Startup ventures and equity finance: How do Business Accelerators and Business Angels assess the human capital of socio-environmental mission led entrepreneurs?

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Introduction

Business accelerators, hereafter referred to as accelerators, have become a significant institutional form of investment in the post Global Financial Crisis (GFC), 2008 era, and an important element of the entrepreneurial finance ecosystem (Pauwels et al., 2016; Mian et al., 2016; Cumming et al, 2019). In the UK alone, Bone et al. (2017; 2019) found that within a decade since first appearing in London in (2007) over 160 active accelerators which on average were assisting 20 early-stage growth potential enterprises annually. They typically provide fixed-term, cohort-based, financial intermediary support to start-ups through a combination of equity investment, shared office space, and entrepreneurship schooling (Gonzalez-Uribe & Leatherbee, 2017). Accelerator programs assist innovative ventures to minimize start up time by leveraging pre-existing networks and organize scarcity management to motivate the top management team (Stayton & Mangematin, 2019).

Accelerators can provide an initial step on the finance escalator (Baldock & Mason, 2015; Brown & Mason, 2017) and hot house business support to inexperienced entrepreneurial founders, preparing them for future equity investment from business angels (hereafter referred as 'angels') and seed venture capitalists (VCs). Hogan et al. (2017) highlight the revised pecking order for innovative businesses, with demand for equity finance highest amongst the youngest innovative businesses which most perceive information asymmetries and lack of availability of bank debt finance. They (ibid) also find

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that a driver for using early-stage equity finance is the perception that it will facilitate further rounds of equity investment, suggesting that accelerators may have an important catalytic role. This underpins the finance escalator concept (Mason, 2017; Owen et al. 2019) and this paper's consideration of whether accelerators have similar investment selection criteria to other early-stage equity investors such as angels and seed VCs, and therefore seeking to align their investments with likely follow-on investor selection requirements.

The rapid growth of accelerators has created a notable knowledge gap in relation to their investment screening and selection criteria. Madaleno et al. (2021) point to limited quantitative evidence around selection, design, operation and impact causation, with reliance on individual case studies. Another recent study by Yin and Luo (2018) highlighted this knowledge deficit and examined investment selection criteria and screening stage processes, but was limited to an intensive study of one, reportedly 'high quality', Singapore-based accelerator. More generally, current consensus suggests that early-stage entrepreneurial seed finance investors, such as angels and VC put most emphasis (at least at earlier stage investment) on the qualities of the management team (Granz et al, 2021; Gompers et al., 2020, Colombo, 2021). However, studies are yet to explore whether and how this applies to accelerators, underlining Cumming et al' (2019) call for research into accelerator practices and performance.

The knowledge gap for accelerators further extends to impact investment, where investors who seek financial returns specifically assist enterprises which can make socio-environmental impact (GIIN, 2020; Henry et al., 2020). Whilst recent studies by Yan et al. (2019) and Owen et al. (2020) explore institutional logics perspectives into whether financial return logics are dominant over socio-environmental logics in the investment decision process, they fail to adequately explore the importance of founding team human capital. Thus, little evidence exists for comparing how different equity investor types (specifically accelerator and angel impact investors) value the entrepreneurial human capital of start-up teams, for example, in relation to their educational qualifications, professional and entrepreneurial experience. This is important because existing evidence suggests a strong link between angels and seed VC equity investments into strong entrepreneurial human capital (Granz et al., 2020;

Gompers et al., 2020), and consequent company growth (Colombo & Grilli, 2005; Woolley, 2019). Thus, whilst various factors may attract equity investment to early-stage ventures such as potential financial returns, market scale and accessibility, and product and services characteristics, extant literature suggests that human capital is the most important investment criterion, particularly for early-stage angel and seed VC investing (Mason et al., 2017; Harrison & Mason, 2017; Colombo, 2021).

This paper addresses the knowledge gap specifically in relation to impact investment accelerators by empirically investigating the following research questions: What are the investment selection criteria of business accelerators specifically in relation to the role of human capital? How accelerators compare in selection criteria with business angels? Angel backed companies are used as a benchmark in this analysis due to their emergent role in the entrepreneurial finance ecosystem (Baldock & Mason, 2015; Owen et al., 2019) and their role as potential follow up investors.

We use data from the Impact of Entrepreneurship Database Program, which includes application data collected from 10,563 for-profit ventures with a socio-environmental mission-led aim (Lyon & Owen, 2019) from 157 countries, who applied to participate in socio-environmental impact accelerator programs between 2013 and 2017. While accelerator programs' service support offerings vary (some offer equity funding while others just training and soft support), we only concentrate on the groups of companies that received equity funding, since we are investigating aforementioned investor alignment. The advantage of this dataset is that it enables comparisons of ventures that received equity from angels or accelerators. Thus, we investigate whether human capital plays an equally prominent role for equity impact accelerator and angel early-stage venture investors, using robust large-scale empirical data, which transcends prior accelerator and impact investment studies.

It should be stated that the data used pre-date COVID-19 which Brown and Rocha (2020) note has changed the dynamics of the early-stage seed investment market where physical human resource contact and assessment is most required (Owen et al, 2019). To some extent it may be argued that the post GFC rise in equity crowdfunding has contributed to relaxation of these requirements with the rise of angel

crowdfunding (Wallmeroth et al, 2018) and also virtual incubators and accelerators (Bonini & Capizzi, 2019), with Howell et al (2020) arguing that COVID-19 has made fundamental changes to 'relational' investing underlining the trend towards angel online activity. However, as current research demonstrates, these changes (whether permanent or not) do not detract from the fundamental importance of the founding teams' human capital and the ability of the experienced entrepreneur to present a compelling business case (Ferrati & Muffato, 2021).

The remainder of the paper is organised as follows. Section 2 presents the theoretical framework and hypotheses building. Section 3 discusses the data and the method used, while section 4 presents the empirical results. Section 5 presents a discussion of the findings and Section 6 provides concluding implications of the paper.

Literature Review and Hypotheses Development

Business Angels, Accelerators and Institutional Logic

In the last decade, a variety of accelerator programs have emerged as a new tool for supporting business start-up ecosystems (Miller & Bound, 2011). Whilst we focus on accelerators that provide early-stage venture investment, we note that they fulfil a different role to angel investors, as outlined in Table 1. Start-up accelerators support early-stage, growth-driven companies through education, mentorship, and financing. They also provide networking opportunities for tenants to establish collaborative relationships with other organizations (Sá & Lee, 2012). Start-ups enter accelerators for a fixed-period of time, and as part of a cohort of companies. The accelerator experience is a process of intense, rapid, and immersive education aimed at accelerating the life cycle of young innovative companies, compressing years' worth of learning-by-doing into just a few months (Hathaway, 2016). According to Clarysse et al. (2016) accelerators often offer upfront investment (£10k-£50k), usually in exchange for 5-10 per cent of equity. They provide time-limited support to cohorts of start-ups (rather than individuals), which comprises programmed events and intensive mentoring. Start-ups are accepted through an application process that is 'in principle' open to all, yet highly competitive.

Angels are individuals that invest their own money into companies that they find attractive. Maier et al. (2016) found that both the academic background and the industry sector in which the business angels work directly correlate with the industry sector in which the start-up operates. Individual or lead angel investors in syndicates typically take a hands-on role in their investee company and they place great importance on the 'chemistry' between themselves and the entrepreneurs (Mason & Harrison, 2015; Van Osnabrugge & Robinson, 2000). Therefore, '*people in the project*' is the most critical factor in an angel's decision to invest (Haines et al., 2003).

- Table 1 near here -

Whilst there has been growing interest in the institutional logic of different forms of early-stage venture investor, this remains nascent and yet to include more detailed investigation of accelerators. Fisher et al. (2017) and Pahnke et al. (2015) indicate that different types of investor, ranging from private individuals and small groups of angels to VC funds and government agencies have different market and social priority (policy) institutional logics which govern their selection criteria and processes.

Overall, institutional logic suggests likely differences between the investment motivation of angels and accelerators dependent on their market profit and socio-environmental preferences (Owen et al, 2020). However, despite recent increasing interest in public supported schemes (Bone et al., 2017; Brunet et al., 2015), the vast majority of accelerators are currently either privately owned or hybrid public-private, private-led operations (Bone et al., 2017). They are, therefore, likely to adopt similar to seed investors' investment criteria (Baldock & Mason, 2015) and be far more comparable to angels than incubators. What therefore appears most interesting is to compare the supply-side selection criteria of founding team human capital of accelerators with angels, since both forms of impact investors are likely to be market oriented (Owen et al, 2020) and specific founder characteristics are associated with improved venture performance. For example, Watson et al. (2003) suggest that entrepreneurial skills are enhanced through higher education, while entrepreneurs with prior entrepreneurial experience are better

5

accustomed to entrepreneurial processes and more likely to avoid costly mistakes than 'rookie' inexperienced entrepreneurs (Sinha & Osiyevskyy, 2018; Blank & Carmeli, 2020). Extensive literature review work suggests that this is the first empirical study of its kind.

Resource-based View (RBV) Theory

Drawing upon the resource-based view (RBV) of the firm, Hayton (2005) argues that in high-technology new ventures, intellectual capital assets offer a unique source of advantage that facilitates entrepreneurship by reducing the risk and increasing the returns from investments in innovation and venturing. RBV offers important insight and explanation for the likelihood of firm success (Barney, 1991) and has also been associated with the likelihood of obtaining external business finance (Blank & Carmeli,2020; Colombo, 2020; Owen et al., 2017; Owen et al., 2019; Mac an Bhaird, 2010). It suggests that internal resources relating to the knowledge and skills base of the management team are critical success factors. These can include previous successful business start-up experience, access to finance and use of business support services exhibited by serial entrepreneurs, and also soft start-up new business spin-outs with an existing management and skills base and sector connections such as suppliers and clients (North et al., 2013). Wang et al. (2019) found that signals based on the entrepreneurial team play a stronger role in enabling technology ventures to raise capital in their IPOs, compared with signals based on the company's technology development. Similarly, Colombo (2021) sees founders human capital background and industry accomplishments as signalling legitimacy and increasing funding success in earlier stage crowdfunding, angel and VC access. Several studies have demonstrated that the internal management resource base, allied to the external connections of the new firm is critical to success, suggesting that network ties (Uzzi, 1999) are vital for start-ups and young business development. This gives rise to the dual importance of internal and external resources in an extended RBV for young firm success (Owen et al., 2017; Owen et al., 2019). General human capital for the case of the entrepreneur is typically measured in the entrepreneurial literature simply by the age of the entrepreneur, educational qualifications (e.g. degree, postgraduate Masters/PhD) and by prior entrepreneurial experience (North et al., 2013). Arguably, an additional dimension facing hybrid socio-

environmental mission-led early-stage ventures is their more complex aims which may face competition between social and financial objectives (Doherty et al., 2014; Owen et al., 2020a). Furthermore, it has been suggested that their founder managers may have less commercial know-how than their mainstream for profit counterparts (Lyon & Owen, 2019). Over time, given such nuances, RBV measurements have become more sophisticated, as presented below.

Management Experience

Managerial experience is traditionally associated with leadership experience and the ability to coordinate resources and make complex operational and strategic decisions. Here we distinguish between prior managerial experience and entrepreneurial start-up experience (see next section). Scholars have found a positive association between previous experience in managerial roles and the performance success of new ventures (North et al., 2013; Owen et al., 2019). The number and variety of prior work experiences (Dahl & Reichstein, 2007) is also an important aspect. An additional factor for socio-environmental mission-led ventures is that their managers' prior sector experience may relate to the operation of not for profit, grant and charitable organisations, leading some to suggest that they lack 'commercial' management skills (Lyon & Owen, 2019).

The successful management of internal resources is believed to be linked to improved high-tech firms' survival rates and their enhanced performance (Dabić et al., 2021). Managerial experience is further expected to assist an individual's understanding of the market and ability to respond to its changes (Newbert et al., 2007). Ucbasaran et al. (2008) also found that entrepreneurs with managerial abilities were more likely to identify opportunities and subsequently introduce products with known customer demand in the market.

In the entrepreneurial finance literature, the most consistent finding from studies of VC fund decision-making is the importance that is placed on the ability of management teams (Baldock & North, 2015; Baldock & Mason, 2015; Owen et al, 2019). Angel investment screening pays greater attention to management skills, quality of management, characteristics of the management team and the

management team's track record (Mason et al., 2017). However, this may be less so for seed VC funds or accelerators, where larger venture portfolios are more likely to be based on disruptive technology and scalability potential, with relatively small initial investment leading to a test bedding in period, sifting out poorer performers, before selecting the better performers for follow-on funding (Baldock, 2016). On the other hand, angels will be more concerned with entrepreneurial agency risk (Mason & Harrison, 2015), being more likely to invest in fewer propositions but hold them over a longer period of time and be more hands on, especially if they are the lead investors intending to work closely with the new venture managers (Owen & Mason, 2017).

These differences are related to the types of risk that accelerators and angels believe they are most competent to control. Accelerator managers interact with their ventures on a daily basis and as accelerator backed ventures spend considerable time together (average 6 months; Bone et al., 2019), thus allowing accelerator managers to become very familiar with ventures and minimise the risks related to information asymmetries. Contrastingly, angels only occasionally meet portfolio ventures and attach more importance to agency risk (Harrison and Mason, 2017). There are several reasons for this: First, angels have a limited number of ventures to back and are therefore more detached from the early-stage market compared with accelerator managers that come across hundreds of applications and perhaps have increased exposure and data that allow them to evaluate opportunities and associated market risks. Second, angels place greater emphasis on ex post investment involvement as a means of reducing risk (Harrison and Mason, 2017; Van Osnabrugge, 2000). To compensate for their limited prior due diligence they look for signals that the management team can deliver and work with them into the mid-term, rather than simply on a short-term basis. Indeed, Mason and Harrison (2015) talk about smart money angel investors having hands on roles in management and ensuring they overcome information asymmetries through close contact. Furthermore, angels tend to invest close to their portfolios and increasingly work in groups which have complementary skills to address management shortcomings (BBB, 2018; Baldock & Mason, 2015). Overall, we would therefore expect that although both angels and accelerators would value the previous managerial experience of the entrepreneurs, angels would put greater emphasis on managerial skills compared with accelerators.

8

Hypothesis 1: Angels are more likely to invest in teams with higher proportions of founders that held a senior management position in the past, compared with accelerators

Founding Experience

Scholars distinguished between previous entrepreneurial and work experience. Specifically, previous entrepreneurial experience, namely, "serial entrepreneurship" is defined as the propensity to start-up more than one company (Delmar & Shane, 2006; Dabić et al., 2021). Empirical evidence supports that prior entrepreneurial experience increases the odds of success for the new venture (Ko & McKelvie, 2018). Previous spin-out activities have been found to send particularly strong positive signals to investors (North et al., 2013; Owen et al., 2019; Dabić et al., 2021). Such signals may become even stronger for serial entrepreneurs who can demonstrate previous successful track records and may have already established links/ties with investors (Owen et al., 2019).

As a result, it is expected that angels would still put more emphasis on the founding experience of the team, for example, the number of ventures that the team has successfully founded previously (Dabic et al, 2021). These elements would provide signals to the angels regarding the quality of the venture. Conversely, since a primary role of accelerators is to hothouse train new venture managers in entrepreneurial skills (such as financial management) as a precursor to obtaining angel and other forms of investment (Clarysse et al., 2016), we, therefore, hypothesize the following:

Hypothesis 2: Angels are more likely to invest in teams with higher proportions of founders with previous founding experience, compared with accelerators

Education

Ko and McKelvie (2018) find that founder human capital, particularly their level of education and prior founding experience, offers important signals that directly impact on the amount of funding received in the first round of financing. In addition, in the second round of financing, they find that the prominence

of the investors in the first round of financing and the education of the founders provide significant signals that impact on the amount of funding received. Other studies indicate that entrepreneurial capital in relation to higher level academic attainment (degree or post graduate qualifications) sends critical legitimizing signals to potential investors (North et al., 2013; Ahlers et al., 2015; Li & Owen, 2016; Woolley, 2019; Colombo, 2021).

The educational level that an individual attains before becoming self-employed has been considered to be very important for the post-entry performance of a firm in terms of productivity, profitability and growth, and positive relationships between the former and latter have been found in studies by Jo and Lee (1996) and Baum et al. (2000). More recently, degree level qualifications – notably from higher order Universities with national and international reputational status - has also been found to have an important signalling role in obtaining lead angel funding on the AngelCrunch crowdfunding platform in China (Li & Owen, 2016). Fisher and Kotha (2015) find that such signals are re-enforced when they link the entrepreneur's background with that of the investor. Ko and McKelvie (2018) also find that higher levels of founders' academic education provide signals that significantly improve access and larger amounts of external funding received by start-ups. Angel practices typically involve a far longer and closer one to one relationship with their portfolio managers than a standard accelerator cohort service would likely offer (Mason & Harrison, 2015). We, therefore, anticipate that the level of education of the entrepreneurial team would be of greater importance to angels in ensuring that entrepreneurs are qualified to receive advice and support and will be more likely to work harmoniously and effectively with the angels.

Hypothesis 3: Angels are more likely to invest in teams with higher proportions of founders with high academic status, compared with accelerators

- *Figure 1 near here -*

Figure 1 presents the conceptual framework of the research. First, the focus is on the human capital characteristics of the venture team, the founders' characteristics, whilst controlling for the industry and country of the venture's operation. Second, the aim is to examine the extent to which human capital influences the investment decision of the funding bodies.

Method and Data

Sample and Data Sources

This study uses information on 10,563 for-profit socio-environmental ventures that applied to join a social impact accelerator program, which is monitored by the Entrepreneurship Database Program (EDP).[3] EDP has been partnering with 178 social accelerators programs operated by 28 organisations to collect detailed data from entrepreneurs during their application processes.[4] The Database includes cross-sectional application data collected from entrepreneurial teams who applied to participate in accelerator programs from 2013 to 2017. We restricted the sample to ventures that indicated that they are for-profit, as we are interested in for-profit ventures which can be more readily generalised to the wider business population applicable to angel and accelerator investments (Teasdale et al., 2013). Although the ventures in this sample operate in 157 different countries, the vast majority come from the United States of America, Mexico, India, Chile, Kenya, Uganda, Colombia, Nigeria and Brazil. The Database contains information related to the entrepreneurs' background and company characteristics. Information on whether the venture has previously acquired external funding through angels, accelerators or non-equity financial sources, is also included. The dataset includes all the ventures that have applied to these programs, not only the ones that were accepted, somewhat reducing the bias described by Bloom and Clark (2011) in existing datasets that only include data from selected or 'successful' enterprises.

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[3] Part of the Global Accelerator Learning Initiative (GALI).co-created by Emory University, the U.S. Global Development Lab at the U.S. Agency for International Development, Omidyar Network, The Lemelson Foundation and the Argidius Foundation, the Kauffman Foundation, Stichting DOEN and Banamex

[4] Note that some organizations run multiple accelerator programs

Measures

Dependent Variables

The dependent variables Accelerator, Angel and Other are constructed as follows: Accelerator is a binary variable that takes the value 1 if the start-up received funding from an accelerator and 0 otherwise, prior to applying to join an EDP monitored accelerator. Angel is a binary variable that takes the value 1 if the start-up received funding from an angel and 0 otherwise, prior to applying to join an EDP monitored accelerator. The variable Other, is also a binary variable that takes the value 1 if the start-up received funding from other non-equity finance sources (such as philanthropic grants and blended socio-environmental soft loan offerings (Owen et al. 2020) and bank debt finance), or did not receive any external funding and 0 otherwise.

Independent Variables

We collect data at the team level and we measure Prior Senior Management Experience as the proportion of founders within the team that held a senior management position in the past (Dahl & Reichstein, 2006). Prior Founding Experience is a very strong signal for many funders as various studies reveal a strong link between founding experience and increased likelihood of success for the new venture (Hsu, 2007; Ko & McKelvie, 2018). We calculate the proportion of founders within the team that have founded one or more start-ups in the past. Academic Status indicates the proportion of founders within the team that hold a Masters or a PhD (Ding, 2011). Data regarding the founders' education is collected as a categorical variable and then transformed into proportions (Åstebro & Bernhardt, 2003).

Control Variables

In our model, we also control for the number of founders, entrepreneur's gender and age (average of the venture team), development level of the country of operation and industry of operation. As regards the entrepreneur's gender, extensive research indicates the existence of a gap between male and female entrepreneurs. Scholars outlined the difficulties that female entrepreneurs face in fundraising especially in the early-stage phases of a start-up (Rosa et al., 1996). There are questions here as to whether women

are disadvantaged or discouraged by predominately male operated business support and financing organisations, or whether they are inherently more cautious or too proud to use external finance, or isolated by smaller and different network ties due to cultural and different experiential factors (Owen et al., 2019; World Bank, 2014; Carter et al., 2013; Uzzi, 1999).

Finally, extensive research already highlights that younger firms, particularly pre-trading or early trading with limited/no track record and which are highly innovative, are more likely to suffer from information asymmetries. These firms find it harder to obatain external financing and appear most in need of related business support, such as through accelerators (Owen et al., 2017; Owen et al., 2019; North et al., 2013; GLA, 2013).

Selection Biases

There are some potential selection biases that require further investigation. First, our data shows that there were companies that applied to join an accelerator program, although they have already received some equity investment from angels. This is intriguing as existing literature suggests that angels' investments typically follow-on from accelerator investments, and not the other way around (North et al., 2013, Owen et al., 2015, Baldock & Mason, 2015). On one hand, self-selection bias offers the possibility that these angel-backed companies do not represent typical angel investor backed companies in the broader community; that the experience of those who choose to participate in an accelerator program was unique or odd in some way. For example, our sample could be biased if only angel backed companies which are struggling to grow, decided to participate in an accelerator program. Alternatively, an explanation could be that angel backed companies see accelerators as a means of follow-on fundraising as mentors who provide support to ventures at such accelerators are often angels.

However, comparison with other empirical work on early stage equity backed companies suggests that it is not a central concern, as our sample looks broadly similar to the more general populous of angel backed ventures – and therefore likely to provide generalisable findings. The characteristics of our angel

backed sample are well in line with other empirical work (in terms of stage of development and level of innovation) and angel backed ventures in our sample raised on average \$70k[5], were less than 3 years old, 56 per cent of them were not profitable the year prior to their application to join an accelerator program and 51 per cent were pre-revenue. This is in line with existing literature, which suggests that the majority of the angel-backed firms receiving angel financing is in fact pre-revenue companies (Wong et al., 2009). 66 per cent of the angel backed ventures in our sample were invention based and 67 per cent had IP protection (patent, copyright or trademark). Similarly, Mason and Botelho (2014) found 71 per cent of the angel backed companies in the UK have IP protection. In addition, 48 per cent of accelerator backed companies and 31 per cent of angel backed companies in our sample that applied to join an accelerator program generated some profit the year prior to applying to join an accelerator program. This indicates that our sample is not biased towards lower quality companies, and that they wish to join an accelerator program to progress further. Whether they received angel or accelerator money, companies may still want to join an accelerator program in order to be associated with a recognised program, emphasising the importance of a 'prominent investor' as highlighted by Ko and McKelvie (2018) and receive exposure through press and media.

Second, it has been pointed out that the relevance or viability of the firm decision to look for external equity financing is critical (Eckhardt et al., 2006). Therefore, one of the other concerns of sampling on the applicants to an accelerator program, rather than going through other ways of identifying the sample, is a self-selection risk; particularly that our sample includes only ventures that are wishing to join an accelerator program (they self-included themselves). Heckman (1979) and Heckman and Robb (1985) suggest that bias due to self-selection comprises of two parts. The first is determined by the individuals (firms) deciding to apply to the programme and the other is coupled to the accelerator programme administrators and their skill in selecting which applications to accept. Both components imply that selection into the programme is not random.

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[5] The median size of BA investments is \$70,000 and the mean \$265,000

These two risks related to selection bias, cannot be controlled for directly, however, for the reasons stated above it appears that they are unlikely to dominate the findings of this research. This understanding of the sample and trade-offs inherent in its selection set the stage for a more detailed definition of the specific variables and models used to test the hypotheses.

- Table 2 near here -

Model Specification

We use a Multinomial Logistic model to analyse how the odds of receiving a specific type of equity investment from accelerators (y_1) or from angels (y_2) versus not receiving any funding at all or receiving funding from other non-equity financial sources (y_o), depend on the particular characteristics of the entrepreneurial team's human capital (management experience in senior positions, founding experience and qualifications). The Multinomial Logic regression generalises logistic regression to more than two possible discrete outcomes (Greene, 1993). Multinomial Logistic models are a linked set of binary logistics models simultaneously estimated for all possible comparisons among outcome categories that allow the data to be analysed more efficiently than multiple independent binary logistic models (Long, 1997). Moreover, the Multinomial Logit model assumes independence of odds ratios of different alternatives; therefore, the model requires that the assumption of 'independence of irrelevant alternatives (IIA)' be satisfied (Greene, 1997) (see equation 1). We validated this assumption, by conducting the Hausman specification test (Hausman, 1978), as well as the Wald test.

$$\Pr(Y_i = m | \boldsymbol{x}_i) = \frac{\exp(\boldsymbol{x}_i \boldsymbol{\beta}_m)}{1 + \sum_{j=1}^{J} \exp(\boldsymbol{x}_i \boldsymbol{\beta}_j)} \qquad \text{(equation 1)}$$

In equation 1, $\Pr(Y_i=m|x_i)$ refers to the probability of belonging to category *m* of the dependent variable *Y*, whilst *β* is a vector of coefficients estimated for each of the *m* categories of the dependent variable and $\boldsymbol{x}$ is a matrix of explanatory variables. In addition to presenting the estimated coefficients from the Multinomial Logit models (as these are difficult to interpret directly), we also report the effect of a

marginal change in each of our independent variables on the probability of belonging to each category of the dependent variable.

- Table 3 near here –

Correlation analysis (Table 3) indicates low level (<.3) of correlations between variables. Tolerance values of all variables employed in the regression were high (>.80) suggesting that multi-collinearity was absent.

Analysis and Results

A regression was applied hierarchically to evaluate the contribution to the model of the different blocks of variables: (1) a first set of control variables including firm characteristics and founders' personal indices and (2) a second set of data on founders' human capital. Table 4 presents the output values of independent variables' effects on Accelerators and Angels funding. These models were constructed so that they have the same independent variables and the same sample. Table 5, presents the marginal effects of the regression model used in Step 2.

- Table 4 near here –
- Table 5 near here –

Table 4 presents benchmark results obtained from Multinomial Logit regression. To ensure model identification in the regressions y_o is set to a base group. All the regression coefficients should be interpreted by comparing with those of the base group and across other groups. As a robustness check, we note that the results remain similar when the base category y_o is changed to a group of companies that received no funding at all (not reported here).

Step 1, the control block indicates that the coefficient for the variable Number of Founders is positive and significant only for companies that received equity from angels. Specifically, the positive and statistically significant sign (p<0.01) on the coefficient for the total number of founders suggests that

firms with a larger number of founders or employees are more likely to receive funding from angels than accelerators.

The coefficient for Female entrepreneur is negative and significant for both types of equity finance, suggesting that the higher the proportion of females within the entrepreneurship team, the less likely it is for the business to raise finance from accelerators and even less likely from angels. Founders' age is positive and significant for both accelerator and angel backed companies. The coefficients of the categorical variable Company Age indicate that older companies are less likely to receive funding from accelerators. This accords with the literature on the managerial resource development role of accelerators (Brown & Mason, 2014), and may be exacerbated by the managerial complexities of hybrid, socio-environmental mission-led early stage enterprises which face competing social and financial aims and may well lack commercial managerial experience and skills (Doherty et al., 2014).

Step 2, indicates that Previous Senior Management Experience is positively and significantly associated with both angel and accelerator funding ($p<0.05$), although the coefficient is significantly higher for angel backed ventures. In other words, managerial experience is an important criterion to both angels and accelerators, but angels would put more emphasis on this criterion and therefore Hypothesis 1 is confirmed.

Previous Experience as a Founder is positively and significantly associated with angels ($p<0.01$) but negatively and significantly associated with accelerators ($p<0.01$), indicating that firms whose founders have previous founding experience are more likely to receive angels funding and significantly less likely to receive funding from accelerators, and therefore Hypothesis 2 is confirmed.

Having a PhD or Masters negatively affects the odds of a firm to receive equity funding from an accelerator program. More particularly, the higher the proportion of founders that hold a PhD or Masters, the less likely it is for their firm to acquire funding from an accelerator program ($p<0.01$), and therefore Hypotheses 3 is confirmed.

Table 5 (marginal effects) confirms that all variables with the exception of the Number of Founders and, in the part of the regression model predicting the likelihood of the venture to receive equity funding from an accelerator, are significant predictors. Similarly, all variables with the exception of Founders' Age in the part of the regression model predicting the likelihood of the venture to receive equity funding from angels, are significant predictors.

The picture that emerges from the above analysis is that, compared to angels, accelerators tend to back younger and smaller firms which are founded by older entrepreneurs, who are less educated and possess significantly less founding experience. Impact accelerators therefore appear to have a key role in management development.

Robustness Tests

We run robustness tests based on alternate measures of founders' human capital. First, instead of using the proportion of founders with previous founding experience, we use the actual number of firms founded by the entrepreneurial team previously. Further, we coded education in an ordered form (i.e. high school or vocational training as 1, bachelor's degree as 2, master's degree as 3 and doctorate degree as 4) and we then used an average number (score) of all team members. Lastly, we altered the previous senior management position variable, by creating a binary variable taking the value 1 if at least one team member in a team had previous experience of CEO or a senior manager position and 0 otherwise. Our findings using these alternative variables are similar to our original findings, suggesting our results are robust.

Discussion

To our knowledge, this research is the first empirical examination of the resource based human capital aspects of accelerator investments. It offers important evidence of significant differences in the types and quality of human capital influencing founding team investment selection by accelerators and angels that has major implications for early-stage venture investment theory, policy and practice.

Implications for Theory

The entrepreneurial finance literature argues that early-stage venture entrepreneurs and their founding teams encounter difficulties in raising equity finance, mainly because external investors are unable to directly observe the quality of the ventures. Thus, early-stage investors make investment decisions based on observable characteristics or signals of quality and legitimacy. A growing number of researchers adopt signalling theory to explain investors attraction to particular ventures (Fisher et al, 2017; Wang et al, 2019; Colombo, 2021). Taking stock from this debate, this paper explores the effect of diverse human capital signals (management and founding experience and level of qualification) on entrepreneurs' success in receiving angel or accelerator funding.

Overall, our results are in line with the theoretical argument that human capital signals are important in reducing the information asymmetries faced by angels and ultimately driving entrepreneurs' success in securing angel funding. However, our results also suggest that the above theoretical argument does not always hold for the case of impact accelerators as some aspects of human capital signals do not contribute to the entrepreneur's success in receiving accelerator funding. This is surprising, because accelerator managers typically claim that founding teams are their main selection factor (Clarysse et al., 2016). However, whilst the entrepreneurial finance literature features human capital signals as crucial for the attraction of equity finance from external investors (e.g. Colombo, 2021; Dabic et al, 2021), such signals appear considerably more important to angel investors than for accelerators. This supports the argument that angels need to overcome entrepreneurial agency (Mason et al, 2017; Harrison & Mason, 2017) to work with a small number of portfolio ventures over long periods of time, whilst the impact accelerators job is to rapidly hothouse management skills development.

Why is this Happening and Why is it Important?

First, accelerators are relatively newly established organisations which are probably still developing the skills required to distinguish investment 'gems' from 'lemons'. Little research yet exists on the process

of how accelerators select portfolio investee companies and on the characteristics of the people that make such decisions. The indications are that accelerators vary considerably in their quality and operation. Some have highly experienced investors and specialisms , whilst others might not (Madaleno et al, 2021; Yin & Luo, 2018). Ingham (2014) suggested that emerging seed VC and angel groups probably offer better tailored support, with accelerator supported firms probably being second tier unless the accelerator is high quality and specialist with the expertise to genuinely mentor and train good quality firms. Our findings support this assertion, but also highlight the required management hothouse training role that accelerators are required to play (Bone et al, 2019).

Second, accelerators are applying a seed VC investment approach (Owen et al, 2019a; Owen, 2021), investing in cohorts with the hope that some of these companies will succeed. In contrast, angels invest in individual ventures and aim to gain from each investment (Harrison & Mason, 2017). Accelerators thus play the seed investment role of fast turnover of companies conforming to pareto principles, undertaking larger numbers of investments to spread risk-return ratios of Markowitz (1952) principles.

Third, an increasing minority of accelerators may be publicly funded (Brunet et al., 2015), and have a gap funding economic-developmental approach, targeting those ventures that do not obtain early angel funding, or are not ready for this. Indeed, accelerators may have different key objectives depending on whether they are backed predominantly by private investors, large corporates, or public funders (Clarysse et al., 2016; Fisher et al, 2017). Public backed accelerators may operate at different, earlier points in the finance escalator, or have different purpose, depending on their main founders. Here we focus on 'impact accelerators'. An important finding is that impact accelerators appear to focus on addressing management skills deficits. Prior research indicates that socio-environmental ventures, which may stem from older first-time entrepreneurs with a social and community interest (Lyon & Owen, 2019) and that these managers often lack prior for profit management skills, such as financial management and marketing development. This may also offer an explanation for the older average age of conversely younger age ventures that the accelerators are backing.

Overall, it appears that the early stage impact investment accelerators investigated are typically targeting a different segment of the entrepreneurial ecosystem than the angels. It could also be argued that accelerators do not use identical to angels' investments criteria due to their different investment logics (Fisher et al, 2017) and finance escalator role (Mason, 2017). As a result, a proportion of ventures that receive equity funding from accelerators may not necessarily be suitable follow-on equity investable businesses. This is in line with the Winston-Smith and Hannigan (2015) finding that receipt of follow-on funding from VCs occurs more slowly for start-ups participating in an accelerator relative to those with angel group financing. This new evidence on the roles within the early-stage equity finance escalator of impact accelerators also has important ramifications for policy and practice.

Implications for Practice and Policy

Our findings have important repercussions for the quality of design and operation of both private and state supported programmes and accelerator managers. First, our research implies that accelerators often back ventures that are unlikely to receive investments from angels and VCs (i.e. with significantly different human capital characteristics). As a result, once companies graduate from an accelerator program, they may find difficulties in securing follow up investments from angels or VC funds and to subsequently exit. Following Ko and McKelvie's (2018) examination of the role of prominent investors in increasing start-ups' follow-on funding and the work of Islam et al. (2018) on the role that signals can play for early-stage start-ups in winning prestigious government research grants, we argue that the quality of the accelerator can play an important role in enabling further funding and improving exit potential. Of course, there is an assumption that impact accelerators will have a suitable pipeline range of good propositions to choose from. Since public accelerators are more likely to operate in 'thin markets' as catalysts to new business pipeline development (Brown & Mason, 2014), this will not always be the case – particularly for more recently established public accelerators. As Owen suggests (2021), the design and selection of early-stage for profit impact investment programmes requires a careful balance between socio-environmental and economic requirements (Murray, 2021) and

ultimately must achieve alignment with private follow-on investors, by signalling a strong team and viable business case (North et al, 2013).

Second, without exits, impact accelerator programs are unlikely to be self-sustainable in the long run. This suggests that accelerator management teams need to adopt a more angels-like investment criteria approach, and ensure that their training and networking 'lean launchpad' approaches enable the generation or recruitment of key founder skills to strengthen both the team and the business concept (Owen & Vendanthachari, 2021). This can improve the likely outcomes, notably in terms of attraction to angel and VC follow-on investors. To this effect, Government sponsored accelerator programs could provide investment training to accelerator managers and seek to recruit experienced accelerator managers with established track records to establish good practice and role models for others to learn from (similar to Lerner (2010) and Owen (2021) requirements for public VC management development). Whilst angel investors typically follow private market logics (Fisher et al, 2017), their impact investor counterparts may have non-financial and philanthropic imperatives that trade-off profit for social good and 'pay it forward' (Owen et al, 2020). To improve their understanding of follow-on private impact investor requirements, accelerators would benefit from recruitment of next level finance escalator (Mason, 2017) investor experience from experienced angels, seed VCs, or successful accelerator managers.

Directions for Future Research

A key study limitation is cross-sectionality. The performance of the accelerator versus angel cases over time remains unknown. Furthermore, it is unclear whether the policy of some government-backed accelerators is to reject angel-backed businesses because they already have angel investment and to provide gap funding instead. Follow-up research is required to improve understanding of the nuances of our findings. Longitudinal research could track the impact of accelerator selection and operation within different entrepreneurial/finance ecosystems (Owen & Mason, 2019), examining firm performance and likelihood of follow-up investments, perhaps adopting the grounded mixed methods

'systems and learning' approach of Owen (2021). Research on the background and investment skills of the accelerator managers would also be of interest to both policy makers and practitioners.

Conclusions

Overall, our research suggests that impact accelerators select more risky, less experienced and less developed new venture management teams, and that they may be better placed to overcome management deficiencies – than angels - as their key roles are management skills hothousing, strengthening founding teams and their business concepts (Bone et al, 2019). However, this puts considerable emphasis on the entrepreneurial, training and network skills of the impact accelerator managers/trainers. We, therefore, support previous studies that emphasise the skill and quality of accelerator teams. We strongly recommend that where government policy supports impact accelerators – whilst accepting their gap risk funding economic-development role – to obtain maximum performance the recruitment and training of impact accelerator staff is crucial. Impact accelerator selection of investment portfolio ventures could also be improved in order to avoid selecting too many 'lemons', enabling improved sustainability and heightened reputation. Policy must address thin markets (which cannot be assessed in this paper) and enable impact accelerators to become more embedded in the entrepreneurial finance ecosystem and improve early-stage finance escalator connectivity (Mason, 2017). Since recent evidence from Owen and Vedanthachari (2021) highlights the key axial role of accelerators in the space between university and private research centres and private impact investment, this can potentially improve the opportunities for socio-environmental ventures to grow sustainably through improved access to follow on investing from Angels and VCs.

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Table 1. Comparison of investment and support characteristics of Accelerators and Angels

	Accelerators	Angels
Duration of support	3 months (Miller and Bound, 2012)	3-8 years (UKBAA, 2018)
Delivery of support	Offered in cohorts on a daily basis	Offered individually, face-to-face on a regular basis (Harrison and Mason, 2017; UKBAA, 2017)
Investment criteria	Team/entrepreneur (Chang, 2013) Sector specialism e.g. IT but must be able to work with the team (Baldock and Mason, 2015)	Team (Van Osnabrugge and Robinson, 2000; Haines et al., 2003; Harrison and Mason, 2017) Market considerations (Mason and Rogers (1996)
Stage	Proof of Concept (PoC) (Hathaway, 2016)	Seed, start-up, early growth (Wiltbank, 2011)
Amount range	£10-50k (Clarysse et al. 2016)	£25- £500k upper ranges typically referring to syndicates (Baldock and Mason, 2015; Owen and Mason, 2017)
Equity	5-10% (Clarysse et al. 2016)	8-20% (Wiltbank, 2011)

Table 2: Descriptive statistics

Variable		Variable value	Obs	Number of cases	Mean/ %	Std. Dev.	Min	Max
Dependent variables								
	Accelerator	Received equity funding from an Accelerator=1, 0 otherwise	10563	509	0.05		0	1
	Business Angels	Received equity funding from a BA=1, 0 otherwise	10563	981	0.093		0	1
	Other	Received none equity finance=1, 0 otherwise	10563	9073	0.86		0	1
Independent variables								
	Prior senior management experience	Proportion of founders with senior management experience. 1 means all founders possess such experience, 0 means none of the founders possess such experience*	9467		0.44	0.422	0	1
	Prior founding experience	Proportion of founders with previous founding experience. 1 means all founders possess such experience, 0 means none of the founders possess such experience*	10493		0.438	0.436	0	1
	Academic status	Proportion of founders that hold an MSc or a PhD. 1 means all founders possess such degrees, 0 means none of the founders possess such degrees*	9219		0.151	0. 315	0	1
Control Variables								
	Number of founders	Count	10529		2.20	0.799	1	3

Female		Proportion of founders who are female. 1 means all founders are females, 0 means none of the founders is a female	10348		0.315	0.36	0	1
	Founders' age							
		Average age of all founders in the team	10259		34.8	9.38	17	90
	Company age		10491					
	1	1 year old			0.21	0.410	0	1
	2	2 years old			0.19	0.396	0	1
	3	3 years old			0.20	0.400	0	1
	4	4 years old			0.15	0.359	0	1
	5	5 years old			0.16	0.320	0	1
	6	6 years old or older			0.087	0.281	0	1
Country level of development								
		Low-income economies	10510	1471	0.14	0.380	0	1
		Lower-middle income economies	10510	2838	0.27	0.446	0	1
		Upper-middle income economies	10510	2417	0.23	0.421	0	1
		High-income economies	10510	3784	0.36	0.481	0	1
Industry of operation								
		Agriculture	10510	1.539	0,15		0	1
		Artisanal	10510	262	0,02		0	1
		Culture	10510	175	0,02		0	1
		Education	10510	1.527	0,15		0	1
		Energy	10510	632	0,06		0	1
		Environment	10510	583	0,06		0	1
		Financial services	10510	915	0,09			
		Health	10510	1.201	0,11		0	1
		Housing development	10510	148	0,01		0	1
		Information and communication technol..	10510	868	0,08		0	1
		Infrastructure/facilities development	10510	134	0,01		0	1
		Other	10510	1.753	0,17		0	1
		Supply chain services	10510	199	0,02		0	1
		Technical assistance services	10510	111	0,01		0	1
		Tourism	10510	271	0,03		0	1
		Water	10510	192	0,02		0	1

* Detailed values are as follows: If 0/3 founders meet the criteria then variable takes the value 0. Accordingly 1/3 it takes the value 0.33; 1/2 it takes value 0.50; 2/3 it takes the value 0.66; and if 3/3 it takes the value 1.

Table 3: Correlations of all variables (Pearson 2-tailed correlation)

	1	2	3	4	5
Accelerator	1				
Business Angels	-0.072***	1			
Managerial experience	0.011	0.068***	1		
Founding experience	-0.078***	0.081***	0.257***	1	
Academic status	-0.113***	0.041***	0.006	0.076***	1
Number of founders	0.002	0.094***	-0.127***	-0.003	-0.004
Female	-0.014	-0.107***	-0.027***	-0.133***	0.028***
Founders' age	0.058***	0.021***	0.216***	0.128***	0.178***
Company age	0.061***	0.065***	0.008	-0.004	-0.063***
	6	**7**	**8**	**9**	
Number of founders	0.077***	1			
Female	-0.127***	-0.105***	1		
Founders' age	0.018*	-0.018*	0.047***	1	
Company age	0.019**	0.014	-0.039***	-0.085***	

* *** p<0.01, ** p<0.05, * p<0.1

Table 4: Multinomial Logit regression

	Step 1		Step 2	
VARIABLES	(1) **Accelerators** (y_1)	(2) **Angels** (y_2)	(3) **Accelerators** (y_1)	(4) **Angels** (y_2)
Prior senior management experience			0.385***	0.597***
			(0.125)	(0.097)
Prior founding experience			-1.093***	0.320***
			(0.157)	(0.099)
Academic status			-0.632***	0.0692*
			(0.075)	(0.037)
Number of founders	0.0995	0.445***	0.183**	0.516***
	(0.062)	(0.050)	(0.077)	(0.055)
Proportion of females	-0.388***	-1.027***	-0.655***	-0.881***
	(0.141)	(0.122)	(0.177)	(0.134)
Founders' age	0.015***	0.011***	0.019***	-0.001
	(0.005)	(0.004)	(0.006)	(0.005)
Company age (2 years)	-2.238***	-0.161	-1.798***	-0.100
	(0.283)	(0.124)	(0.324)	(0.134)
Company age (3 years)	-1.975***	0.245**	-1.464***	0.299**

	(1)	(2)	(3)	(4)
	(0.254)	(0.113)	(0.284)	(0.124)
Company age (4 years)	-0.099	0.360***	-0.096	0.272**
	(0.142)	(0.119)	(0.184)	(0.132)
Company age (5 years)	0.374***	0.407***	0.562***	0.421***
	(0.137)	(0.129)	(0.164)	(0.144)
Company age (6 years)	0.451***	0.649***	0.462***	0.663***
	(0.145)	(0.135)	(0.171)	(0.150)
Industry controls	Yes	Yes	Yes	Yes
Level of country development controls	Yes	Yes	Yes	Yes
Constant	-4.002***	-5.271***	-2.728***	-5.712***
	(0.332)	(0.298)	(0.425)	(0.332)
Observations	9,999	9,999	8,054	8,054

(Base category: y_0 = Non-funded companies and companies that received non equity funding from other sources)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Multinomial Logit Marginal Effects Regression

	Accelerators (y_1) Marginal effects		Business Angels (y_2) Marginal effects	
	dy/dx	Delta-method Std. Err.	dy/dx	Delta-method Std. Err.
Prior senior management experience	0.011**	0.011	0.047***	0.010
Prior founding experience	-0.042***	0.018	0.028***	0.013
Academic status	-0.023***	0.063	0.008**	0.015
Number of founders	0.004	0.007	0.039***	0.007
Female	-0.019***	0.017	-0.062**	0.016
Founders' age	0.001***	0.010	-0.007	0.008
Company age (2 years old)	-0.065***	0.017	-0.003	0.012
Company age (3 years old)	-0.055***	0.020	0.035***	0.015
Company age (4 years old)	0.005	0.026	0.019**	0.010
Company age (5 years old)	0.019***	0.023	0.029**	0.027
Company age (6 years old or over)	0.016**	0.006	0.052***	0.012

Industries controls	Yes	Yes
Level of country development	Yes	Yes
Log likelihood	-3415.0953	
LR test of $\alpha=0$	chi2(62)=1019.96***	
Observations	8054	

(Base category: y_0 = Non-funded companies and companies that received non equity funding from other sources)

*** p<0.01, ** p<0.05, * p<0.1