Paper II:
Venture Uncertainty, Market Uncertainty and Human Capital in Equity Crowdfunding: Evidence from a Natural Experiment

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Abstract

Building on signalling theory, this study provides empirical evidence on the impact of the venture's human capital traits, its uncertainty level, and market uncertainty levels on equity crowdfunding investors' decisions. We test these effects using a natural experiment by analyzing data from before and after the COVID-19 outbreak. We do so by using a proprietary dataset of 13,362 individual investor-investment decisions from the Israeli PipelBiz platform (between July 2018 and December 2020). Overall, we find that uncertainty was negatively associated with investments, while human capital was positively associated with it. We also find that human capital moderates the effects of uncertainty on investment decisions. Finally, we find that this interaction effect is also evident in high uncertainty conditions as analyzed both before and after the COVID-19 outbreak. Moreover, post-COVID-19 outbreak, ventures' uncertainty level increased, and their human capital levels decreased compared to the pre-outbreak period.

Keywords: Equity crowdfunding, Signalling theory, Human capital, Market uncertainty, COVID-19, Natural experiment

1. Introduction

Entrepreneurial finance literature argues that early-stage ventures send signals to potential investors to reduce information asymmetries and better present their ventures' quality and success prospects (Berger & Udell, 1998; Spence, 1973). Equity Crowdfunding (ECF) is a growing online fundraising mechanism enabling entrepreneurs to "make an open call to sell a specified amount of equity or bond-like shares in a company on the internet" (Ahlers et al., 2015, p. 955). While ECF shares some similarities with traditional players in entrepreneurial finance, such as business angels (BA) and venture capital (VC), it has unique characteristics differentiating it from them as well (Brown et al., 2018; Le Pendeven et al., 2021; Lukkarinen, 2020).

In ECF, the open call is often initiated by an entrepreneur who may be a stranger to the potential investor. And while ECF investors include both sophisticated/accredited and unsophisticated/unaccredited investors (Wang et al., 2019), the significant latter group often does not have sufficient experience in performing in-depth due diligence checks of the ventures under consideration, and therefore must rely on openly-sent signals to evaluate investment opportunities (Bonini & Capizzi, 2019; Kshetri, 2018), or rely on the platform's own screening procedures and quality checks (Tuomi & Harrison, 2017). As a result, the decision to invest in a venture through an ECF campaign is often perceived as a relatively high-risk investment (Estrin et al., 2018; Walthoff-Borm et al., 2018).

Since crowd investors experience high uncertainty levels with regard to a venture's true quality and its future prospects (Ahlers et al., 2015; Signori & Vismara, 2018), fundraising entrepreneurs need to communicate signals unveiling information that may better inform the investor in her decision-making processes (Ahlers et al., 2015; Chen et al., 2009). In this context, earlier research has emphasised both the investment terms (e.g., Harrison & Baldock, 2015; Knockaert et al., 2010; Leland & Pyle, 1977; Mason & Stark, 2004) and the venture's human capital as critical indicators for investors' decision-making (e.g., Mason & Stark, 2004; Mitteness et al., 2012; Muzyka et al., 1996; Pintado et al., 2007; Unger et al., 2011). Furthermore, recent studies in the ECF context also confirm that both investment terms and human capital are important signals of ventures' quality for crowd investors (e.g., Ahlers et al., 2015; Barbi & Mattioli, 2019; Coakley et al., 2022; Piva & Rossi-Lamastra, 2018). And that the importance of these signals becomes

even more pronounced as the ECF industry and its stakeholders mature through time (Lukkarinen et al., 2022).

Nevertheless, earlier studies tended to treat uncertainty (as assessed from investment terms) and human capital (as assessed by the entrepreneurial team members' experience and knowledge) as factors independently impacting investors' decisions. In the current study, we argue for an interaction effect between these indicators, where human capital moderates the effects of uncertainty on investment decision-making. Here, we build on earlier notions suggesting that human capital may serve as an uncertainty mitigator, assuming that higher capacities and skills of the venture's team enhance their ability to deal with problems and adverse situations, which are acquired through experience and diversity (Baum & Silverman, 2004; Hsu, 2007). In this respect, we follow earlier calls for investigation of interaction effects between different signals originating from the same sender in the context of entrepreneurial finance (Colombo, 2021; Unger et al., 2011), as well as the call to study the selection criteria of investors active within non-traditional domains of finance (Fraser et al., 2015).

Accordingly, we address the following research questions. First, we examine (1) whether entrepreneurs' human capital and the ventures' uncertainty levels affect investment decisions in ECF? Second, we test (2) whether there is an interaction effect between the venture's human capital and uncertainty levels on investment decisions in ECF? Finally, since exogenous shock, such as the outbreak of the COVID-19 crisis in early 2020, introduced additional uncertainty to capital markets (Andersen et al., 2007; Campello et al., 2010; Lee & McKibbin, 2004), we also examine (3) whether these effects remain consistent in light of higher uncertainty following the outbreak of COVID-19?

We answer these questions by analysing a proprietary dataset of 13,362 investment decisions made by 8,683 unique unaccredited investors on PipelBiz, Israel's biggest equity crowdfunding platform. This includes decisions made between July 2018 and December 2020 in a market where ECF has exhibited ongoing growth and where clear regulation overseeing ECF practice has been in place since 2018 (Efrat et al., 2020).

Overall, when using investment amount as our dependent variable, our findings follow expectations. First, we find a negative association between the venture's uncertainty levels and amounts invested by each investor. Second, we show a

positive association between human capital levels and amounts invested. Third, we confirm that human capital moderates the association between uncertainty level and investment amount by reducing its negative impact. Fourth, when splitting our sample, most of these associations are also evident also during high uncertainty conditions as after the COVID-19 outbreak. The one exception is that uncertainty level has no effect on amounts before the COVID-19 outbreak but has a negative effect after it. The latter finding suggests that investors are usually more concerned with human capital, but under higher market conditions, they also consider more closely issues related to venture uncertainty as captured by the investment terms the venture offers.

However, when using an individual investor's share of investment (out of total investments made by all investors) as our dependent variable, we reveal several different effects. Here, we find that the share of investment is positively associated with uncertainty levels and negatively associated with human capital. Moreover, we confirm that human capital moderates the association between uncertainty and share of investment by reducing its positive impact. We interpret this as a situation in which investors who invest in ventures with high uncertainty levels tend to require a higher share of ownership to compensate for risks taken. The risk mitigation power of human capital reduces their need to trade risk with higher stakes in the business, which is further enhanced in the interaction term identified.

Our paper presents several contributions. First, we provide evidence about an interaction effect between campaign uncertainty levels and human capital, where human capital moderates the effects of uncertainty on ECF investment decisions. Second, unlike earlier studies that have mostly focused on analysis at the aggregate campaign level, we present findings about the effects of uncertainty and human capital at the individual investors' decision level. Third, we presented our findings based on a unique large dataset from a context previously unexplored, namely the Israeli ECF market. Fourth, we use alternative composite measures for uncertainty levels and human capital, while earlier studies have used each indicator separately, while ignoring their close interrelations. Finally, we provide evidence that high uncertainty caused by exogenous shock effect ECF investors' decision-making. Here, profiles of ventures fundraising through ECF before and following the COVID-19 outbreak differ significantly. Campaigns in the period following the outbreak are characterized by higher uncertainty levels and lower human capital levels, when compared to those pitched before the outbreak.

The rest of the paper is organized as follows. The next section provides the literature review and hypothesis development. This is followed by a presentation of our methodological choices and analyses. The empirical results are then summarized and discussed. And the paper concludes by highlighting the study's contributions, limitations, and implications.

2. Literature review

In general, investment in entrepreneurial ventures incorporates a significant degree of risk. And while risk-taking may have both positive (profit/benefit) and negative (loss) results, investors wish to maximise the former and minimise the latter. Unsurprisingly, concerns with adverse risks associated with potential agency and market risks (Berger & Udell, 1998; Das & Teng, 2001; Fiet, 1995) have played central roles in entrepreneurial finance literature.

To address related concerns, literature has often drawn on signalling theory to explain entrepreneurs' communication with prospective investors (Bafera & Kleinert, 2022). Signalling theory addresses the challenges of reducing information asymmetries between two actors holding incomplete and different information through successful communication towards gaining desirable outcomes (Connelly et al., 2011; Spence, 1973). A signal is the action the signaller takes to communicate positive information regarding an endeavour to a receiver, encouraging their reaction in the form of a desirable outcome. According to Connelly et al. (2011), signals should be observable to potential receivers and costly to the signaller to be effective.

The specific context of ECF incorporates a combination of uncertainties for investors, including both the inherent endogenous uncertainties about a young firm's ability to successfully commercialise and grow, the time it may take, as well as the potential of fraudulent behaviour by entrepreneurs and other moral hazard problems (Agrawal et al., 2014; Daskalakis & Yue, 2017; Lin, 2017; Shneor & Torjesen, 2020). Unsurprisingly, compared to other crowdfunding models, ECF is often viewed as representing the highest risk for investors (Shneor, 2020) thanks to the greater uncertainty associated with such investments. Nevertheless, devoting much time and effort in intensive communications between small-sum investors and fundraisers makes little economic sense, leading such investors to seek

relevant information in a plethora of digital media and communication channels (Moritz et al., 2015) and drawing relevant signals from them.

Hence, to mitigate related concerns, recent studies show that entrepreneurs can improve their capital-raising outcomes by actively signalling their startups' quality and reducing uncertainties and information asymmetries. Some of these signals include whether the company holds patents (Piva & Rossi-Lamastra, 2018), the share of equity being offered (Ahlers et al., 2015; Kleinert et al., 2020), successful prior funding rounds (Barbi & Mattioli, 2019; Kleinert et al., 2020), a venture's age (Barbi & Mattioli, 2019; Mohammadi & Shafi, 2018), the number of team members (Ahlers et al., 2015; Barbi & Mattioli, 2019), the company's pre-money valuation (Hornuf & Neuenkirch, 2017; Mohammadi & Shafi, 2018), and the entrepreneurial team's experience and education, often referred to as a human capital signal (Ahlers et al., 2015; Le Pendeven et al., 2021; Piva & Rossi-Lamastra, 2018).

2.1. Signalling theory

In the realm of entrepreneurial finance, signalling theory tackles the issue of information asymmetry between investors and entrepreneurs. During their fundraising efforts, entrepreneurs transmit signals that signify the quality of their venture, its prospects, and their intentions to potential investors. The investors, however, have to estimate the venture's likely future outcomes based on incomplete information regarding the venture's quality and the commitments of the founding team (Colombo, 2021; Connelly et al., 2011; Klein & Maldonado-Bautista, 2022). Therefore, investors employ various decision-making criteria to address the information asymmetry problem for the purpose of reducing uncertainties associated with their investments.

2.2. Uncertainty and decision-making

Uncertainty plays a pivotal role in entrepreneurial finance, shaping the decisions and strategies of investors. In the realm of startups and new ventures, uncertainty is an inherent characteristic, stemming from both the entrepreneur's actions (endogenous) and external factors such as market and environmental conditions (exogenous) (Huang & Pearce, 2015; Packard et al., 2017).

Knight (1921) distinguishes between uncertainty and risk. While risk is categorised as either relying on somewhat known probabilities or on statistical calculations based on past knowledge. Uncertainty is the assumption that it is often impossible to infer from past events, as each situation is unique and has no known probabilities or outcomes in advance. Recent works further elaborate on the subject and distinguish between Known, Unknown, and Unknowable (unknown unknowns) risks (KuU). Known risks are defined as situations where conditions are specified, and probabilities are known or can be inferred from past activities, similar to Knight's (1921) definition of risk. Unknown and Unknowable risks differ based on whether events can be defined in advance. Therefore, Unknown risks are those where scenarios are known but probabilities cannot be assigned to them, while Unknowable risks refer to unknown and unanticipated events and, therefore, unknown probabilities for their occurrence. Examples of such extreme exogenous events (unknown unknowns) are the 2008 global financial crisis, the September 11th terror attack, climate disasters, and recently, the COVID-19 pandemic and economic crisis, leading to a higher level of uncertainty, also referred to as extreme uncertainty (Diebold et al., 2010; Kleindorfer, 2010; Packard et al., 2017).

The term uncertainty is most relevant when describing the condition in which investors are requested to make decisions, oftentimes based on an abstract idea, non-existent markets and products not yet fully developed and tested. In evaluating a proposal and its outcome, investors need to consider the controllable (endogenous) factors, such as agency and moral risks and information asymmetry between investors and entrepreneurs. Uncertainty level is determined by the reliability and completeness of information as provided by fundraisers, and the extent to which it is being perceived as reliable and complete by the investor. Thus, reduced information asymmetry between entrepreneurs and investors leads to decreased uncertainty levels (Ahlers et al., 2015; Barrero et al., 2017; Foss et al., 2020; Leland & Pyle, 1977).

Decisions, including those related to finance and investment, are made under conditions of uncertainty (Foss et al., 2020; Vismara, 2018). Therefore, decision-makers will search for ways to reduce the controllable (endogenous) uncertainty by gathering credible information about the venture, while entrepreneurs can leverage signals to convey their qualities to potential investors (Bafera & Kleinert, 2022). When perceived as credible by investors, these signals can significantly

reduce the uncertainty associated with the intrinsic value of an investment opportunity (Connelly et al., 2011).

The ECF literature consistently posits that to bridge the information gap and reduce uncertainty between potential investors and fundraising entrepreneurs, the entrepreneurs need to effectively convey the venture's true quality and their dedication and future intentions. Specifically, signals provided in the form of financial indicators and human capital can serve as helpful informational cues when assessing the uncertainty associated with such investments.

First, earlier ECF research suggests that fundraising success is negatively associated with ownership share on offer or positively associated with ownership share retained by the entrepreneurs (e.g., Ahlers et al., 2015; Battaglia et al., 2022; Vismara, 2016). This is explained by the view that a higher ownership proportion retained by the entrepreneur can be read as a signal of the entrepreneur's commitment and self-confidence in the venture's future success prospects (Nitani et al., 2019). Accordingly, offering a larger share of ownership may signal lower commitment and lower self-confidence, hence leading to greater uncertainties.

Second, earlier ECF studies also find that the amounts raised in an ECF campaign are positively associated with the target goal amount set for the campaign (e.g., Lukkarinen et al., 2022; Troise et al., 2022; Vismara, 2016). This is explained by the view that setting higher fundraising goals may signal ambition and growth-orientation, therefore increasing the venture's perceived future value (Lukkarinen et al., 2016), especially when considering that the campaign has been quality-checked by the platform before its approval for publication (Tuomi & Harrison, 2017). At the same time, research also shows that target amounts are negatively associated with the likelihood of success in terms of reaching target goals (e.g., Ahlers et al., 2015; Troise et al., 2022; Vulkan et al., 2016). Taken together, one can assume that higher campaign goals reduce investors' uncertainty, as it requires greater efforts from entrepreneurs to convince a greater number of investors, in addition to passing the preliminary checks by the platform.

Third, and similarly, research shows that higher levels of ventures' pre-campaign valuations are associated with higher amounts raised, but a lower likelihood of campaign success overall (Coakley et al., 2022; Estrin et al., 2022; Johan & Zhang, 2022). This is explained by the view that higher valuation implies that more shares are made available at a set price (Hornuf & Schwienbacher, 2017). This increases

the dispersion of ownership among more investors, and hence reducing the influence of any individual investor on the entrepreneur and relevant strategic decision-making, while raising agency risks that may de-motivate investors (Estrin et al., 2022).

Fourth, ECF research shows that a venture's ability to successfully raise funds prior to a specific campaign (Estrin et al., 2022; Kleinert et al., 2020; Mamonov & Malaga, 2018), or at an early stage of it (Estrin et al., 2022; Lukkarinen et al., 2016; Vulkan et al., 2016), both are positively associated with the campaign's success overall. This has been explained as a signal indicating third-party endorsements (Kleinert et al., 2020), enhancing investor confidence and trust (Lukkarinen, 2020), especially when the fundraising venture has already successfully navigated the due diligence processes of professional investors (Mamonov & Malaga, 2018).

Fifth, while entrepreneurial finance research has suggested that having exit plans enhances the likelihood of investments by BAs (Sudek, 2006; White & Dumay, 2020) and VCs (Fried & Hisrich, 1994), early ECF literature often finds no such effects (Ahlers et al., 2015; Vismara, 2016). This was mostly explained as 'cheap talk' of ventures at a very early stage when using ECF for fundraising (Ahlers et al., 2015). However, since recent literature points towards a growing sophistication of both ECF investors and fundraising ventures (Lukkarinen et al., 2022), new evidence suggests a positive association between exit plans and funding success (Kleinert et al., 2020) and that plans of listing on a secondary market increase investor participation in the primary market (Lukkarinen & Schwienbacher, 2023), one can expect that exit and other foreseeable liquidation opportunities may carry growing impact on investor decisions, as risk reduction indicators.

Bringing the above insights together, we suggest that ECF campaigns offering a higher share of ownership, setting lower funding goals, higher valuations, low levels of prior funding, and not stating exit opportunities can be characterized as representing investments with higher uncertainty levels. On the other hand, campaigns offering small ownership shares, setting higher funding goals, lower valuations, having successful prior funding records, and those stating exit opportunities can be characterized as investments with lower uncertainty level. Hence, in accordance with the above, we hypothesize the following:

> **Hypothesis 1a:** ECF investors' decisions are negatively associated with the uncertainty level of a prospective investment.

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Exogenous shocks lead to higher levels of uncertainty. Unanticipated exogenous events are mostly associated with long-term uncertainty, leaving investors vulnerable due to the uncontrollable nature of events, forcing them to reevaluate their investment criteria and actions (Barrero et al., 2017; Diebold et al., 2010; Packard et al., 2017).

Several studies have examined the effects of global crises on economic markets, financial institutions, households, and investors. Lee and McKibbin (2004) showed that following the SARS epidemic, uncertainty concerning the affected economies' future led foreign investors to lose confidence and decrease their investments. Campello et al. (2010), found that during the 2008 financial crisis, 86% of financially constrained firms in the US had to reduce their investment activity. Hoffmann et al. (2013) found that during the financial crisis, individual investors' return expectations and risk tolerance has decreased, and uncertainty levels increased. Mason and Harrison (2015) discovered that business angels (BAs) amplified their investment count but diminished the amount invested per transaction. Block and Sandner (2009) reported a downturn in the average funding secured per round by firms in advanced stages during the GFC, which was further intensified by the then-unfavorable IPO markets.

Similarly, the COVID-19 outbreak increased uncertainty levels to its highest degree as measured by the economic policy uncertainty (EPU) index (see figure 1), developed by Baker et al. (2016). Indeed, uncertainty levels were viewed as greater than during the 2008 crisis and similar to those experienced during the Great Depression between 1929-1933. These were evaluated based on real-time stock market volatility measurements, newspaper-based measures of economic uncertainty, and a survey of perceived business-level uncertainty (Baker et al., 2020a; Baker et al., 2020b). Accordingly, the COVID-19 macroeconomic uncertainty shock raised concerns regarding its long-term implications for the economy, leading to decreased industrial production and employment rates. Concerning investments, equity transactions, and especially the accessibility of seed funding for startups who are the most vulnerable to extreme uncertainty conditions decreased dramatically during that period (Baker et al., 2020a; Brodeur et al., 2021; Brown & Rocha, 2020; Brown et al., 2020; Cowling et al., 2012).
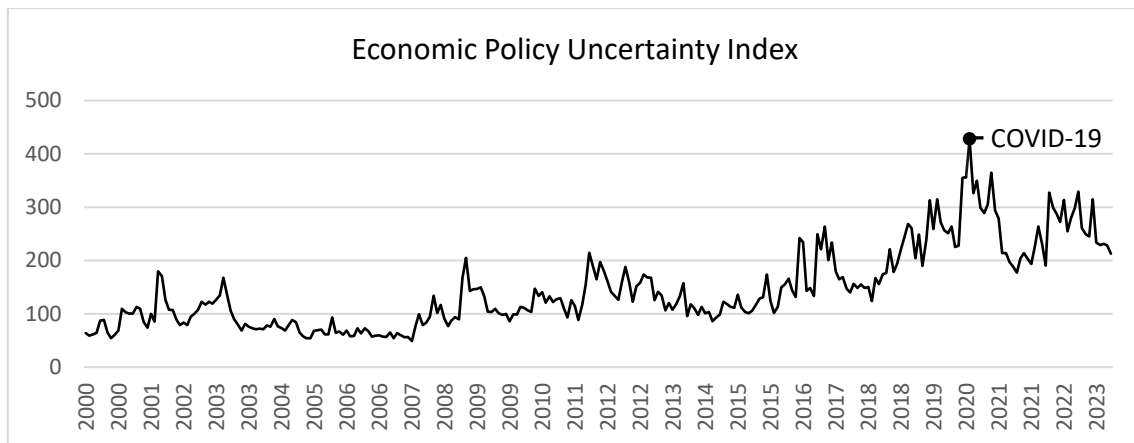
Figure. 1 Economic Policy Uncertainty Index

In the context of ECF, the Cambridge Alternative Finance Benchmarking Reports recorded a fall in global volumes from \$1.5 billion in 2018 to \$1 billion in 2019, bouncing back to \$1.5 billion by the end of 2020 (Ziegler et al., 2021). Similarly, Cumming et al. (2021) found that ECF volumes in the US remained stable overall with only a moderate decrease during the early days of the COVID-19 outbreak. Gama et al. (2023) found a negative association between daily COVID-19 cases and campaign success in peer-to-peer lending. Under such conditions fundraising entrepreneurs needed to recalibrate their offerings, while reflecting compensations for the greater market uncertainties. Such compensations may manifest in offering higher ownership share, settling for more conservative valuations, opting for leaner operations and hence aiming for lower sum goals, as well as reducing expectations for exit plans in foreseeable future, to name a few. Accordingly, due to the (endogenous) uncertainties associated with ECF more broadly and the extreme (exogeneous) uncertainty associated with COVID-19's macro-economic effects (Packard et al., 2017), we hypothesise that overall uncertainty of fundraising ventures in ECF will increase. Accordingly, we suggest the following hypotheses:

> **Hypothesis 1b:** ECF campaigns launched before the COVID-19 outbreak are associated with lower uncertainty levels compared to campaigns launched after the outbreak.

2.3. Human capital

Human capital is regarded as the set of knowledge and skills at a person's disposal (Becker, 2009; Piazza-Georgi, 2002). Becker (2009) distinguished between education as a form of investment in general human capital, and work experience as a form of specific human capital, using both to explain the relation between work skills and business outcomes. Similarly, Colombo and Grilli (2005) identified two human capital forms coining the terms "wealth effect" addressing education, and "capability effect" addressing experience. The general-wealth effect was proxied by the entrepreneur's education, academic degrees, and age. While specific-capabilities effect was proxied by the entrepreneur's industry-specific experience in the new venture's sector or other managerial experiences. Addressing productivity and success, Becker (2009) states that these two forms of human capital complement and reinforce each other. Here, schooling education mainly provides theoretical knowledge and analytical skills, while real-life professional experience provides practical insight into the business environment and operations, while developing discipline and abilities of working along customers, employees, and other relevant stakeholders.

Human capital, in the form of education, experiences, and skills, is a key factor in new ventures' performance (Colombo & Grilli, 2005; Piazza-Georgi, 2002). The entrepreneurial finance literature has long addressed the emphasis VCs and BAs put on the venture teams' human capital traits when making investment decisions (e.g., Mason & Stark, 2004; Mitteness et al., 2012; Muzyka et al., 1996; Pintado et al., 2007; Unger et al., 2011), positively associating human capital with the venture's likelihood of success and survival (Gimmon & Levie, 2010; Prohorovs et al., 2019; Unger et al., 2011).

Research on the role of human capital in ECF investors' decision-making begins with Ahlers et al. (2015) who showed positive associations between the number of board members and their education and successful campaign outcomes. Later, Piva and Rossi-Lamastra (2018) found that business education and, to a lesser degree, industry-related education were positively associated with campaign outcomes. Moreover, several studies show that ventures where the entrepreneurs held higher degrees at the master's or PhD levels were associated with more positive campaign outcomes (D'Agostino et al., 2022; Kleinert et al., 2020).

In terms of professional and work experience, research presents inconsistent results, which can be linked to use of different measurements. Here, some found that the founding team members' work experience, either industry-specific or other, was not significantly associated with campaign outcomes, but their entrepreneurial experience was positively associated with campaign outcomes (Piva & Rossi-Lamastra, 2018; Troise et al., 2022). Others found that ventures with team members with professional business or finance experience were more likely to achieve positive campaign outcomes (Barbi & Mattioli, 2019). However, one of the more consistent findings across studies suggests a positive association between the venture's team size and CF campaign outcome (Ahlers et al., 2015; Coakley et al., 2022; D'Agostino et al., 2022; Troise et al., 2022; Vulkan et al., 2016), as capturing the breadth of human capital that may be at the venture's disposal. Accordingly, we suggest the following hypothesis:

> **Hypothesis 2:** ECF investors' decisions are positively associated with the levels of human capital of the fundraising venture's team.

In addition to its direct effect on ECF investors' decisions, human capital may also exert an indirect effect when moderating the effect of uncertainty. Such effect may originate in the understanding that human capital in the form of both knowledge and experience may enhance the venture's team's ability to address adversities and challenges, as well as adjust to change and react well to risks (Bartel & Lichtenberg, 1987; Becker, 2009). In surveying BAs in the UK, Harrison and Mason (2017) found that the venture's founding team's human capital, in the form of knowledge and experience, has a risk reduction effect. Zacharakis and Meyer (1998) underlined the founding team's characteristics' importance in easing concerns with other uncertainties when information is limited. Moreover, and in the same spirit, earlier works argued that experienced entrepreneurs possess strategic skills that positively impact success (Baum & Silverman, 2004) and are better capable of dealing with problems and adverse situations (Hsu, 2007). Surprisingly, and to the best of our knowledge, this effect has not yet been examined in the ECF context. Hence, in line with the above, we suggest the following hypothesis.

> **Hypothesis 3:** The negative effect of uncertainty on ECF investors' decisions will be moderated by the levels of the venture team's human capital.

However, increasing uncertainties following the COVID-19 outbreak have led ventures to massive layoffs and salary cuts (Brown & Cowling, 2021; Kalogiannidis & Chatzitheodoridis, 2021). These trends are likely to have hit fundraising ventures as well, which may have experienced even greater pressures to present leaner budgets, leading them towards opting for less costly personnel, shrinking numbers of highly skilled employees, or reducing the number of costly experienced advisors in their management teams and boards. Accordingly, we hypothesize the following:

> **Hypothesis 4:** ECF campaigns launched before the COVID-19 outbreak are associated with higher levels of human capital than campaigns launched after the outbreak.

At the same time, under growing uncertainties following the COVID-19 outbreak, one may also assume that investors would further rely on human capital as a risk mitigation factor. This may be especially relevant, as previously acquired knowledge, education, and experience are unlikely to be affected by the pandemic directly but may become more valuable in tackling the challenges it may bring with it on the firm's path towards growth and survival. We therefore present hypothesis 5:

> **Hypothesis 5:** The negative effect of high market uncertainty on ECF investors' decisions will be moderated by the levels of the venture team's human capital both before and after the outbreak of COVID-19.

Figure 2 presents our overall theoretical model including all outlined hypotheses above.
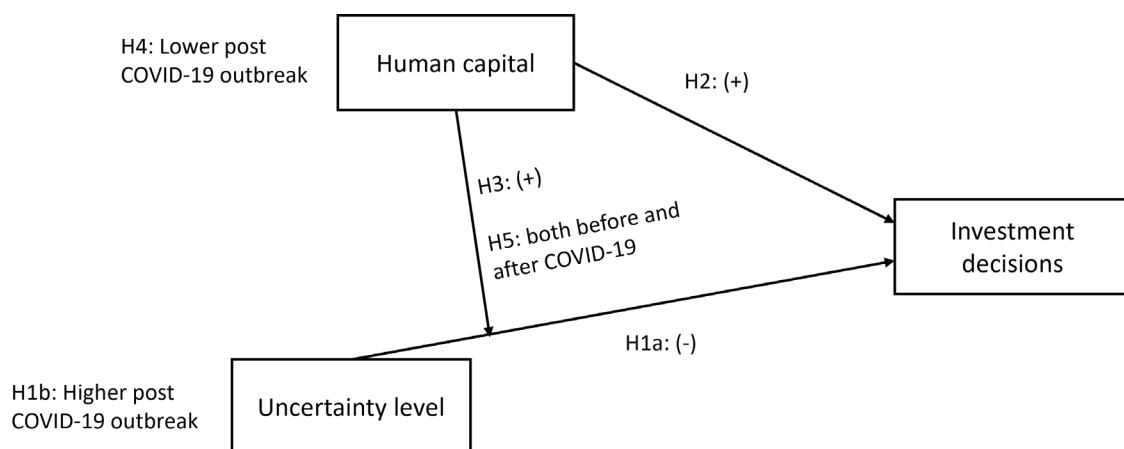

Figure 2. Conceptual model

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3. Data and methodology

3.1. Natural experiment

A natural experiment is a type of observational study that exploits naturally occurring phenomena in which the assignment of treatments to subjects has been determined by factors outside the control of the researchers such as natural disasters, policy changes, or economic fluctuations. Natural experiments serve as a valuable methodological approach for investigating naturally occurring situations as they unfold in the real world (Dunning, 2012; Leatherdale, 2019). Prior studies utilised COVID-19 as a natural experimental setting to evaluate its impact on public behaviour and mental health (Duncan et al., 2022; Prati & Mancini, 2021). In this study, we use the COVID-19 outbreak in March 2019, and its significant implications for economic uncertainties to study its effect on ECF investors' decision-making.

3.2. Context

Israel represents an interesting and relevant setting to conduct the natural experiment outlined in the current study. First, similar to other economies, the Israeli economy reacted strongly to the outbreak of COVID-19 in terms of a major increase in unemployment, as well as stock market volatility rates. On March 13, 2020, The Tel Aviv Volatility Index (VTA35) reached a peak, representing a one-day sharp increase of 58% in volatility (see figure 3), reflecting the concerns and pressure of investors from the spread of the coronavirus and its consequences on the global economy (Cafri, 2020). In the months before the crisis, unemployment rates in Israel stood at 3.3%, and with the outbreak of the coronavirus epidemic in March 2020 and the following restrictions, the average unemployment rate reached 16.4%. Unsurprisingly, the Israeli economy faced great uncertainty regarding the scope of the health crisis, its extent and its consequences on the capacity of the various industries to return to normal activity (Flug et al., 2021). However, Israel has reacted relatively fast to the COVID-19 outbreak, and by the end of March 2021, Israel was ahead of other OECD countries, having 55% of its population fully vaccinated (Rosen et al., 2021). Additionally, the Israeli government has allocated $42 billion in public support for businesses, including grants for coverage

of fixed costs during the crises and reduced municipal business taxes for SMEs and the self-employed (Kaplinski, 2021).

Second, Israel is strongly associated with its innovation-driven entrepreneurial ecosystem (GEM, 2018), ranking 10th globally on the Bloomberg 2018 Innovation Index and 10th on the Global Entrepreneurship Monitor's Entrepreneurial Spirit Index (GEM, 2018).

Third, Israel has a growing ECF market with 2022 volumes estimated at $29M, overseen by dedicated regulation, which became effective in 2018 (Efrat et al., 2020). Currently, companies can openly offer shares to unaccredited Israeli investors as long as the activity is taking place on a dedicated and authorised platform. From a fundraising venture's perspective, the regulation limits the amount that can be raised through ECF to $1.6M per year. Furthermore, from the individual unaccredited investor's perspective, the regulator limits the maximum investment to $2.8K per campaign and $5.6K per year (ECN, 2017).
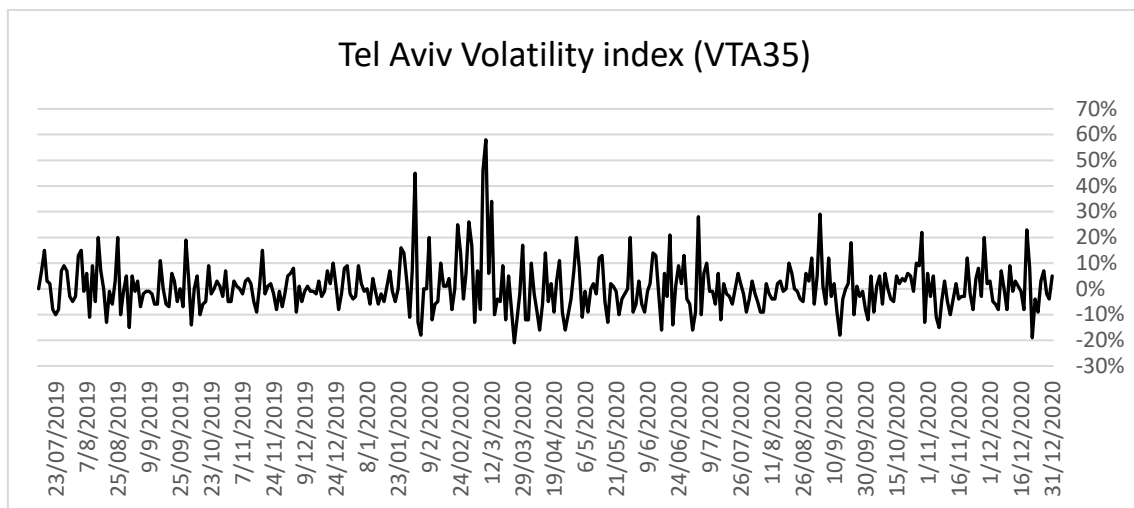
Figure 3. Tel Aviv Volatility index (VTA35)

3.3. Sample and variables

Our sample consists of the complete set of 13,362 investment decisions made by 8,683 unique unaccredited investors in 49 technology-based ventures ECF campaigns between July 2018 and December 2020 on the Israeli-based equity platform PipelBiz. The platform began its operations in 2015, offering securities to limited and accredited investors only. However, in 2018, the platform was authorized to operate as an Offering Coordinator, thus allowing privately held

companies to openly offer shares to unaccredited investors. The platform operates under the 'all-or-nothing' model, implying that fundraising ventures will only receive the funds raised if the funding goal was reached (Cumming et al., 2020). In 2020, it was reported that PipelBiz has raised more than $20M for early-stage ventures since its establishment (Sasson, 2020).

3.3.1. Individual investor-level decisions

Earlier research mostly assessed investment decisions at the aggregate level using the campaign level of analysis (e.g., Coakley et al., 2022; Nitani et al., 2019; Vismara, 2016; Vulkan et al., 2016). The current study is one of a handful that examines such decisions at the individual investor level. For capturing investment decisions in the ECF context, we use two measures. The first, funding amount measured by the log value of the monetary investment made by an individual investor in a particular campaign, as used in earlier research (Barbi et al., 2023; Hervé et al., 2019). The second, share of investment is the log value of the percentage an individual's investment out of total investments made by all investors in a particular campaign.

3.3.2. Capturing campaigns' uncertainty levels

Following earlier discussions, we have used the indicators identified in previous research to assess the uncertainty associated with each ECF campaign, including: (1) the share of equity on offer measured as the minimum percentage of ownership on offer for all investors in the specific campaign (e.g., Ahlers et al., 2015; Battaglia et al., 2022; Vismara, 2016); (2) the goal amount measured as the monetary value of the minimum goal amounts in USD (e.g., Lukkarinen et al., 2022; Troise et al., 2022; Vismara, 2016); (3) the pre-campaign valuation was measured as the monetary value in USD (e.g., Coakley et al., 2022; Estrin et al., 2022; Johan & Zhang, 2022); (4) indications of successful prior financing was measured with a dichotomous variable carrying the value 1 if information about prior financing was provided and 0 if not (Estrin et al., 2022; Kleinert et al., 2020; Mamonov & Malaga, 2018); and (5) presentation of an exit plan was measured with a dichotomous variable carrying the value 1 if any form of exit plan was mentioned in the campaign, and 0 if not (Kleinert et al., 2020).

Since all these indicators are likely to be highly intercorrelated, we cluster campaigns into two distinct clusters labelled as 'high' and 'low' uncertainty level campaigns. To assign these values we used a cluster analysis procedure (Ketchen & Shook, 1996), and more specifically, the k-means clustering algorithm method. This approach divides the data to a pre-specified number of clusters according to the minimum distance within clusters and maximum distance between clusters (Hair et al., 2018).

Accordingly, the 'high-uncertainty' campaigns' cluster is comprised of 8,547 observations, representing 63.96% of the sample. This cluster offered a higher share of equity (3.177%), aimed to raise lower funding amount ($186,400), had a lower pre-money valuation, presented fewer exit opportunities, and provided less evidence on prior funding. The 'low-uncertainty' campaigns' cluster is comprised of 4,815 observations, representing 36.04% of the sample. This cluster offered a lower share of equity (1.624%), targeted higher funding amounts ($208,768), had a higher pre-money valuation, presented exit opportunities, and provided more evidence on prior funding. A one-way ANOVA revealed a statistically significant difference ($p < 0.001$) between all clustering variables. Table 1 provides descriptive statistics on each cluster and the significance of differences using ANOVA.

Table 1: Two-clusters solution

	Mean (SD)	Mean (SD)	ANOVA F value	Sig.
Clustering variables	Cluster 1 (n=8547)	Cluster 2 (n=4815)		
Target Min ($)	186,400.049 (87507.063)	208,768.608 (96929.341)	186.0337	0.000
Company Valuation ($)	5,571,783 (2,025,720)	13,293,281 (2,169,825)	42493	0.000
Min Equity Offered (%)	3.177 (2.525)	1.624 (0.820)	1720.015	0.000
Exit opportunity	0.216 (0.412)	0.315 (0.465)	160.7682	0.000
Prior Financing	0.289 (0.453)	0.533 (0.499)	829.4047	0.000
Cluster label	High uncertainty level	Low uncertainty level		

Table 1: Two-clusters solution

3.3.3. Human capital measurements

Since earlier literature has measured human capital using different measures, we have opted for creating a single continuous measure involving multiple items that

jointly load on a single factor. Accordingly, we have followed a factor analysis procedure. To ensure our data lends itself to such analyses, we first ensured that both the Bartlett's test of sphericity, testing the overall significance of all correlations in the correlation matrix, was significant ($\chi2$ (6) = 20034.426, p<0.001), as well as that the KMO measure of sampling adequacy indicated that the strength of the relationships among variables was good (KMO=0.784).

For constructing a single human capital factor we have used the following items: (1) a dummy variable for professional experience, indicating that at least one team member has previous working experience in the field of business or finance (Barbi & Mattioli, 2019; Lukkarinen et al., 2016), (2) industry experience is a dummy variable indicating whether at least one team member has previously worked in the same sector in which the venture operates (Barbi & Mattioli, 2019; Lukkarinen et al., 2016; Piva & Rossi-Lamastra, 2018), (3) entrepreneurial experience is a dummy variable indicating that at least one team member worked for an entrepreneurial venture in the past (Piva & Rossi-Lamastra, 2018), and (4) the number of team members (using the log value), captured the number of people working for the venture (Ahlers et al., 2015; Barbi & Mattioli, 2019). All four items we used loaded highly on a single factor, achieving a Cronbach's alpha of 0.811, which is above the 0.7 recommended threshold (Hair et al., 2018).

3.3.4. Control variables

We control for several variables. First, to capture variables associated with the investor's characteristics, we include investor age at the time of investment and Gender (Hervé et al., 2019). To control for the product characteristics we include two dummy variables product certification by an expert intermediary (Bapna, 2019; Mohammadi & Shafi, 2018), and product protectability capturing whether the company has protected its intellectual property via patents (Ahlers et al., 2015; Mohammadi & Shafi, 2018; Ralcheva & Roosenboom, 2020). We further control for company age, as a proxy for the firm's developmental stage (Barbi & Mattioli, 2019; Hervé et al., 2019; Lukkarinen et al., 2016). Finally, we further control for founder employment capturing whether the founder is fully employed by the venture or not.

Descriptive statistics of all variables are reported in Table 2, and a correlation matrix is provided in Table 3.

Table 2: Descriptive Statistics, Equality of Variance, and Equality of Means Tests

Variable	Period (before/after Covid outbreak)	Mean	Std. Dev	Levene's Test for Equality of Var		t-test for Equality of Means				
				F	Sig.	Equal variances	t	df	Sig. (2-tail)	Mean Difference
Gender	Full sample	0.139	0.346							
	Before	0.138	0.345	0.210	0.647	assumed	-0.229	13360	0.819	-0.001
	After	0.140	0.347			not assumed	-0.229	13292.863	0.819	
Log_Investor_Age	Full sample	1.560	0.158							
	Before	1.548	0.157	0.957	0.328	assumed	-8.749	13360	0.000	-0.024
	After	1.572	0.159			not assumed	-8.751	13298.294	0.000	
Log_Company_age	Full sample	3.038	0.542							
	Before	2.864	0.653	1606.219	0.000	assumed	-37.537	13360	0.000	-0.335
	After	3.199	0.340			not assumed	-36.737	9513.186	0.000	
ComCEO	Full sample	0.622	0.485							
	Before	0.732	0.443	1859.508	0.000	assumed	25.864	13360	0.000	0.212
	After	0.520	0.500			not assumed	25.981	13332.435	0.000	
Product Certification	Full sample	0.493	0.500							
	Before	0.553	0.497	5.501	0.019	assumed	13.517	13360	0.000	0.116
	After	0.437	0.496			not assumed	13.515	13280.045	0.000	
Product Protectability	Full sample	0.623	0.485							
	Before	0.459	0.498	2584.072	0.000	assumed	-39.724	13360	0.000	-0.315
	After	0.775	0.418			not assumed	-39.464	12583.343	0.000	
HC_Factor	Full sample	0.000	0.928							
	Before	3.105	0.575	3657.366	0.000	assumed	33.035	13360	0.000	0.511
	After	2.595	1.109			not assumed	33.757	10579.764	0.000	
Uncertainty level	Full sample	0.640	0.480							
	Before	0.556	0.497	1209.428	0.000	assumed	-19.640	13360	0.000	-0.161
	After	0.717	0.450			not assumed	-19.568	12973.590	0.000	
HC X Uncertainty	Full sample	1.801	1.513							
	Before	1.690	1.590	1284.151	0.000	assumed	-8.130	13360	0.000	-0.212
	After	1.903	1.431			not assumed	-8.098	12943.559	0.000	
Log_Inv_amount_USD	Full sample	2.6434	0.3807							
	Before	2.633	0.392	34.368	0.000	assumed	-2.949	13360	0.003	-0.019
	After	2.653	0.370			not assumed	-2.943	13126.141	0.003	
Log_Share_investment	Full sample	-3.012	0.460							
	Before	-3.045	0.478	119.035	0.000	assumed	-7.910	13360	0.000	-0.063
	After	-2.982	0.440			not assumed	-7.885	13036.375	0.000	
COVID	Full sample	0.519	0.500							

Notes: Full sample N = 13362, Before COVID-19 outbreak, N = 6430, After COVID-19 outbreak, N= 6932

Table 3: Correlation Matrix – Full sample

		1	2	3	4	5	6	7	8	9
1	Gender	1								
2	ComCEO	-0.010	1							
3	Log_Company_age	-0.029**	0.220***	1						
4	HC_Factor	-0.015	0.109***	0.119***	1					
5	Uncertainty level	0.001	-0.300***	-0.143***	-0.037***	1				
6	Product Certification	-0.013	0.438***	0.124***	0.112***	-0.509***	1			
7	Product Protectability	0.029**	-0.011	0.147***	-0.220***	-0.083***	-0.178***	1		
8	COVID-19	0.002	-0.218***	0.309***	-0.275***	0.168***	-0.116***	0.325***	1	
9	Log_Share_Investment	-0.046***	0.067***	0.052***	-0.089***	0.094***	-0.046***	-0.060***	0.068***	1
10	Log_Inv_amount_USD	-0.044***	0.075***	-0.001	0.072***	-0.095***	0.110***	0.080***	0.026**	0.718***

Notes: N =13362, Significance: * P ≤ 0.05, ** P ≤ 0.01, *** P ≤ 0.001

Table 3: Correlation Matrix – Full sample

Table 4: Regression Analysis; DV: Log inv Amount

	Full Sample			Before Covid-19 Outbreak			After Covid-19 Outbreak		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	1.814***	1.789***	1.737***	1.745***	1.614***	1.352***	1.722***	1.689***	1.5321***
	(0.037)	(0.038)	(0.040)	(0.053)	(0.061)	(0.082)	(0.060)	(0.059)	(0.062)
Gender (0=male)	-0.091***	-0.090***	-0.090***	-0.095***	-0.094***	-0.096***	-0.088***	-0.086***	-0.083***
	(0.009)	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)
LInvAge	0.529***	0.520***	0.522***	0.560***	0.566***	0.571***	0.490***	0.478***	0.482***
	(0.020)	(0.020)	(0.020)	(0.031)	(0.031)	(0.031)	(0.027)	(0.026)	(0.026)
Com CEO	0.041***	0.042***	0.046***	-0.012	-0.012	-0.024	0.077***	0.090***	0.104***
	(0.008)	(0.008)	(0.008)	(0.015)	(0.015)	(0.015)	(0.010)	(0.010)	(0.010)
Certificate	0.089***	0.068***	0.074***	0.034**	0.040***	0.048***	0.126***	0.053***	0.069***
	(0.007)	(0.008)	(0.008)	(0.010)	(0.011)	(0.011)	(0.010)	(0.013)	(0.013)
Protect	0.065***	0.068***	0.070***	0.016	0.024*	0.039**	0.151***	0.167***	0.176***
	(0.007)	(0.007)	(0.007)	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)	(0.011)
LComAge	-0.033***	-0.053***	-0.055***	0.006	-0.002	0.005	-0.012	-0.006	0.007
	(0.006)	(0.007)	(0.007)	(0.009)	(0.010)	(0.011)	(0.013)	(0.013)	(0.013)
HC factor		0.040***	0.056***		0.041***	0.113***		0.046***	0.078***
		(0.004)	(0.005)		(0.009)	(0.017)		(0.004)	(0.006)
Uncertainty level		-0.037***	0.049*		0.017	0.327***		-0.107***	0.072**
		(0.008)	(0.023)		(0.012)	(0.066)		(0.012)	(0.025)
Uncertainty X HC			-0.029***			-0.096***			-0.065***
			(0.007)			(0.020)			(0.008)
Covid-19	0.017*	0.047***	0.048***						
	(0.007)	(0.008)	(0.008)						
R^2	0.074	0.083	0.084	0.053	0.056	0.060	0.120	0.144	0.153
R^2 change		0.011	0.001		0.003	0.003		0.024	0.008
N	13362	13362	13362	6430	6430	6430	6932	6932	6932

Unstandardized coefficients are reported, with standard errors in parentheses. Significance noted as: * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$

Table 5: Regression Analysis; DV: Log Share inv

	Full Sample			Before Covid-19 Outbreak			After Covid-19 Outbreak		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	-0.053***	-3.885***	-3.955***	-0.084***	-0.040	-0.1246	-0.028	0.048	-0.161*
	(0.008)	(0.046)	(0.049)	(0.010)	(0.066)	(0.089)	(0.015)	(0.073)	(0.077)
Gender (0=male)	-0.010***	-0.098***	-0.098***	-0.013***	-0.118***	-0.119***	-0.006	-0.074***	-0.071***
	(0.002)	(0.011)	(0.011)	(0.003)	(0.015)	(0.015)	(0.003)	(0.015)	(0.015)
LInvAge	0.076***	0.550***	0.552***	0.086***	0.615***	0.616***	0.062***	0.413***	0.418***
	(0.005)	(0.025)	(0.025)	(0.006)	(0.034)	(0.034)	(0.007)	(0.033)	(0.033)
ComCEO	0.005**	0.138***	0.143***	-0.022***	-0.101***	-0.105***	0.015***	0.186***	0.204***
	(0.002)	(0.009)	(0.009)	(0.003)	(0.016)	(0.016)	(0.003)	(0.013)	(0.013)
Certific	-0.016***	-0.068***	-0.060***	-0.025***	-0.130***	-0.127***	-0.010***	-0.040*	-0.018
	(0.002)	(0.010)	(0.010)	(0.002)	(0.012)	(0.012)	(0.003)	(0.016)	(0.016)
Protect	-0.011***	-0.127***	-0.125***	-0.008***	-0.086***	-0.082***	-0.005	-0.058***	-0.046***
	(0.002)	(0.009)	(0.009)	(0.002)	(0.012)	(0.013)	(0.003)	(0.013)	(0.013)
LComAge	0.003	0.046***	0.044***	0.017***	0.288***	0.290***	0.000	0.016	0.034*
	(0.001)	(0.008)	(0.008)	(0.002)	(0.011)	(0.012)	(0.003)	(0.016)	(0.017)
Uncertainty level		0.077***	0.193***		0.249***	0.349***		-0.036*	0.203***
		(0.010)	(0.027)		(0.013)	(0.072)		(0.015)	(0.031)
HC Factor		-0.057***	-0.036***		-0.282***	-0.259***		0.001	0.044***
		(0.004)	(0.006)		(0.010)	(0.019)		(0.005)	(0.007)
Uncertainty X HC			-0.039***			-0.031			-0.087***
			(0.009)			(0.022)			(0.010)
COVID-19	0.005**	0.055***	0.057***						
	(0.002)	(0.009)	(0.009)						
R^2	0.029	0.080	0.082	0.076	0.250	0.2507	0.017	0.068	0.078
R^2 Change		0.051	0.001		0.174	0.000		0.051	0.011
N	13362	13362	13362	6430	6430	6430	6932	6932	6932

Unstandardised coefficients are reported, with standard errors in parentheses. Significance noted as: * $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$

4. Results

Tables 4 and 5 present the results of the regression analyses. Table 4 reports the results when using the log transformation of investment amount as the dependent variable, and table 5 presents the results when using the log transformation of the share of investment as the dependent variable.

4.1. Control variables

Model 1 reports the unique effects of the control variables, which are largely in line with the findings of previous research (Barbi et al., 2023; Hervé et al., 2019). A negative coefficient of Gender and a positive coefficient of age (p-value < 0.001), show that, on average, males and older investors invest larger amounts than female and younger investors. Founder's employment was found to have a significant and positive affect on the investment amount (p-value < 0.001), and investment share (p-value < 0.01). Product External certification and product protectability were found to have a positive and significant effect on investment amount (p-value<0.001), while a negative and significant effect on the share of investment (p-value<0.001). Firm age was found to be positively associated with investment amount (p-value < 0.001).

4.2. Uncertainty level

In model 2 we introduce the independent variables. The campaign's uncertainty level was found to be negatively associated with investment amount (coefficient = -0.037, p-value < 0.001), while positively associated with the share of investment (coefficient = 0.077, p-value < 0.001). This evidence partly supports H1a.

4.3. Human capital

Human capital was found to be positively and significantly associated with investment amount (coefficient = 0.040, p-value < 0.001), while having a negative and significant association with investment share (coefficient = -0.057, p-value < 0.001). This evidence partly supports H2.

4.4. Interaction effect

In model 3 we introduce the interaction effect, hypothesising that human capital will moderate the effect of uncertainty on investment decision-making. We find a negative moderation effect when using the investment amount as a dependent variable (coefficient= -0.029, p-value < 0.001), as well as when using the share of investment as a dependent variable (coefficient= -0.039, p < 0.001), hence confirming H3.

To facilitate the interpretation of the moderation effects, we used the PROCESS SPSS path analysis macro (Hayes, 2017) for graphical representation. Figures 4 and 7 present the interactions when using the full sample, and when using investment amount and share of investment as dependent variables, respectively. Figure 4 shows that investment amounts in low-uncertainty campaigns increase when human capital levels are high to a greater extent than in high-uncertainty campaigns. Figure 7 shows that investment shares in high-uncertainty campaigns decrease when human capital levels are high to a greater extent than in low-uncertainty campaigns. Both cases present a reduction in the effect of uncertainty thanks to human capital, where higher amounts are invested in low-uncertainty campaigns, and a lower share of ownership is required in high-uncertainty campaigns to compensate for risks taken.

4.5. High market uncertainty: COVID-19

We use a natural experiment setting to study the effect of the high uncertainty caused by an exogenous shock on ECF investors' decision-making. For this purpose, we divide our sample into two sub-samples: before and after the COVID-19 outbreak. We use March 2020 as our critical splitting point, the date when the Israeli government enforced the first lockdown and social distancing policies (TOI, 2020). As a result, we ended up with 6,430 observations from the period before the COVID-19 outbreak and 6,932 observations from the period after the COVID-19 outbreak.
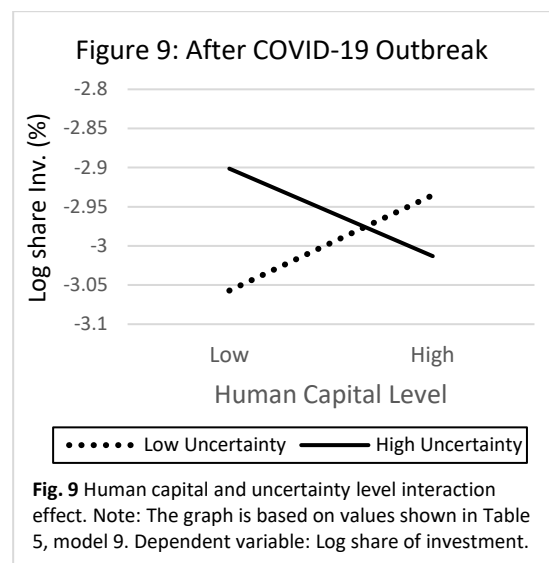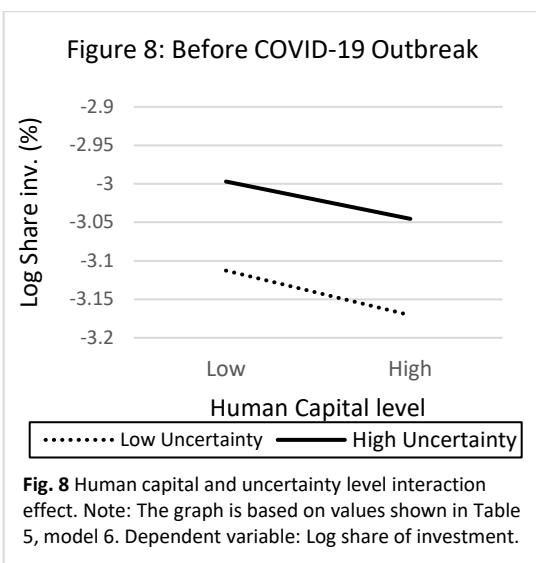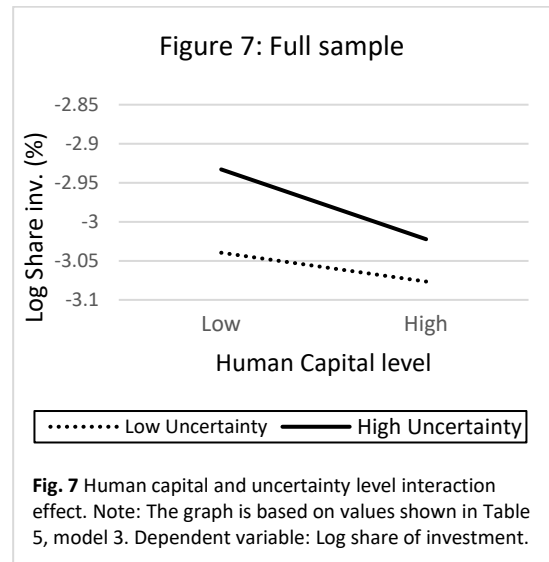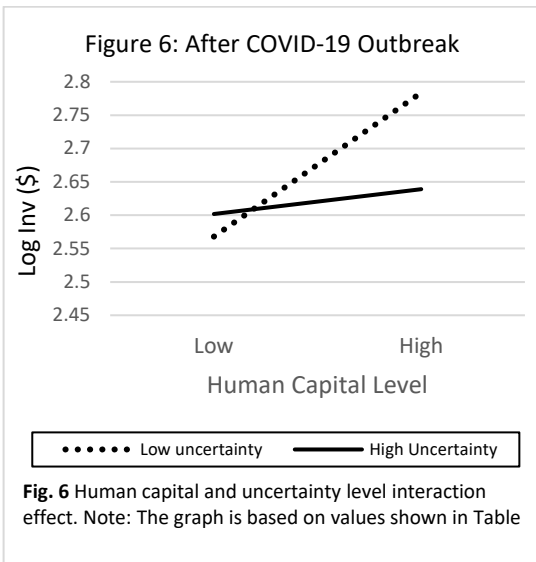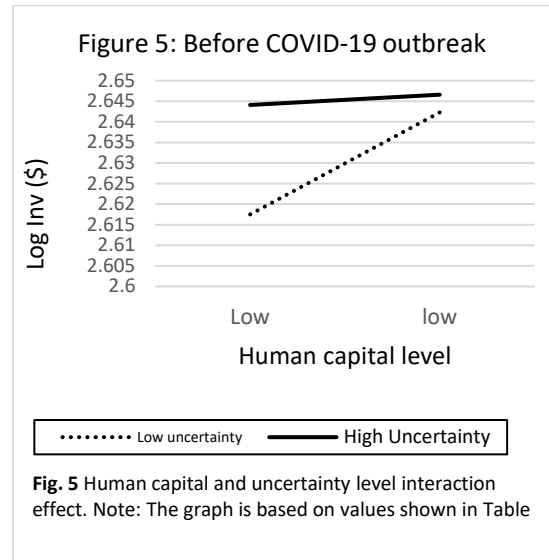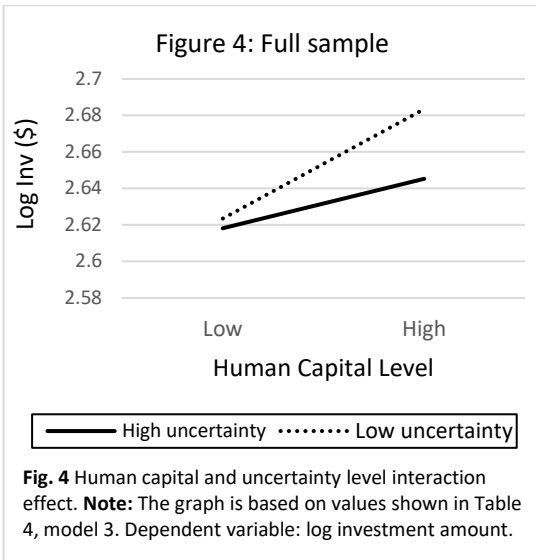
H1b suggested that campaigns launched before the COVID-19 outbreak are associated with lower uncertainty when compared to campaigns launched after the COVID-19 outbreak. Table 2 shows that the mean scores of campaigns' uncertainty level was 0.556 and 0.717, before and after the outbreak, respectively.

Since equality of variance between the two scores was disconfirmed, we test for significance of mean differences under the assumption of unequal variances. Our findings indicate that uncertainty levels were significantly higher after the COVID-19 outbreak (t(12973.590) = -19.568, p < 0.001). Thus, H1b is supported.

H4 suggested that campaigns launched before the COVID-19 outbreak are associated with higher human capital levels when compared to campaigns launched after the COVID-19 outbreak. Table 2 shows that the mean scores of campaigns' human capital were 3.105 and 2.595, respectively, before and after the outbreak. Since equality of variance between the two scores was again disconfirmed, we test for significance of mean differences under the assumption of unequal variances. Our findings indicate that human capital levels were significantly higher before the COVID-19 outbreak (t(10597.764) = 33.757, p < 0.001). Thus, H4 is supported.

H5 suggested that the team's human capital moderates the effects of the campaign's uncertainty levels on investment decisions. In models 6 and 9, we introduce the interaction term. First, when considering investment amount as the dependent variable, we find a moderation effect both before (coefficient= -0.096, p-value<0.001) and after (coefficient= -0.065, p-value<0.001) the COVID-19 outbreak. Second, when considering the share of investment as the dependent variable, we find a moderation effect after the COVID-19 outbreak (coefficient= -0.087, p-value<0.001) but not before it (coefficient= -0.031, n.s.). Hence, partially supporting H5.

Again, we provide graphical representations of the interaction effects to facilitate the interpretation of the moderation effects. Figures 5 and 6 represent the interaction effects before and after the COVID-19 outbreak, when using investment amount as the dependent variable. In both periods we see that investment amounts in low-uncertainty campaigns increases when human capital levels are high to a greater extent than in high-uncertainty campaigns. Figures 8 and 9 represent the interaction effects before and after the outbreak, when using share of investment as the dependent variable. In Figure 8, we see that the decrease in share of investment thanks to improved human capital does not differ between high and low uncertainty campaigns before the COVID-19 outbreak. However, Figure 9, on the other hand, shows that after the outbreak the share of ownership decreases with higher human capital of high-uncertainty campaigns, but increases with higher human capital in low-uncertainty campaigns. This indicates that under

Figure 4: Full sample

Fig. 4 Human capital and uncertainty level interaction effect. **Note:** The graph is based on values shown in Table 4, model 3. Dependent variable: log investment amount.

Figure 5: Before COVID-19 outbreak

Fig. 5 Human capital and uncertainty level interaction effect. Note: The graph is based on values shown in Table

Figure 6: After COVID-19 Outbreak

Fig. 6 Human capital and uncertainty level interaction effect. Note: The graph is based on values shown in Table

Figure 7: Full sample

Fig. 7 Human capital and uncertainty level interaction effect. Note: The graph is based on values shown in Table 5, model 3. Dependent variable: Log share of investment.

Figure 8: Before COVID-19 Outbreak

Fig. 8 Human capital and uncertainty level interaction effect. Note: The graph is based on values shown in Table 5, model 6. Dependent variable: Log share of investment.

Figure 9: After COVID-19 Outbreak

Fig. 9 Human capital and uncertainty level interaction effect. Note: The graph is based on values shown in Table 5, model 9. Dependent variable: Log share of investment.

higher uncertainty conditions human capital serves as an uncertainty reduction indicator moderating the need to compensate for uncertainty level with higher equity stakes, but also as a value accelerator in low uncertainty campaigns leading investors to acquire higher ownership stakes for leveraging the unique combination of low uncertainty and high human capital in otherwise adverse market conditions.

5. Discussion

Our analyses of key factors affecting ECF investor decisions present several interesting findings. First, we find that campaign uncertainty levels are negatively associated with amounts invested. This supports earlier findings using data both at the individual investor (Barbi et al., 2023) and aggregate campaign levels (e.g., Estrin et al., 2022; Kleinert et al., 2020; Lukkarinen et al., 2022; Vismara, 2016). Furthermore, we show that uncertainty levels are positively associated with share of investment, indicating that ECF investors compensate for taking greater risks by acquiring larger shares of ownership in the relevant ventures. Nevertheless, we do so while referring to a composite measure of various uncertainty indicators rather than individual indicators, as was done in earlier studies, while better capturing overall venture uncertainty perceptions without bias towards specific indicator effects.

Second, we show that a venture's human capital attributes are positively associated with amounts invested. This also supports earlier findings mostly identifying such associations at the aggregate campaign levels (e.g., Ahlers et al., 2015; Battaglia et al., 2022; Piva & Rossi-Lamastra, 2018; Troise et al., 2022). Additionally, we find that human capital levels are negatively associated with share of investment, indicating that ECF investors acknowledge the added value of human capital to firm valuations, leading them to be satisfied with lower share of ownership in firms having teams with a strong human capital profile. Here, again we do so while referring to a composite measure of human capital rather than different individual indicators separately, while minimising measurement bias due to any specific indicator effects.

Third, we present findings regarding the interaction effect between uncertainty level and human capital on ECF investment decisions. Here, we find that human capital moderates the effects of uncertainty on investment decisions by serving as

a risk mitigator (Harrison & Mason, 2017; Zacharakis & Meyer, 1998). Accordingly, when available it leads to greater amounts invested, and the taking of a lower share of total investments by individual investors. To the best of our knowledge, the current study is one of the first to document such effect in the ECF context.

Fourth, we provide evidence that high uncertainty, as caused by an exogenous shock, effects ECF investors' decision-making. Here, we present evidence that the profiles of ventures using ECF before and following the COVID-19 outbreak differ significantly. Campaigns in the period following the outbreak are characterised by higher uncertainty levels and lower human capital levels. The former may be explained by the general rising cost of equity capital under conditions of increased uncertainties (Ke, 2022; Liu & Wang, 2022). And the latter can be explained by the reasoning that growing market uncertainties results in lower investments in human resources, layoffs, and salary cuts (Brown & Cowling, 2021; Kalogiannidis & Chatzitheodoridis, 2021), which may leave ventures with weaker teams overall.

Fifth, when comparing the above-mentioned effects before and after the COVID-19 outbreak we find different results. While human capital has a positive association with amounts invested before and after the outbreak, it only had a negative effect on share of investment before the outbreak, but not after it. Seen together with the finding above about lower levels of human capital after the outbreak, one can assume that this reduction in human capital has weakened its effect on the share of investments taken up by ECF investors after the outbreak.

Next, when considering the uncertainty level associated with the venture as an investment object, we see a negative effect on amounts invested after the outbreak but not before it. Furthermore, we find it has a positive effect on share of investment before the outbreak but a negative effect after it. Here, again, taken together with the finding that uncertainty levels have increased after the outbreak, one can assume there is less willingness to invest, which translates both into lower amounts invested and taking up lower shares of investment. Before the outbreak, or under normal circumstances, uncertainties indeed have led to taking larger shares if investment to compensate for risks taken. However, when both venture and environmental uncertainties are enhanced at the same time as following the outbreak, investors may tend to limit their exposure to the risk by limiting the share of ownership they take as well.

Finally, when examining the uncertainty reduction moderation role of human capital on investment decisions, we find it to be evident both before and after the COVID-19 outbreak with respect to amounts invested. However, while we find the same effect on share of investment taken by investors after the outbreak, we do not find evidence for such effect before the outbreak. This indicates a further growing importance of human capital under conditions of greater market uncertainties, as an element not only helping to mitigate firm level uncertainties, but also market level uncertainties.

6. Conclusions

The current study sought to examine the potential effects of campaign uncertainty, human capital, and their interaction on individual investors' decisions in the ECF context. Furthermore, it also tested these effects' consistency under conditions of growing market uncertainties as caused by an exogenous economic shock. Overall, we find that the venture's uncertainty level is negatively associated with investment decisions, that human capital is positively associated with them, and that it further moderates the concerns with venture uncertainties in such decisions.

Our findings make several contributions. First, we present evidence that a venture's human capital does not only effect investors decision directly, but also moderates the effect of venture uncertainties on such decisions. We show that these effects hold also under conditions of growing market uncertainty. Second, to the best of our knowledge, this is a first attempt to use a natural experiment setting to study the effect of high market uncertainty caused by exogenous shock on investors decision-making. Third, most studies on ECF decision-making used data from European-based platform (Block et al., 2018; Piva & Rossi-Lamastra, 2018; Shafi, 2021), this is one of the first studies utilizing data from a less explored context. Forth, while prior research focused on campaign-level analysis, our analysis is at the individual investor level, suggesting new composite measures for human capital and campaign uncertainty, as well as comparing our findings in two different time periods reflecting both controllable (endogenous) and uncontrollable (exogenous) uncertainties, before and after the COVID-19 outbreak. Finally, we present composite measures of venture uncertainty and human capital, while minimizing biases of any individual indicator, which may better reflect complex perceptions influenced by multiple indicators rather than any individual ones.

Nevertheless, the current study also has several limitations that should be acknowledged and serve as fruitful grounds for future research. First, this study uses a large dataset from a concrete context, which may represent limitations on the generalizability of the findings into other contexts. Accordingly, future studies may revisit our hypotheses based on data collected in different national contexts, platforms, and with respect to different investment crowdfunding models (such as lending, invoice trading, real-estate investments, or bonds). Second, while our primary focus was on examining the interaction effect of human capital and uncertainty on investment decisions, other interaction effects that may be relevant remain outside the scope of the current study. In particular it may be worth exploring potential interactions of social capital with uncertainty as well as with human capital on investment decisions, as social capital has been identified as a critical asset underlying crowdfunding dynamic (Cai et al., 2021).

Finally, our findings may also present relevant insights for practitioners. First, entrepreneurs considering ECF fundraising should, to the extent possible, design their offerings in a manner conducive to more positive investor reactions. This includes elements contributing to uncertainty reduction such as offering lower ownership shares, attempting at raising higher amounts of funding, presenting realistically high pre-campaign valuations, providing information about prior funding successes, and presenting long-term exit plans. Additionally, entrepreneurs should pay special attention towards enhancing their human capital endowments thanks to its direct and indirect effects on investment decisions by clearly highlighting the team's educational background, industry, and entrepreneurial experiences, as well as in recruiting relevant members to strengthen existing teams when necessary. Such information should be clearly stressed in campaign presentations and messaging. Second, the same insights can also inform platform design and campaign advice provided by platform managers to aspiring fundraisers. Here, platforms may create easier and more appealing visualizations of human capital indicators, as well as investment terms and financial indicators, making such information more easily available to prospective investors. Finally, platforms may create automatic content generators for promotional efforts, extracting information these specific information points from the campaign texts, for a more effective promotions of campaigns.

7. References

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