more successful entrepreneurial exits concerning businesses they (co-)founded themselves – in a portfolio of (digital) startups in pursuit of a return on investment.

Network effects as described depend on digital technologies, and in particular their ability to reduce the cost of storage, computation and transmission of data. More specifically, in their literature review, Goldfarb and Tucker (2019) emphasize the reduction in five distinct

categories of economic costs associated with the rise of digital technologies, viz. (1) search costs, (2) replication costs, (3) transportation costs, (3) tracking costs, and (5) verification costs. "Search costs are lower in digital environments, enlarging the potential scope and quality of search. Digital goods can be replicated at zero cost, meaning they are often non-rival[9]. The role of geographic distance changes as the cost for transportation for digital goods and information is approximately zero. Digital technologies make it easy to track any one individual's behavior. Last, digital verification can make it easier to certify the reputation and trustworthiness of any one individual, firm, or organization in the digital economy" (Goldfarb and Tucker, 2019, pp.3-4).

The reduction of the aforementioned five types of costs to very low levels, and sometimes even (close to) zero, has a number of important implications for the nature of digital economic activity (Goldfarb and Tucker, 2019). Most importantly, it is easier than ever before to adopt and use digital technologies. Firms are also encouraged to do so given that it may benefit their productivity growth (Brynjolfsson and Saunders, 2010; Draca et al., 2009). At the same time, quite some factors are found to enhance or mitigate this relationship – think of firm age, firm size, and the potential for network effects – and thus, not every firm benefits to the same extent, and some not at all. Lower costs due to digitization also provides unprecedented opportunities for (digital) entrepreneurs to create new value by means of innovative business models (Brousseau and Penard, 2007).

4 Digital Platforms and Digital Entrepreneurship

Digital platforms have become one of the most discussed forms of and influence on digital entrepreneurship, as a growing literature attest to. This literature has studied the design and development of such platforms, their social, business and economic impacts, and the regulatory challenges that they pose.

A universally accepted definition of a digital platform is lacking.[10] Similar to traditional platform business models, such as newspapers that bring together readers and advertisers, a digital platform fulfills an intermediate, or matching function, between various users, but in

[9]In case of non-rivalrous goods, increased demand does not affect the supply left for other individu-als. A good example is Netflix, where more views of the movies and series offered by them does not have any effect on the opportunities for other people to also watch these movies and/or series.

[10]As will be pointed out below, the lack of a precise definition of digital platforms makes regulation more difficult.

the digital economy.

Coyle (2017, p.R5) defines a platform as "a business strategy as much as an organization", and many scholars share the idea that digital platforms are both firm and market (Chen, 2019). Generally, digital platforms contain four kinds of participants (who often switch roles or fulfill more than one role at once): the owners of the platform, the producers of content, the customers who consume the content, and the providers of the interfaces between producers, customers and the owners (Van Alstyne et al., 2016). A distinction can be made between one-way digital platforms (such as *Spotify*) and two-sided (such as *Uber*) and multi-sided platforms (such as *Microsoft*) (Litan, 2016). Multi-sided platforms tend to be intermediaries or matchmakers, and often do not even produce their own content (such as Facebook) (Nuccio and Guerzoni, 2018).

Digital platforms have themselves changed the nature of competition in markets, and disrupted many traditional, pipeline business models. Oft-quoted examples are of Amazon upending traditional booksellers such as Borders, or Netflix upending traditional video-rental firms such as Blockbuster. This has led Van Alstyne et al. (2016, p.57) to warn that "When a platform enters a pipeline firm's market, the platform almost always wins." While digital platforms are, for reasons that will be explained below, prone to dominate their market, they lead to further disruption through enabling 3rd party entrepreneurs to start new digital ventures on the platform. For this reason, Litan (2016, p.581) considers digital platforms as "launching pads for new and potentially disruptive firms".

Thus, digital platforms are an essential phenomenon in digital entrepreneurship. As it was defined in section 2, digital entrepreneurs pursue opportunities to produce and trade in digital artifacts on platforms, and/or create these platforms. In the remainder of this section these two ways of using digital platforms for entrepreneurship will be discussed.

4.1 Establishing and Growing a Digital Platform Firm

First, consider the entrepreneurial act of creating and growing a digital platform. In the light of the fact that digital platforms offer, due to network economies and demand economies of scale, unparalleled scope for fast and rapid scale-up, the establishment of a new digital venture that can become a global digital platform has become somewhat of the *ne plus ultra* of digital entrepreneurship. Both entrepreneurs and venture capitalist have come to chase after the next *Facebook* or *Netflix*. Start-up accelerators aim explicitly to create the next

Unicorn, a start-up that is valued in excess of a billion dollars. The scaling up of digital platforms are indeed often fast and their market valuation exorbitant. For example, Chen (2019, p.5) describes that "social media platform ByteDance and ride-hailing platform Didi Chuxing from China are valued more than the GDP of many developing countries such as Kyrgyzstan, Uganda and Zambia". Scaling up a digital venture to become a billion-dollar digital platform is, notwithstanding the prominent examples already mentioned, extremely difficult. As Sussan and Acs (2017, p.68) pointed out, "Almost everyone who tries to build one fails."

The central challenge facing a digital entrepreneur in establishing and growing a digital platform firm is to maximize positive indirect network effects. This is both a source of success and failure, since, as Rochet and Tirole (2003, p.990) pointed out, "Platform owners or sponsors in these industries must address the celebrated 'chicken-and-egg problem' and be careful to 'get both sides on board.'" Typically, digital platform owners will attempt to grow the number of users on the platform through actively building a community, encouraging collaboration between different users, maintain good communications, work on extending connections and perhaps most importantly, curating the content of the platform – the so-called 5 C's model of network growth. The 5 C's are dependent on digital technologies such as rating and recommendation systems, and matching algorithms (Sutherland and Jarrahi, 2018). If successful, this can lead to a positive feedback loop between customers on both sides of the platform. In this feedback loop, the extent of data that platform collect from their customers will determine their success and competitiveness – the more data, the better they can predict customer behaviour, refine matching algorithms, and hence tailor their services and product to the need of customers (Nuccio and Guerzoni, 2018). As such, the development and use of data analytical tools, including artificial intelligence (AI), are key tools used by digital entrepreneurs.

A second, and related challenge that digital entrepreneurs face in the establishment of a successful digital platform, is that it requires significant outlays on fixed costs. It is therefore mistaken to assume that because many costs in the digital economy has fallen significantly (see section 3) and that many scholars and policy makers describe digital entrepreneurial entry as easy, that there are not fundamental costs to incur. For instance, Nuccio and Guerzoni (2018) reports that Google's capital expenditure peaked at US$10,9 billion in 2016.

The combination of high fixed costs in operation, and positive indirect network effects means that if digital platforms can obtain large numbers of users (and hence generate big data), their

business models can over time become highly profitable, due to the fact that marginal costs of extending their service to a new customer or user is very low. This combination of high fixed costs and low marginal costs results in successful digital platforms often becoming very profitable, or of holding in promises of high profit growth in the future. They can become superstar firms. It also accentuates the first-mover advantage of establishing a platform (Nuccio and Guerzoni, 2018) which makes it very difficult for new entrants. Litan (2016) therefore argues for a new role for antitrust policy to ensure adequate competition both on platforms and between platforms.

4.2 Competing on Digital Platforms

Digital entrepreneurs pursue opportunities to produce and trade in digital artifacts on platforms, and/or create these platforms. In the previous sub-section, the creating and growth of digital platform firms were discussed. This sub-section discusses some of the key challenges and features of digital entrepreneurship on digital platforms. The growth and dominance of digital platforms in the digital economy has come to mean that "ultimately most firms will have no choice but to do business on somebody else's digital property, and to agitate for better terms if the owner gets too greedy. Call it the class struggle of platform capitalism" (The Economist, 2016).

This has both positive and negative consequences for digital entrepreneurship. Some would even argue that the negative implications of platform capitalism outweighs the positive consequences. While this issue cannot be adjudicated in this paper, some of the positive and negative consequences can be highlighted.

On the positive side, participation on digital platforms have offered many opportunities for micro-entrepreneurs (Howcroft and Bergvall-Kareborn, 2018). This includes opportunities for digital artifact creation, most often app development as on Apple's iOS platform or Google's Android platform. For app developers the platform is a marketplace to connect with the owners of computing devices such as mobile phones, tablets and computers (Van Alstyne et al., 2016). By 2015 there were already 1,4 million apps in the Apple AppStore, generating revenue estimated at US $ 25 billion for the developer-entrepreneurs (Van Alstyne et al., 2016). By 2019 this stood at 1,8 million. At the end of 2019 the major app platforms offered over 5,5 million apps[11] , namely, Google Play (2,57 million apps), Apple Appstore

[11]Source of data: Statista at: https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/

(1,84 million apps), Windows Store (669,000 apps) and the Amazon App Store (489, 000 apps).

Further on the positive side, digital platforms are also judged to hold out promise for (recombinant) innovation by entrepreneurs, as a result of the possibilities of recombining digital artifacts which are "open, reprogrammable, and accessible by other digital objects" (Parker et al., 2017, p.256). To harness this possibility, many of the largest digital platforms such as Apple, Google and Microsoft have shifted part of their innovation outside of the core firms to developers (many micro-entrepreneurs) in its platform ecosystem, and provide their own platform resources[12] and advantages to these entrepreneur-developers (Parker et al., 2017).

How various digital platforms govern their ecosystems to facilitate and control digital entrepreneur developers to create and benefit from new apps depends on the platform's strategic model. In particular, whether it emphasizes openness (and permissionless innovation) or control. In this regard Parker et al. (2017, pp.256-257) contrast the governance models of Apple iOS and Google Android, showing that while Google Android is more open and thus generate more app development and innovative activities by micro-entrepreneurs, the more controlled Apple iOS environment is more profitable, but perhaps less innovative. This points to the fact that a key strategic decision facing platform owners is how open they should be, and how to manage their openness in order to minimize negative (demand) externalities and bad behaviour, such as scamming and spamming (Van Alstyne et al., 2016; Coyle, 2017).

Regarding the negative effects of digital platforms on entrepreneurship, a major fear is that as digital platforms gain market power that they will drive traditional small businesses out of the market and will reduce the traditional and typical sources of work. Given these concerns,Howcroft and Bergvall-Kareborn (2018, p.24) is of the opinion that "the claim that crowdwork is nurturing enterprise is highly questionable".

Another fear is that entrepreneurs on digital platforms may be especially prone to role conflict, which could increase their stress and reduce their performance (Nambisan and Baron, 2019). The reason for role conflict on digital platforms stems from the governance by the platform owner which could conflict with the goals of the individual entrepreneurs. For instance, the platform owner faces the incentive to increase the number of users on the platform and may engage in actions to increase this which may be detrimental to the revenues of independent entrepreneurs operating on the platform – for instance in forcing

[12]Such platform resources include System Development Kits (SDKs), Application Programming Interfaces (APIs), code libraries, templates, and Standard License Agreements (SLAs) (Parker et al., 2017).

price discounts. As such the issue is that digital entrepreneurs operating on a platform may lose some independence (Nambisan and Baron, 2019).

Finally, digital platform entrepreneurship not only affects digital entrepreneurship (on and between platforms) but also traditional entrepreneurship. Again, the effects are both positive and negative. One positive effect is that many traditional firms are benefiting from digital the accumulation of data by digital platforms. Examples include the production of wearable devices (e.g. *Fitbit*) which increase in value (consumer surplus) through connection to software driven by growing volumes of data on the cloud. The most significant is probably the impact of competition from digital platforms and on-platform entrepreneurs on traditional firms. Burtch et al. (2018) study how digital platforms affect local entrepreneurial activity – particularly the entry and exit of entrepreneur. They start from the possibility that digital platforms may facilitate entry, for instance by making work more flexible and reducing entry costs; but also, that they may reduce entry due to offering alternatives to self-employment on the gig labor market. In essence, digital platforms may raise the opportunity costs of entrepreneurship. They test this using data on the effect of *Uber* (the ride-hailing platform) and P*ostmates* (an on-demand delivery platform) on crowdfunding campaign launches on Kickstarter (a crowdfunding platform). Taking the rate and volume of crowdfunding campaign launches as a measure of entrepreneurship, they find a "negative and significant effect on crowdfunding campaign launches and thus local entrepreneurial activity, after entry of Uber or Postmates..." and that "gig-economy platforms predominantly reduce lower quality entrepreneurial activity, seemingly by offering viable employment for the unemployed and underemployed." (Burtch et al., 2018, p.5497).

In conclusion, digital platforms have become one of the most discussed forms of and influence on digital entrepreneurship. Digital entrepreneurs create and grow digital platforms, and they also participate on digital platforms. These kinds of digital entrepreneurship have become substantial and significant, with impacts extending to the non-digital, traditional entrepreneurship sphere. There is a growing concern that digital platforms are not all that good news for entrepreneurship (Howcroft and Bergvall-Kareborn, 2018). Others have however argued that there is not yet sufficient research on the negative implications of digital platforms on entrepreneurship (Nambisan and Baron, 2019). Clearly, this is an avenue for future research.

5 Supporting and Regulating Digital Entrepreneurship

A third broad question that the emerging field of digital entrepreneurship has tried to answer is, how can digital entrepreneurship be fostered and regulated? Here, research has focused on two aspects: how to understand, describe and strengthen digital entrepreneurial ecosystems, and how to regulate digital entrepreneurship, in particular given the tendency of network effects and demand economies of scale to lead to winner-take-all outcomes and market dominance by a few superstar firms. In this section, these two aspects will be discussed.

5.1 Supporting Digital Entrepreneurship Ecosystems

There are many definitions of entrepreneurial ecosystems (EEs). According to Ács et al. (2014, p.479) an EE refers to the "dynamic institutionally embedded interaction between entrepreneurial attitudes, abilities and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures". It consists of "sets of actors, institutions, social networks, and cultural values that produce and sustain entrepreneurial activity" (Roundy et al., 2018, p.1). According to Stam (2014, p.1) EEs are "interdependent set of actors that is governed in such a way that it enables entrepreneurial action. It puts entrepreneurs center-stage and emphasizes the context by which entrepreneurship is enabled or constrained".

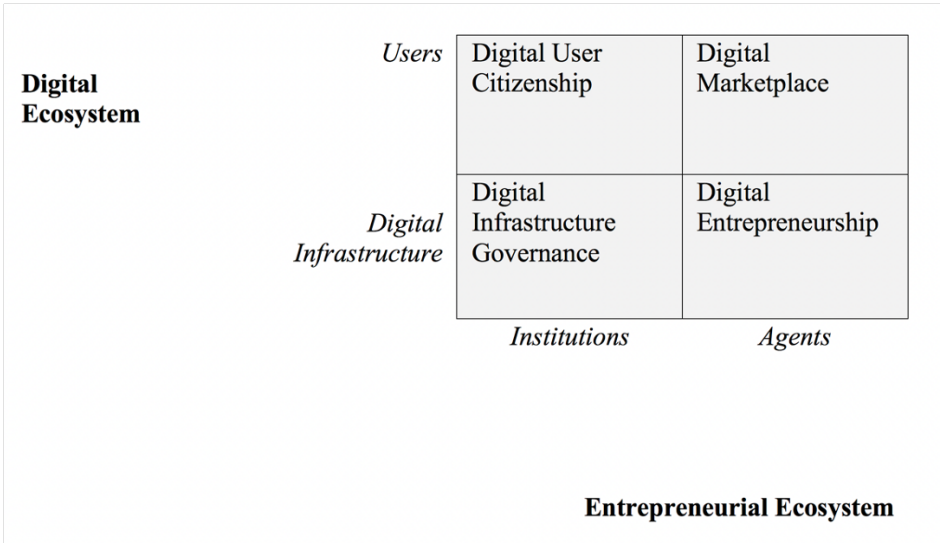
Current thinking in entrepreneurship support policy is that governments and other agencies should not try to identify and support potential individual high-growth enterprises (pick winners) but rather provide a broad environment – ecosystem – that is conducive for the emergence of such firms. Modern entrepreneurship support policy is thus aiming to strengthening entrepreneurial ecosystems.

In the case of digital entrepreneurship, similar considerations apply – hence, support policies for digital entrepreneurship need to understand the digital entrepreneurship ecosystem (DEE). The DEE is however more complex: this is because given that the production of and trade in digital artifacts are central in digital entrepreneurship, there is also a digital ecosystem to contend with. The digital ecosystem is "a self-organizing, scalable and sustainable system composed of heterogeneous digital entities and their interrelations focusing on interactions among entities to increase system utility, gain benefits, and promote information sharing, inner and inter cooperation and system innovation" (Sussan and Acs, 2017), following Li et al. (2012, p.119). The digital entrepreneur operates in the DEE which is at

the intersection of the entrepreneurial ecosystem (EE) and the digital ecosystem.

As described by Sussan and Acs (2017) the DEE comprises of Digital Infrastructure (DI), users of digital infrastructure and digital artifacts, entrepreneurial agents, and the institutions (rules of the game) that shape their interaction. Based on these components, they provide a conceptual framework from which to approach understanding and researching the digital entrepreneurial ecosystem (DEE). Their framework can be explained with reference to Fig 1.

Figure 1: *The Digital Entrepreneurial Ecosystem*



Data source: Sussan and Acs (2017, p.63)

In Fig 1, digital user citizenship refers to "the ability to participate in society online" (Sussan and Acs, 2017, p.64). Users can be either agents in the digital economy or customers. The digital ecosystem includes digital infrastructure, the regulations and protocols underpinning data privacy and security, and digital talent (Chen, 2019).

Support for the DEE therefore requires an appropriate combination of support for the digital ecosystem as well as for the entrepreneurial ecosystem, and understanding how elements of each interact. For instance, providing strengthening the institutions underlying the entrepreneurial ecosystem, for instance by securing data privacy and data ownership rights, will have implications for the development of digital infrastructure, and for the way in which agents and users interact in the digital marketplace. Much more research is needed in these areas.

5.2 Regulating Digital Entrepreneurship

The unique regulatory challenges posed by the emergence of digital entrepreneurship are due to the characteristics or features and consequences of digital infrastructures and entrepreneurial ecosystems interacting. This sub-section will explain these features and indicate the conundrums they pose for regulators.

The first challenge is how to define digital entrepreneurship, and moreover how to define a digital platform for the purposes of regulation. As was argued in section 2, digital entrepreneurship is distinctive due to the centrality of digital artifacts and their influence on the process of entrepreneurship.

In the case of traditional entrepreneurs who sell goods online or (for example) drive a taxi as part of the Uber ride-hailing platform, they do not produce or sell digital artifacts and merely uses a digital artifact (e.g. the Uber app) to facilitate a part of their business. The owners of the Uber platform, however, are digital entrepreneurs, as they have created a digital artifact and used this to establish and grow a firm. Regulating the Uber platform as distinct from regulating the self-employed drivers is a challenge. The Uber example given here is representative of the challenge. For instance, while the self-employed drivers are competing against each other, Uber may or may not be a monopoly, or it can become a monopoly if it should drive competitor taxi firms out of the market. Therefore, the difficulty that the regulator face is to determine whether a digital platform firm is a monopolist or not?

If prices are considered, these mostly do not show signs of price collusion of mark-up pricing, due to the tendency of consumer prices to decline in the digital economy (see section 3). If market share is considered, it begs the question in which domain, since many digital platforms have spread their brand image to cross domains, e.g. Google provides not only a search engine but also advertising space, translation services, and even driverless cars, Facebook not only connectivity but finance and a marketplace, and Amazon do not only sell books but also own food stores (Van Alstyne et al., 2016; Rossotto et al., 2018).

A second major challenge that regulators face is precisely due to this domain crossing (or "shape shifting" or "envelopment"). Shape shifting allows the digital platform to benefit from "regulatory arbitrage". An example is that of the already mentioned Uber entering into taxi transportation but without being subject to the regulations applying to more traditional taxi firms (Chen, 2019). In essence, shape shifting by digital entrepreneurs makes it difficult

to define a digital platform. The lack of clear definition, compounded by the speed at which digital entrepreneurs can act and metamorphose, means that digital platforms can occupy "legal grey areas" (Coyle, 2017, p.R6) and that digital entrepreneurs may outrun the regulator (Sussan and Acs, 2017).

A third major challenge that regulators face with respect to digital entrepreneurship and digital platform entrepreneurs is due to their substantial intangible assets, including their relative intangible physical presence. Digital entrepreneurs reside in digital space and may not be tied to any one physical location. This, and the complexity in defining and delineating a digital platform as was discussed, allows digital platforms to avoid taxation through selection of jurisdiction for reporting profits and use of transfer pricing (Chen, 2019; Nuccio and Guerzoni, 2018; Rossotto et al., 2018).

A fourth challenge for regulators is due to the nature and extent of innovation by digital platform and their entrepreneurs. Their innovation has been seen as being a way to attain and ensure market dominance. Chen (2019) explains that this can be through proactive acquisition of possible rivals (i.e. Merger and acquisition activity substitute for R&D), and /or by copying a new rivals product or service – also described as market consolidation (Rossotto et al., 2018). Other strategies could involve patent thickets and other defensive innovation strategies. The problem that regulators face in regulating this as anti-competitive behaviour is that antitrust authorities generally considers innovation a mitigating behaviour of firms that enjoys monopoly profits. As Nuccio and Guerzoni (2018, p.317) point out, antitrust laws "punish not market power per se, but its abuse." Abuse would typically be taken to manifest in higher prices, discriminatory prices, and large mark-ups or margins without significant innovation. As few of the global digital platforms seems guilty of these abuses and offer in fact considerable consumer surplus as well as engage in innovation,[13] they conclude that in the case of digital platforms, that the consequences of high levels of concentration may not be that harmful (Ibid, p. 323).

A fifth challenges that regulating entrepreneurship poses is that abuse by digital entrepreneurs may be taking different forms that the above traditional monopolistic market power abuses. New forms of abuse include data privacy and security violations, consumer and voter manipulation. As these abuses relates to data, it has focused scrutiny on the ability of digital platforms to accumulate big data. What is the implication when data becomes a valuable commodity? Should and could data be protected and shared? A major challenge is that

[13]Nuccio and Guerzoni (2018, p.324) argue that "only extraordinary efforts in RD allow incumbents to stay ahead of competitors and potential entrants."

"the market power obtained by access to or the holding of vast amounts of data connected to algorithms may create barriers to entry for second movers" (Lundqvist, 2017, p.713). Other challenges in this regard include limiting cybercrime, data misuse and a general lack of trust in the digital economy (Chen, 2019).

A further form of abuse by digital entrepreneurs include the possible exploitation of workers on labor (gig) platforms. Growing concerns are been raised in this regard. This is because the gig economy has grown exponentially at the same time that there has been rising concern over the exploitation of workers on these platforms. Exploitation of workers is a concern as these workers are unregulated, they are not employees but independent contractors, they do mostly micro-tasks (gigs) at low rates of remuneration, their performance evaluation and management is often subject to "algorithmic control" and they mostly have little legal recourse against poor labor practices and working conditions (Howcroft and Bergvall-Kareborn, 2018).

Finally, a challenge that is perhaps not so much a regulatory challenge as a challenge of global governance and the outcome of the new challenges to regulation that digital entrepreneurship poses, is the existence and widening of digital gaps. While digital technologies can in principle diffuse instantaneously, practice has seen very obstacles to the diffusion and moreover the adoption by digital technologies that supports digital entrepreneurship. UNIDO (2019, p.1) for instance found that with respect to advanced digital production (ADP) technologies, that the use and adoption of these "remains concentrated globally [...] ten economies – the front-runners – account for 90 percent of all global patents 70 percent of all exports associated with these." Given digital gaps, concerns have been voiced about the dangers of "data colonialism" by the actions of global platform firms in emerging economies (Rossotto et al., 2018).

In conclusion, while the regulatory challenges posed by digital entrepreneurship are substantial, the generation of large volumes of data on entrepreneurs through and on the digital economy, can in fact help authorities and support agencies in their governance functions. The digital footprints and digital shadows casts by entrepreneurs online will allow matching scarce resources with entrepreneurs of high ability who are more likely to succeed, has been lack of information. Indeed, as far as entrepreneurial success is concerned, the current consensus is still that it is largely unpredictable. With large datasets becoming available, a number of scholars have recently argued that it will become easier to predict success and thus tailor support and other governance measures (Menon, 2018). Ng and Stuart (2016) for example, taking the career histories of two million entrepreneurs and using machine

learning algorithms, classify entrepreneurs into "hobos" and "highflyers", with hobos being "self-employed entrepreneur who often depart relatively low-wage jobs and may further sacrifice income for the autonomy of self-employment" and highflyers who "exit high-wage, high-advancement careers to launch high potential companies" (p.5). This is a promising line of future research that offers the potential to improve the allocation and efficiency of public support policies for all entrepreneurs.

6 Concluding Remarks

The main purpose of this paper was to provide an overview of state-of-the-art knowledge in the field of digital entrepreneurship research. With this goal in mind, a selection of latest theories and empirical evidence have been discussed with regard to a number of key research questions that are currently being pursued in this field.

The paper started by defining the main concepts in the field. This is important, since it is not so clear-cut how to pinpoint digital ventures or digital entrepreneurs. In essence, digital entrepreneurship refers to the pursuit of opportunities based on the use of digital technologies. Digital entrepreneurs produce and trade in so-called digital artifacts on digital artifact "stores" (or platforms) or they create these digital platforms themselves.

The paper then moved on to discussing the most important effects of the nature of the digital economy on entrepreneurial activity. The various impacts of digitization on entrepreneurship that have been discussed clearly illustrate why the digitization and digitalization of (mostly developed) economies has led to serious and lasting changes in the entrepreneurial landscape. These changes are likely to accelerate as a result of the COVID-19 pandemic.

The paper also described one of the most discussed forms of digital entrepreneurship, namely digital platforms. Digital entrepreneurs create and grow such platforms or compete on it. The presence and impact of digital platforms has become substantial, with implications extending to traditional, non-digital entrepreneurship. Digital platforms come with both positive and negative consequences, but more research is needed on any of these issues to clearly judge which ones out-weigh the others.

Finally, it is of the utmost importance to understand the main features of the context in which digital entrepreneurs typically operate. For this, the conceptual framework of the digital entrepreneurial ecosystem presented in section 5.1 can be of help. However, future

research should still focus on testing the various propositions that have been derived from it. No matter how well policymakers' understanding, regulatory challenges posed by digital entrepreneurship remain substantial.

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