

# **Digitization in the Market for Entrepreneurial Finance: Innovative Business Models and New Financing Channels**

*ETP Special Issue*

*Fabio Bertoni*

SKEMA Business School—Univ. Côte d'Azur

*Stefano Bonini*

Stevens Institute of Technology, School of Business

*Vincenzo Capizzi*

Università del Piemonte Orientale

*Massimo G. Colombo*

Politecnico di Milano, Department of Management, Economics, and Industrial Engineering

*Sophie Manigart*

Ghent University and Vlerick Business School

*In memory of Mike Wright*

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This paper and the entire Special Issue are dedicated to the memory of Mike Wright, Imperial College who left shoes too big for us to fill.

## **Abstract**

Digitization dramatically changes entrepreneurs' business models and their implications for the type and timing of finance that support them. It creates new financial channels (including crowd-investors and initial coin offerings) that complement, and in part substitute, traditional entrepreneurial finance intermediaries. These new players offer a broader set of opportunities to raise funds for both new and established ventures, but also raise concerns over bubble formation, fraud, cybersecurity, and unintended consequences for investors. Digitization also changes the way in which traditional investors work through artificial intelligence and machine learning.

Despite the profound impact of these innovations on the entrepreneurial ecosystem, we still have limited knowledge of their functioning, of the interactions between companies and financial backers, and of the potential conflicts among financial backers with diverging goals and interests.

This special issue sheds light on this phenomenon, focusing on the economic, cultural, and regulatory determinants of fintech development, and on the new forms of information production and processing engendered by digital entrepreneurial finance. In this editorial we provide a general overview of digitization in the market for entrepreneurial finance, illustrate how the different articles in the special issue contribute to advance our knowledge on some key issues, and identify promising avenues for future research in this field.

## 1. Introduction

Digitization, the process of creating a digital representation of a product or a process, is probably the most important transformation of the global economy since the industrial revolution. Entrepreneurial business models are changed as inherently digital products and services are designed to compete on a global scale (Monaghan et al., 2020). Scalability and growth disproportionately reward founders and investors, igniting a cycle of increased attention by traditional and non-traditional investors.

Taking a financial industry perspective, digitization is disrupting the traditional financial services sector, including banking and insurance, driven by a new breed of entrepreneurial companies. These fintech and insurtech companies aim to either offer a better experience to the end customer, including offering totally new services, or improve the efficiency of their delivery of financial services (D'Acunto et al., 2019; Bollaert et al. 2021). Payment systems have started being digitized decades ago with the widespread adoption of credit and debit card. Yet, these early developments did not truly challenge the strength of the incumbent players' monopolistic rents and largely kept the industry unaltered. With digital transformation, the financial industry has seen radical changes in all areas: smaller more agile players, pioneered by PayPal, have brought game-changing technologies to the payment market. Innovative start-ups have broken the seemingly unconquerable domain of currency exchange. Ingenious players have started using artificial intelligence (AI) and machine learning (ML) to provide tailored management services and advanced trading tools

in areas previously simply non existing such as for instance bond trading. Finally, the very essence of finance and banking – lending and capital provision – has been similarly and deeply affected by this phenomenon (Cong and He, 2019; Chen et al., 2019; Thakor, 2020). Banks, while still subject to regulatory supervision, have reacted to the threat of newcomers by venturing into previously unexplored territories (Buchak et al., 2018).

While billions of dollars have been invested in the fintech industry around the globe, there are significant gaps in our understanding of their specific role, and of their impact on customers, other entrepreneurial companies, and incumbents, and about what drives their success (Goldstein et al., 2019; Allen et al., 2021). These are critical questions especially in the light of the COVID-19 pandemic that has massively hit the global economy, challenging traditional sources of start-up capital (Howell et al., 2020) but also spurred digitization at an unprecedented rate.

Second, digitization also alters the type and timing of finance that support entrepreneurs. It has opened alternative financing channels like crowdfunding and initial coin offerings (ICOs) which now complement traditional venture capital (VC) and business angel (BA) funding. This fast and disruptive process has led to a new environment in which the proliferation of innovative funding sources for new ventures has substantially increased the complexity of the start-up financing eco-system. Equity underwriting is considerably simplified and disintermediated (Hervé & Schwienbacher, 2018), offering start-ups the opportunity to obtain finance from a crowd of small retail (i.e., non-professional) investors. Moreover,

alternative financing channels provide start-ups with a different type of value added (e.g., market test) from the one offered by VC and BA, and funding opportunities that might be particularly useful when other sources are not available (Walthoff-Borm et al., 2018).

Finally, digitization also rejuvenates traditional entrepreneurial finance intermediaries like BA and VC investors, e.g., by offering new target search technologies or new methods to assess risk, which is now data driven and significantly more granular (Bartlett et al., 2019).

Within this context of radical change in the entrepreneurial finance ecosystem (Sussan & Acs, 2017), this special issue aims at improving our understanding of the impact of digitization on the market for entrepreneurial finance. We explore how digitization has spurred fintech entrepreneurship, developed new types of players in the entrepreneurial finance ecosystem, and transformed traditional entrepreneurial finance channels. We elaborate the overarching framework of analysis of the special issue in the next section, and discuss the specific contributions selected for this issue in Section 2.

## **2. A framework of analysis**

### **2.1. Fintech and new providers of financial services**

The process of digitization has found ideal grounds in the financial services industry, giving rise to the notion of fintech sector. Broadly defined, fintech refers to companies leveraging on technological solutions to expand and improve the offering of financial services at large. Fintech is a global phenomenon. In the US, VC investments in fintech grew from \$7.8 billion

in 2017 to more than \$20 billion in 2020 (NVCA, 2021). China is home to some of the most highly valued fintech companies in the world (e.g., Ant Financial, JD Digits, and Du Xiaoman Finance). In Europe, London (UK), Berlin (Germany), Amsterdam (Netherlands) and Stockholm (Sweden) are among several active hotspots of fintech activity (e.g., Adjen, Revolut, Mollie, Klarna). And interestingly, fintech companies are also revolutionizing financial systems in developing countries such as India, which is home to several fintech unicorns (e.g., Paytm, Zerodha), and Africa, where mobile payment and banking systems are boosting financial inclusion (e.g., Paystack, Paga). The size of the underlying markets and niches and the possibility of taking advantage of slow responses by incumbents have led to an exponential rise of fintech deals. Despite the pandemic slowdown in the first half of 2020, fintech deals almost doubled in just 4 years: global venture capital activity in fintech was \$42.3bn (+81% on 2017), global private equity activity in fintech was \$2.7bn (+145% on 2017), and global M&A activity in fintech was \$61.3bn (+77% on 2017) (source: KPMG, 2021).

While this growth has been largely welcomed as a much-awaited channel through which oligopolistic rents that reduced efficiency for the consumers are weakened (e.g., Robinhood, a commission-free investment platform that attracted the largest venture capital fintech investment in 2020), its distribution is extremely heterogeneous and very little is known about the consequences of such innovations.

For example, after decades of relative stagnation, the multi-trillion USD financial advisory market has been abruptly shaken by the emergence of robo-advisors. Robo-advisors are expected to manage more than \$2 trillion of assets by the end of 2020 and more than \$16 trillion by 2025 (Deloitte, 2016). New entrepreneurial companies such as Betterment, Nutmeg or FutureAdvisors have raised billions in VC financing and have transformed the approach to financial advisory by introducing rapid communication, AI and ML tools and, importantly, by and large automating a process that was inherently personal. Stolper and Walter (2019) and Foerster et al. (2017) have shown that human-managed financial advisory is profoundly, for good or for worse, influenced by the affinity between investors and advisors, measured as homophily. Robo-advisors remove the human component from the equation. Is this a harmless change? Robo-advice mitigates some investment biases (Rossi and Utkus, 2020) and, at least to some extent, democratizes access to financial investments (Reher and Sokolinski, 2020). However, robo-advice could also change investors' exposure to risk: Loos et al. (2020) find that after joining a robo-advising service, investors hold more risky assets but have better diversified portfolios across regions and industries. Changes in the behaviour of consumers of Fintech services such as consumer lending (Affirm) and trading (Robinhood) have also been documented. In aggregate this evidence indicates a compelling need to investigate the - intended and unintended - effects and consequences of such transformative processes in finance.

## **2.2. New channels for entrepreneurial finance**

The rise of alternative financial channels is probably the most visible outcome of the digitalization of entrepreneurial finance ecosystem. The last ten years, we have witnessed the emergence of equity crowdfunding, peer-to-peer (P2P) lending, and ICOs, which have profoundly changed the entrepreneurial finance ecosystem, offering a more granular sequencing of capital provision (Bonini and Capizzi, 2019; Block et al., 2018). Excluding China, the volume of alternative financial markets grew from \$89 billion to \$91 billion in 2019 (+3%), and to \$113 billion in 2020 (+24%) (Cambridge Centre for Alternative Finance, 2021). China, which represented a substantial portion of the global alternative finance market until 2018, has instead seen a considerable slowdown following the introduction of stricter regulation: the Chinese market, which, accounted for 48% of the global volume in 2019, is only 1% of the global volume in 2020 (Cambridge Centre for Alternative Finance, 2021).

Equity crowdfunding involves the sale of firms' equity shares through an online platform. Its global volume was \$1.5 billion in 2020, which is 15% of the total seed and venture stage equity investments (Cambridge Centre for Alternative Finance, 2021). P2P lending matches crowd of lenders with borrowers who are seeking loans through an online platform, and is still the largest type of global alternative financial market, despite the significant slowdown due to new regulation introduced in China (Cambridge Center for Alternative Finance, 2021).

The growth of these alternative financial channels has been made possible by the



introduction and diffusion of digital platforms that have dematerialized and streamlined the process of distributing information, accessing investors, transferring securities and making payments. The spectacular rise (and partial decline) of ICOs, whose global volume (reflected in ICO proceeds) increased from \$7 billion in the 2017 up to \$20 billion in 2018 (PWC, 2020), and then down to \$3 billion in 2019 (Haffke and Fromberger, 2020) has clearly indicated the possibility of a complete digitization of the process of not only funding but also of developing a company in a decentralized setting. With an ICO, entrepreneurs have been able to overcome these boundaries cutting out intermediaries and regulators alike and directly catering to individual investors. Yet, this increased complexity also poses significant challenges in selecting the optimal source of financing, in matching investors with companies and in reaching the broadest possible investor base.

### **2.3. The transformation of the “traditional” entrepreneurial finance industries**

A similarly relevant question points at the consequence of the digital transformation of traditional entrepreneurial finance providers. AI and ML have vastly enriched investors' decision-making practices, resulting not only in faster decisions but also in more accurate and complete analysis based on a wider set of information, even when this information has a degree of structure and is rapidly changing (Jordan & Mitchell, 2015; Thakor, 2020).

AI-driven platforms, for example, help venture capital funds or angel investors scout opportunities and select the most promising deals, as shown by the examples of SocialCapital and InReach Ventures that have largely automated the process of screening

and due diligence. The adoption of AI in entrepreneurial finance are accompanied by significant ethical, regulatory, and economic problems, however, that call for further scrutiny.

### **3. Key questions**

In this special issue, we set to provide much-needed evidence on digitization and the market for entrepreneurial finance. We focus on some open questions with far-reaching consequences on the ongoing transformation of the entrepreneurial finance ecosystem and its future growth trajectory. In particular: how the availability of venture capital and credit markets in affects the development of fintech ventures across different countries; the interdependencies between country-level regulation of digital finance channels, with special reference to ICOs; the change in the boundaries of fundraising following the introduction of blockchain currencies; the disrupting role of peer-to-peer lending in replacing traditional banks; the rising role of crowd-funding platforms as digitally distributed information discovery mechanisms; the automation of investment decision in early stage financing through ML selection models; and the link between entrepreneurs' human capital and the innovativeness of venture capital-backed high-tech start-ups.

In the following we will present a more detailed overview of each topic as how papers included in this special issue contribute to its understanding.

#### **3.1. Fintech and start-up formation**

The exponential growth of a technology-fueled industry that was essentially non-existent before the global financial crisis, raises several interesting questions about a more general topic: the institutional determinants of startup formation and the development of entrepreneurial industries (Shane, 2008). Fintech startups are not evenly distributed around the globe, and hence we might question how the availability of funding sources for entrepreneurial ventures in a particular region drive the emergence of fintech startups.

One of the key tenets of entrepreneurial finance is that entrepreneurship can benefit from a well-functioning financial market. A substantial number of studies in the literature support the fact that financial markets, and especially the availability of VC and credit, are one of the key institutional factors influencing the quality and quantity of entrepreneurship (Chowdhury et al., 2019; Deloof et al., 2019; Popov and Roosenboom, 2013; Samila and Sorenson, 2011). The literature however also shows that the availability of capital alone is not sufficient to start the virtuous cycle of entrepreneurial finance (e.g., Florida and Smith, 1990), and that it is difficult, if not impossible, for governments to single-handedly kickstart a well-functioning entrepreneurial finance market (see Lerner, 2012).

Kolokas et al. (2021) contribute to this debate by focusing on how the availability of VC and credit in a country has differently contributed to the growth of local fintech start-ups. The starting point of their analysis, and their main contribution to the existing literature on this subject (e.g., Cumming and Schwienbacher, 2018; Haddad and Hornuf, 2019), is that they incorporate and explicitly focus on the fundamental non-linearity of the relationship

between financing and entrepreneurship. This non-linearity derives in part from the complex interaction between formal and informal elements of a national innovation system (e.g., Li and Zahra, 2012), and specifically by the interaction between different types of providers of entrepreneurial finance. But non-linearity also derives from the fact that the norms and practices of entrepreneurial finance investors require a critical mass of investment activity to become fully functional. The authors argue that this “phase transition” is fundamental for VC financing, and it will result in a weaker positive impact of the availability of VC on fintech entrepreneurship in those countries with limited fintech entrepreneurship. In contrast, the norms and practices of banks should expose them less to this externality, limiting the non-linearity.

When looking at the “median country”, the authors find that the relationship between VC availability and fintech entrepreneurship is weaker (stronger) in countries with less (more) fintech entrepreneurship. As expected, these differences are not observed for credit availability. Finally, the authors look at the interaction between VC and credit and find that the two sources of financing are in substitution. This contribution is particularly relevant because the literature tends to be segmented along different sources of financing (Cumming and Johan, 2017; Cumming and Vismara, 2017).

This work raises several additional questions that we hope future research will be able to answer. First, the authors study the interplay between two fundamental sources of financing (VC and credit) for start-ups, but the landscape of financing sources is much broader and

includes both traditional sources such as subsidies, grants, and business angels as well as more recent forms of financing such as crowdfunding and ICOs. The interaction among, and potential non-linearities of, these different sources of financing has not been explored yet. Second, the authors study startup formation at the national level but a more fine-grained level of analysis would be interesting. As mentioned earlier, fintech companies tend to cluster in hotspots, often around existing successful initiatives (e.g., a whole ecosystem of fintech companies has grown around Ant Financial in Hangzhou, China). This is clearly a phenomenon that is not unique to fintech and has a more general interest for research in entrepreneurship and regional studies. Finally, the cases of mobile banking (van der Boor et al., 2014) and shadow banking (Buchak et al., 2018). clearly illustrate that fintech companies not only represent investment opportunities for, but they are also potential competitors of traditional entrepreneurial finance investors (see also Stulz, 2019; Thakor, 2020). To this extent, financing gaps could harm fintech entrepreneurship through the mechanisms described in Kolokas et al. (2021), but they could also provide interesting business opportunities for fintech companies. This makes the relationship between fintech and incumbent investors even more complex and interesting to study.

### **3.2. The boundaries of financing mechanisms**

Advances in digitization have spurred the emergence of ICOs, which has profoundly changed the way in which some start-ups raise capital. This has given rise to the question to which

extent ICOs are eliminating the boundaries of sovereign regulations? On the one hand, the decentralized nature of blockchain-based tokens seems to be incompatible with a specific country's regulation. On the other hand, though, the country of investors may claim rights to impose constraints on investors residing in its territory. The patchy record of transparency of many issuers and a strict crackdown by some countries, the US and China in particular, on ICOs have cooled off this phenomenon in the second half of 2019. However, the COVID-19 pandemic has had a very heterogeneous impact on individual economies across the world and has determined a sharp decline in access to finance for entrepreneurial ventures especially in Europe and the U.S. (Howell, et al., 2020). The disintermediated, direct-financing nature of ICOs has the potential of leading to a comeback of such source of financing for new ventures in an even more digital, post-pandemic environment.

While dealing with the issues of regulation in ICOs may involve revisiting the entire concept of boundaries of the firm, addressing these questions is clearly an urgent priority. To this end Bellavitis et al. (2021) provide a compelling empirical analysis of (a) how regulatory changes may have spillover effects in other countries and (b) how these regulatory spillover effects are different in the short-term versus the long-term. Their results indicate that following a ban on ICOs in China and Korea, other countries have experienced a sudden drop in offerings that however led to an increase in the quality of the offering flow to the market. These results are viewed in the light of an innovative institutional theory of regulatory spillovers, which suggests that regulatory bans in specific countries can have far-

reaching effects in other countries that policymakers need to clearly factor in their regulatory design. In particular, the authors note that “*national regulators and policymakers cannot operate independently in a vacuum without regard to other countries’ policies towards ICOs*”. Differently, in a highly digital world where the boundaries between individual countries’ regulation and financial markets become increasingly porous, policymakers should frame their interventions keeping in mind the inbound and outbound effects on other countries, but similarly be attentive to external regulatory choices as they might reflect in unexpected domestic changes. Similarly, entrepreneurs necessarily may afford – but also need – to take a more holistic view to fundraising that extends significantly beyond their domestic setting.

### **3.3. Information production in equity crowdfunding**

While the first two papers in this special issue analyse how country-level institutions and policy interventions impact how digitization affects the market for entrepreneurial finance, ex et al. (2021) focus on how one particular policy intervention impacts the functioning of equity crowdfunding campaigns. The equity crowdfunding market is fraught with information opacity on the one hand and small, unprofessional investors with limited incentives and/or capabilities to produce information on the other hand (Vismara, 2018a). It hence offers ample opportunities to design practices that alleviate information asymmetries. Cumming et al. (2021) exploit the possibility of the French law to allow a “testing the waters”-policy in equity crowdfunding campaigns, i.e., soliciting non-binding indications of

investor interest prior to filing disclosure material. This policy is prohibited in the U.S.A. because it might induce investors to invest without proper disclosure (Cumming et al., 2021). In contrast, proponents highlight the desirable feature that this practice may increase information production, which might be especially useful in environments where information is opaque, like crowdfunding campaigns. This information may be valuable to actual investors in this campaign but also to the crowdfunding platform managers. They show that individual investors who indicated their willingness to invest 1 EUR in a campaign tend to invest only 0.18 EUR and hence that the initial indication of interest is highly hypothetical, suggesting that the information provided by these indications of interest might be limited. They explain this discrepancy as a “hypothetical bias”, which is a situation whereby “what people say is different from what they do” (Hausman, 2012). This concept is widely used in consumer research. This phenomenon is driven by the fact that in a hypothetical distant context, desirability is driving individuals’ answers but in a real, close situation, feasibility dominates (Liberman and Trope, 1998). Cumming et al. (2021) further show that this hypothetical bias in testing-the-waters situations in crowdfunding campaigns is significantly less pronounced among women but higher among investors living in higher income areas or in areas with higher levels of education, which are hampered by lower levels of social trust, which negatively affects the likelihood of fulfilling commitments. Importantly, despite the high level of hypothetical bias, campaigns that attract a higher initial indication of interest have, on average, a higher probability of success and aggregate



intended and realized investments are quite close. Allowing for testing the waters in equity crowdfunding hence allows to reveal information on the campaign outcome: initial indications of interest are a strong signal of ultimate campaign success, even when they are non-binding. This is consistent with the notion that the crowd can forecast the collective behavior of investors, in line with earlier findings that non-expert investors are good at predicting financial outcomes in financial markets (Jame et al., 2016; Avery et al., 2015). These results are not only important for policy makers to guide them into regulating equity crowdfunding, but also for entrepreneurs and crowdfunding investors.

#### **3.4. Peer to peer lending as a nexus of trust**

What has boosted the growth of alternative financial markets? This is a crucial research question that has somehow been neglected by the extant entrepreneurial finance literature. Indeed, most previous studies have initially concentrated attention on the factors that drive the success of fundraising campaigns, in reward-based crowdfunding (e.g., Mollick, 2014; Colombo et al., 2015; Butticiè et al., 2017), equity crowdfunding (e.g. Ahlers, et al., 2015; Vismara, 2018b), P2P lending (Morse, 2015), and more recently in ICOs (e.g. Fisch, 2019; Giudici and Adhami, 2019). A growing literature has also considered post-campaign outcomes, and notably has investigated whether and under what conditions running a successful campaign in an alternative financial market increases the probability of obtaining finance from traditional channels, especially VC (e.g., Roma et al., 2017; Signori and

Vismara, 2018; Colombo and Shafi, 2019; Buttice et al., 2020). Conversely, the drivers of the diffusion of alternative financial markets have received relatively less attention.

Saiedi et al. (2021) tackles this issue in P2P lending. They consider drivers of the supply of funds (i.e., the lender side), and focus attention on the role of distrust in banks and other traditional financial institutions arising from individuals' perception of these institutions as incapable, unreliable and/or opportunistic. They show that in states where individuals have higher distrust in banks, there is higher participation in funding P2P loans and the amounts committed to P2P loans are greater. Moreover, the positive relation between distrust in banks and the inclination to subscribe P2P loans is stronger for borrowers who reside in areas with limited access to banks and for smaller loans, that presumably are too small for banks.

These results expand our understanding of the motivations of crowd investors. Previous studies have highlighted (extrinsic and intrinsic) "positive" motivations that are related to the expected increase of the personal utility of crowd investors in P2P lending (e.g., Lin et al., 2013). Saiedi et al. (2021) point to a "negative" motivation of P2P lenders, distrust in banks, that reduces their opportunity cost of making a bid to P2P loans.

Their results are also complementary to evidence provided by previous studies that considered the demand side of P2P lending, showing that borrowers view P2P platforms as an alternative to local banks. For example, Tang (2019) provides evidence that P2P platforms operate as substitutes for banks. Butler et al. (2016) find that borrowers located

in areas with poorer access to banks seek loans on Prosper.com at higher interest rates, especially when they are relatively high-risk and seek small loans. These findings again suggest that banks and P2P platforms are viewed by borrowers, especially marginal ones, as substitutes. The results of Saiedi et al. (2021) point to a reinforcing mechanism on the supply side. Indeed, many prospective lenders are attracted to P2P platforms because of their distrust in banks, and these lenders are favourably inclined to finance marginal borrowers.

### **3.5. The automation of investment decisions**

The opportunity to adopt AI and ML algorithms for investment decisions in entrepreneurial finance remains still largely unexplored. Blohm et al. (2021) address this issue by exploring how AI-aided investment decision making compares with investment decisions of business angels (BAs) and angel investment organizations (AIOs), two major providers of early-stage funding (e.g., ACA, 2019, EIF, 2020). Differently from more structured and formal investors such as venture capitalists, BAs are individual investors, typically high net worth individuals investing their own wealth in young ventures and providing portfolio companies also with non-monetary contributions (such as coaching, mentoring, relationship network, reputation). Over time BAs have been increasingly professionalizing more and more their investment practices and some organized themselves in AIOs – also referred to as groups, networks, or clubs, depending on their internal structures. However, BAs and AIOs still tend to base their

investment decisions on heuristics, soft information, and intuition, though honed by experience. This induces cognitive biases – such as local bias, overconfidence, and loss aversion – in their decision making (Tversky and Kahneman, 1974; Huang and Pearce, 2015).

Therefore, Blohm et al. (2021) investigate whether ML can support BAs' investment decisions - especially those of less experienced BAs and those more affected by cognitive biases – to maximize the efficiency as well as the profitability of their investment process. The authors compare the investment returns of a state-of-the-art ML algorithm with the investment returns of 255 BAs who invested via a large angel investment organization.

The first major finding is that, on average, ML-based investment decisions lead to higher early-stage investment returns than those achieved by human BA investors. Second, BAs' decision biases are the reason ML algorithms generally outperform, presumably because the latter are unbiased, in that they do not suffer from cognitive resource limitations when processing and interpreting a large amount of complex data and they are unaffected by possible misjudgements emerging in a human-based decision-making process. This finding emphasizes the role of BAs' human capital as a fundamental decision driver in complex and uncertain contexts, such as investing in the entrepreneurial finance ecosystem. Interestingly, Blohm et al. (2021) found that experienced BAs are able to suppress their decision biases and thereby achieve higher investment performance than ML algorithms. This implies a possible selective human advantage in early-stage decision making. Future research will have

to face the challenge of understanding how to set new and more efficient investment practices leveraging on both the advantages of AI with the strengths of BAs' human capital.

### **3.6. Human capital and innovation**

It is a stylized fact in the entrepreneurship literature that the human capital of start-ups' founders and of the members of their top management teams ("top management quality") stands out as a critical determinant of the creation and success of entrepreneurial firms (Colombo and Grilli, 2005; Mosey and Wright, 2007).

It is well known that venture capitalists and other early-stage investors pay special attention to the top management team quality of private firms before investing in them (Colombo and Grilli, 2005; Bernstein et al., 2017; Gompers et al., 2020). However, there has been relatively little analysis in the literature on the relationship between the top management quality of Vc-backed private firms and their capacity to innovate successfully, therefore boosting the growth of economic and social systems. Chemmanur et al. (2021) use a hand-collected dataset on the characteristics of the top management teams of VC-backed private firms to fill this gap in the literature by empirically analysing two related research questions. First, how does the top management quality of private firms affect their innovation productivity and innovation strategies in the years immediately before going public? The authors make use of various measures of top management quality and relate them to measures of innovation inputs, such as R&D expenses, and measures of innovation outputs such as the

number of patents awarded to firms (quantity of innovation) and the number of citations per patent (quality of innovation), as well as measures of their innovation strategies. Second, how does the market for initial public offerings (IPOs) reward greater innovativeness and various innovation strategies of private firms in terms of the market valuation of their equity (both at the IPO and in the immediate post-IPO secondary market)?

Chemmanur et al. (2021) hypothesize that higher quality management teams hire higher quality scientists and other researchers, invest in more innovative projects, and manage these projects more ably, leading to higher innovation productivity. Consistent with this, the authors show that firms with higher top management quality are associated with higher innovation productivity in their pre-IPO years. The above relationship holds for measures of input to innovation (R&D expenses) and for measures of innovation output such as the number of patents (innovation quantity) and citations per patent (innovation quality). Further, the empirical analysis shows that firms with higher quality top management teams are more likely to produce explorative rather than exploitative innovations and are more likely to hire higher quality inventors. Finally, as for the second research question, the Authors find that the financial market rewards firms with greater pre-IPO innovation productivity and with explorative rather than exploitative innovation strategies with higher valuations (both at IPO and in the immediate post-IPO equity market).

#### **4. Discussion and Conclusions**

The disruption that digitisation is causing to financial intermediation opens a number of key questions on public welfare, financial inclusion, discrimination, cybersecurity, and regulation (Allen et al, 2021; Bollaert et al, 2021; Goldstein et al. 2019). Even if we restrict the analysis to the relatively narrower field of digital entrepreneurial finance, the challenges and opportunities for researchers are enormous.

First, as suggested by Farag and Johan (2021), new forms of intermediation in entrepreneurial finance can give us a new way of looking at central themes in corporate finance from new angles. New players differ in the way they produce and process information, which creates opportunities for researchers. This is for instance the case with crowdfunding (Le Pendevin et al. 2021), where the flow of information between firms and investors is much easier to observe and quantify than in other entrepreneurial finance settings. Distributed ledger technology can also provide an unparalleled level of transparency over customer engagement and investor transactions in startups, which opens interesting opportunities to research the effects of financial events (such as mergers and acquisitions and venture capital rounds) on operating activities.

Second, our understanding of the relations between digital and traditional financial channels for entrepreneurial ventures is still rather limited. Some previous studies show a positive association between digital and traditional financing sources (Drover et al., 2017). Other studies highlight boundary conditions under which access to digital financial channels makes the receipt of follow-on financing from professional investors more likely (Buttice et al. 2020;

Roma et al. 2017). In this special issue, Saiedi et al. (2021) suggests a substitutive relation. We need further research adopting more fine-grained lens, that distinguish between different types of alternative (equity crowdfunding, P2P lending, ICOs) and traditional (independent VC, corporate VC, governmental VC, BAs) financing channels. Moreover, while conventional wisdom associates alternative financing channels with ventures' seed stage, there are ventures that use digital finance after the receipt of finance from traditional sources (Colombo and Shafi, 2019). Considering that the financing of entrepreneurial ventures is path-dependent, in that their early funding choices persist over time (Vanacker et al., 2014; Samuelsson et al., 2020), it is important to understand how digital finance has changed the sequences through which entrepreneurial ventures receive financing and what are the implications for the performance of these firms, as reflected in their ability to grow and/or go through a successful exit (through an IPO or an acquisition). Moreover, one wonders whether firms created by entrepreneurs who traditionally experience difficulties in obtaining external finance from professional investors, e.g., because of their gender (Marlow and Patton 2005) or because of their firm's location in peripheral areas far from VC hubs (Colombo et al., 2019; De Prijcker et al., 2019), exhibit different patterns in terms of sequences of use of digital and traditional financial channels. Do these new players help to alleviate financing constraints for these ventures, leading to a further democratizing of entrepreneurial finance? Further, we currently lack an understanding of what the



performance consequences are of these funding differences, both in types of funding and in the timing and sequence of funding.

Third, the proliferation of AI and ML-driven solutions to virtually every economic activity makes it natural to expect a quick and disruptive application to the complex task of project selection by professional investors, where large swaths of data can be utilized to identify dominant opportunities. However, the potential of a large-scale adoption of big data and machine learning algorithms opens important operating and ethical questions. From an operating standpoint, we need to understand better whether the identification of future successful trends and ventures is the type of high-signal-to-noise ratio application where machine learning excels (Israel et al., 2021), or whether the entrepreneurial finance context is too noisy and dynamic to generate reliable outcomes. The paper by Blohm et al. (2021) provides initial evidence of superior performance of data-driven techniques over traditional approaches, especially when investors lack relevant experience. We expect however this area to spur substantial more research that can further probe the existence of an upcoming transformation of investment selection practices.

From an ethical perspective, the success in the adoption of AI/ML investment selection tools won't be determined solely by its financial performance. A rich and growing literature has recently highlighted how gender and race biases are surprisingly widespread in the financing of ventures (Gornall and Strebulaev, 2021; Hebert, 2021; Zhang, 2021). These biases translate in a systematic underfunding of female and minority start-ups and related vigorous

calls to address such differential access (e.g Lang and Van Lee, 2020). While algorithmic approaches may be expected to be unaffected by these kind of human distortions, the empirical evidence has shown otherwise, identifying a surprising presence of biases that machine supervisors often fail to spot (Obermeyer et al. 2019; Manyika et al. 2019). This evidence has far-fetched implications: from ethical and legal considerations with regards to non-discriminatory decisions, to the economic effects of hampering the development of new ventures. Broad interdisciplinary considerations with regards to algorithm usage and design are therefore urgently required to ensure equal and unbiased access to funding for early-stage companies.

Finally, the digital revolution poses interesting policy questions. The extent to which the disintermediation of entrepreneurial finance is welfare improving is a matter of debate and, as such, is the extent to which regulators should intervene to curb or promote it. Brummer and Yadav (2019) discuss several regulatory issues with fintech's trilemma, including regulatory sandboxes and pilot programs. The fact that regulators are tackling fintech issues differently also allows researchers to determine the effectiveness (and unwanted effects) of the different choices (Cumming et al., 2021; Bellavitis et al., 2021 partly build on this in this special issue). Interestingly, some of the new players happen to provide finance to the small and highly innovative firms that policymakers particularly care about, sometimes displacing existing intermediaries. This means that regulators will need to understand how these new

players work, and possibly reconsider the effectiveness of policies based on subsidizing or facilitating financing via more traditional intermediaries (e.g., SME guaranteed loans).

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