Essay 1:

Post-fundraising performance of equity crowdfunding firms: The role of professional investors

Abstract:

This study investigates the role of professional investors in the post-fundraising performance of equity crowdfunding (ECF) companies. Utilising an augmented dataset of 1,034 ECF firms that successfully raised funds on Crowdcube, Seedrs, and SyndicateRoom between 2011 and 2022, our analysis shows that BA-backed and VC-backed firms (portfolio firms) have superior growth prospects than non-backed firms. However, the positive relationship between the presence of BAs or VCs and firm growth is moderated by firm age at the time of investment. This effect is evident when BAs invest in firms older than two years old and VCs invest in younger firms. Besides, BA-backed and VC-backed firms are inferior to non-backed firms in profitability. While VC-backed firms have fewer granted patent numbers than non-backed firms over the sample period, BA involvement positively correlates with the number of granted patents during the first three years before turning negative thereafter. The intangible assets ratio of BA-backed and VC-backed firms is lower than that of non-backed firms. Regarding co-investment structures, we find a negative relationship between syndicated firms (i.e., co-investment of more than one BA/VC) and innovative performance. This study is relevant for ECF firms in determining whether professional investors are crucial for long-term success and, if so, which types of professional investors or co-investment structures are the best fit.

1. Introduction

Equity crowdfunding (ECF) is the method to raise capital in return for shares through an open call on Internet-based platforms (Ahlers et al., 2015). Both professional and retail investors can invest in the campaigns listed on the ECF platforms, with business angels (BAs) and venture capitalists (VCs) being the leading players in the ECF market (Wang et al., 2019)[1]. BAs are high-net-worth accredited investors who not only invest capital but also provide business expertise, connections and mentorship to startups (Drover et al., 2017; Van Osnabrugge, 2000). Whereas VCs are professional investors who raise funds from many investors to invest in startups (Gompers & Lerner, 2000; Van Osnabrugge, 2000). VCs invest more significant amounts of capital than BAs and offer startups guidance and industry connections. Retail investors are those investing a small amount of money, so holding a

[1] Business Angels and Venture Capitalists are also among the major financial providers for young firms in traditional financial markets.

relatively small number of company shares (see Section 2.2) (Signori & Vismara, 2018; Vismara, 2019).

Professional investors participate in the ECF market for several reasons. First, investing in startups seems highly risky, but the success of a startup can help professional investors achieve a "winner-take-all market" situation where few competitors survive (Block et al., 2018). Second, financial technology advances facilitate risk assessment, financial information treatment, and monitoring cost reduction (Block et al., 2018), making it convenient for professional investors to invest in ECF firms. Third, startups possess innovative ideas and talented human resources that professional investors are eager to acquire. Fourth, professional investors sometimes invest in ECF firms due to the convenience and hand-off nature of the ECF market (Wang et al., 2019). In the traditional entrepreneurial financial market, BAs and VCs play a central role, offering guidance and support to their portfolio firms. Meanwhile, in the ECF market, they can act similarly to retail investors and treat their investments as passive since they do not necessarily need to contribute to the portfolio firms. Retail investors' investment motives in the ECF market are dominant by financial motives (i.e., return on investment), but non-financial motives (i.e., helping others, being a part of the community, and trusting others) also play a role (Cholakova & Clarysse, 2015). Empirical evidence has underscored the importance of BA(s) and VC(s) on ECF funding success and post-offering outcomes.[2] Professional investors undertake due diligence before investing in a startup; therefore, professional investors (i.e., VCs or BAs) backing startups provide positive signals about the campaign's success (Fricke et al., 2021; Lukkarinen & Schwienbacher, 2023; Wang et al., 2019), especially for firms backed by multiple BAs and VCs (Kleinert et al., 2020). After the first successful ECF campaign, firms backed by BAs or VCs are found to have a lower failure probability (Hornuf et al., 2018; Signori & Vismara, 2018) and a higher survival rate, as well as seasoned equity offering (SEO) (Coakley et al., 2018; Coakley et al., 2022a; Drover et al., 2017; Hornuf et al., 2018; Signori & Vismara, 2018). However, studies have yet to examine the impact of professional investors on firm performance after the first successful ECF campaign.[3]

It is well known in the literature that professional investors bring expertise and connections to startups; however, it is yet to be explored whether the knowledge and connections of professional investors enhance the financial performance of firms that

[2] According to Signori and Vismara (2018), a firm encounters four scenarios after successfully raising funds on the ECF platform, namely seasoned offering (SEO), mergers and acquisitions (M&A), continued activity, and failure.

[3] Eldridge, D., Nisar, T. M., & Torchia, M. (2021). What impact does equity crowdfunding have on SME innovation and growth? An empirical study. *Small business economics*, *56*(1), 105-120. https://doi.org/10.1007/s11187-019-00210-4 control the effect of professional investors on firm performance when examining whether ECF firms outperform non-ECF firms. They find no impact of professional investors (i.e., BA or VC) on the innovation performance and growth opportunities of SME firms.

successfully raise capital through ECF. Therefore, we investigate whether firms backed by professional investors (i.e., BAs and VCs) outperform non-backed ones. Furthermore, we also examine whether BA and VC affect firm performance differently since the motives of BA and VC investors might differ. For instance, VCs concentrate on ex-ante investments, emphasising the importance of screening and due diligence before any investments (Van Osnabrugge, 2000). Meanwhile, BAs focus on ex-post investments, which support portfolio firms through active involvement after the investment (Van Osnabrugge, 2000). Given time-constraint pressure, VCs are willing to obtain more substantial control rights to move the portfolio firms toward target outcomes, while BAs hold weaker control rights (Dutta & Folta, 2016; Van Osnabrugge, 2000). Finally, we examine the impact of co-investment on a firm's performance. The co-investment term is used for a campaign funded by more than one BA or VC or even both VC(s) and BA(s) (Manigart & Khosravi, 2023). While co-investment stands as a prevalent trend in entrepreneurial finance and ECF, our understanding of its implications on the performance of ECF firms is limited (Manigart & Khosravi, 2023). Portfolio firms co-invested by multiple professional investors benefit from a broader range of industrial knowledge, networks, and management experience (Bonini et al., 2019). However, BA&VC co-investments may also have potential drawbacks due to conflicts of investment motivations (Dutta & Folta, 2016; Van Osnabrugge, 2000), consequently negatively affecting firm performance.

To examine the impact of professional investors and co-investment on ECF firm performance, this study uses the augmented dataset collected from Crowcube, Seedrs, SyndicateRoom, Crunchbase, UK Companies House, Orbis, and Wayback Machine. The sample includes 1,034 ECF firms that successfully raised funds from the United Kingdom (UK) ECF market between 2011 and 2022. Firm performance data is collected starting one year after the initial public offering and continues until the most recent year, for which financial statements are available on the UK Companies House website. We conduct a two-step approach to investigate the relationship between professional investments and firm performance, including entropy matching and fixed effect regression analyses.

The findings show that firms backed by BAs and VCs generally do not outperform non-backed firms. We find that the presence of BAs improves the firm growth measured by two proxies, namely $size$ and $employee$, while no evidence supports the role of VCs. Noticeably, the firm age at the time of investment moderates this effect. BAs do not impact firms younger than 02 years old (startups) but enhance the $size$ and $employee$ in more mature firms (pre-existing firms). Conversely, VCs contribute to the increase in startup' size and employee numbers but do not influence older firms. Both BAs and VCs fail to guarantee the profitability of portfolio firms; in fact, those backed by professional investors experience more losses than

non-backed firms. BA involvement boosts the number of granted patents in the short term before turning negative afterwards. VC-backed firms are more likely to have fewer granted patents than non-backed firms over the period. The presence of professional investors links to a lower intangible assets ratio. The results imply passive investment motives among professional investors in the ECF compared to their roles theorised in the venture capital theories. Co-investment among investors of the same types is a negative predictor of innovative performance proxied by patent numbers and intangible assets ratio. Nonetheless, we do not find evidence supporting the impact of BA&VC co-investment on portfolio firms.

The study makes significant contributions to the ECF and entrepreneurial literature. The first contribution is that it expands upon the limited research on drivers of post-fundraising performance. By investigating the impact of BAs and VCs, we first provide evidence about the role of professional investors in ECF firm performance. The presence of professional investors is positively associated with growth prospects but negatively related to profitability and innovation performance. We provide evidence on passive investment motives posited by Wang et al. (2019) among investors providing financial support during the public ECF campaign, leading to diverse effects on firm performance. Our second contribution is that we highlight the distinct impacts of BAs and VCs, contrasting with the effects observed in the traditional entrepreneurial financial market. Unlike the conventional entrepreneurial financial market, BAs and VCs in the ECF market are more heterogeneous regarding investment motives once professional and retail investors co-invest in a firm through an Internet-based platform. The convenience makes the ECF market more attractive in the eyes of some professional investors who pursue a passive investment strategy and are less likely to provide managerial support. A strong negative relationship between innovative performance and the presence of professional investors can be partially explained by a passive investment strategy. Furthermore, we contribute to the entrepreneurial literature by comparing the impacts of BAs and VCs. We find no differences between firms backed by BAs and VCs in size, employee numbers, profitability, and the intangible assets ratio, except for the number of granted patents. In other words, the impact of BAs and VCs on portfolio firms in the ECF market is not distinctive. Last but not least, we expand the ECF and entrepreneurial literature by investigating the influence of co-investment. BA&VC co-investments do not significantly impact firm performance when we use entropy balancing but become significant at a 10% level when we apply nearest neighbour matching. To some extent, it indicates a positive rather than a negative relationship, as suggested in empirical evidence in the traditional entrepreneurial financial market. In other words, it implies a supplementary rather than subtractive relationship between BAs and VCs in the ECF market.

The remainder of the paper is structured as follows: Section 2 presents the literature review and hypotheses development; Section 3 describes the data collection process and research methodology; Section 4 summarises the findings and robustness tests; Section 5 concludes with implications and suggestions for future research.

2. Literature review and hypothesis development

ECF is a method of financing in which entrepreneurs sell their shares to a group of investors (usually retail investors) through an open call on Internet-based platforms (Ahlers et al., 2015). The market has three main participants: fundraisers (ECF firms), funders (investors), and ECF platforms. Any firm, irrespective of its development stage, can raise funds from the ECF market; however, most fundraisers are startups. The investors in the ECF market are primarily retail investors known as "the crowd" who provide small amounts of money to entrepreneurs (Belleflamme et al., 2014; Drover et al., 2017). Apart from retail investors, the ECF market also attracts professional investors (i.e., BAs and VCs) (Hornuf & Schwienbacher, 2018; Signori & Vismara, 2018; Wang et al., 2019). These investors often play a central role as primary investors in financing deals in the traditional entrepreneurial financial market. In contrast, in the ECF market, they co-invest alongside retail investors in the same financing round. This difference can lead to different investment motives and investment behaviour of professional investors in the ECF market. The ECF platform is vital for matching fundraisers and potential investors (Kleinert et al., 2022). The core functions of the ECF platform include preselection, structuring, and communication, which reduces information asymmetry among fundraisers and funders (Loher, 2017). Besides, ECF platforms provide fundraisers and funders with supporting services before, during, and after the campaigns (Rossi & Vismara, 2018).

This section summarises three crucial strands of literature related to our research questions. The first strand focuses on the ECF outcomes after a successful equity offering campaign. The second strand explores professional investors and their impact on firm performance. The third strand investigates the co-investment phenomenon regarding syndication and BA&VC co-investment. Based on these, we develop two hypotheses examining the effect of professional investors on ECF firm performance.

2.1 Equity crowdfunding outcomes

The ECF literature has developed rapidly in recent years, along with the development of the ECF market. Many scholars have concentrated on the determinants of funding success, (Ahlers et al., 2015; Bapna, 2019; Bapna & Ganco, 2021; Caputo et al., 2022; Coakley et al., 2022b; Cumming et al., 2022; Cumming et al., 2019; Donovan, 2021; Fricke et al., 2021;

Hornuf et al., 2022; Johan & Zhang, 2020; Kleinert et al., 2020; Lukkarinen et al., 2016; Vismara, 2016, 2018), and funding dynamics (Chen & Ma, 2023; Cholakova & Clarysse, 2015; Cumming et al., 2022; Hervé et al., 2019; Hornuf & Schwienbacher, 2018; Meoli & Vismara, 2021; Nguyen et al., 2019; Stevenson et al., 2019; Vismara, 2018; Wang et al., 2019). In recent years, a few studies have focused on the post-fundraising outcomes after a successful ECF campaign. There are generally four post-offering outcomes: (1) Seasoned ECF offering[4] (SEO) dubbed as follow-up ECF offering - securing additional capital after their initial ECF offering; (2) mergers and acquisitions (M&A) – merger is when two firms are combined and or acquisition when one firm buys another one; active – (3) maintaining active status updated on the UK Companies House website; and (4) failed firms (Signori & Vismara, 2018) explore the determinants of post-fundraising outcomes and find that determinants of SEO and M&A include positive sales, non-executive directors, patents, target capital, tax incentives, and quick success. However, firms that offer voting rights and attract several investors in the campaign are less likely to be involved in any SEOs or M&As (Signori & Vismara, 2018). Regarding the failure event, a firm offering voting rights has a higher chance of failure, while those with positive sales, quick success, and qualified investors are less likely to dissolve (Signori & Vismara, 2018).

Focusing on the event of SEO, Coakley et al. (2018) conclude that overfunding, lead investors (i.e., BAs and VCs), and shareholder structure are positively associated with the likelihood of conducting SEOs. Besides, overfunding, the time gap between the first and the next offering, and the amount of initial funds scaled by the follow-up target capital are determinants of a successful SEO (Coakley et al., 2018). Also, Hornuf et al. (2018) find that ECF firms in Germany have a higher probability of obtaining SEO but a higher chance of failure than UK firms. The number of senior management members and initial VC investors positively affects the likelihood of conducting an SEO. In contrast, a higher average age of senior management is negatively correlated with raising additional funds. Hornuf et al. (2018) claim that four factors reduce the probability of failure: senior management numbers, filed patent numbers, the funding raised during the previous ECF campaign, and location in big cities. Cumming et al. (2019) find that high ownership-control-separation is linked to a higher probability of failure, a lower chance of being backed by professional investors, and poor long-term performance prospects. These results are similar to those reported by Signori and Vismara (2018). Coakley et al. (2022a) search for further evidence on the determinants of SEOs. They

[4] Signori, A., & Vismara, S. (2018). Does success bring success? The post-offering lives of equity-crowdfunded firms. *Journal of corporate finance (Amsterdam, Netherlands)*, *50*, 575-591. https://doi.org/10.1016/j.jcorpfin.2017.10.018 classify seasoned offering (SEO) into public SEO (fundraising through another ECF round) and private SEO (fundraising through a BA or VC round).

find that the number of investors, quick success, and shareholder structure link to a higher chance of conducting and succeeding in a first SEO campaign. However, the percentage of equity offered and the ratio of the SEO goal to the initial campaign goal negatively affect the probability of a successful SEO campaign. In the ECF literature, SEO is often considered a successful outcome. Still, it does not always serve as a positive signal in the ECF market because startups associated with distressed banks tend to lean towards raising funds through the ECF market (Blaseg et al., 2021).

A few studies have documented other investment exits in the ECF market besides M&A and SEO through the secondary market. For instance, Lukkarinen and Schwienbacher (2023) report secondary market listings as a potential investment exit. Generally, the secondary market refers to where investors sell the shares bought previously through the primary market. In the context of ECF, the ECF secondary market is where sellers and buyers trade shares with the prices and quantity being offered by sellers, but trading takes place without the requirements of information disclosure of startups (Lukkarinen & Schwienbacher, 2023). This study demonstrates that communicating listing plans positively correlates with funding success.

A few scholars have paid attention to ECF firms' financial performance. Walthoff-Borm et al. (2018) first evaluate the performance of ECF firms relative to non-ECF firms following their initial successful fundraising campaigns, using an augmented dataset of companies that successfully raised funds from Crowdcube and Seedrs. They indicate that non-ECF firms are more likely to survive than ECF firms, but there is no significant difference in financial performance between the two. ECF firms, however, appear to outperform non-ECF firms in patent applications, indicating higher innovative performance of ECF firms. Similarly, Eldridge et al. (2021) assess the impact of ECF on small and medium-sized enterprises' innovation and growth.They find no significant relationship between ECF and firm innovation, inconsistent with Walthoff-Borm et al. (2018). In addition, Eldridge et al. (2021) highlight that ECF firms are strongly correlated with growth opportunities and financial performance. The inconsistency may arise from using different data sources. Eldridge et al. (2021) analysed 230ECF firms in the UK between 2014 and 2017 without specifying the platforms[5] while Walthoff-Borm et al. (2018) includes ECF firms between 2012 and 2015 from Crowdcube and Seedrs. Besides, Eldridge et al. (2021) predominantly focus on SME firms with a revenue limit of no more than £25 million, whereas Walthoff-Borm et al. (2018) did not set out this requirement.

[5] Eldridge, D., Nisar, T. M., & Torchia, M. (2021). What impact does equity crowdfunding have on SME innovation and growth? An empirical study. *Small business economics*, *56*(1), 105-120. https://doi.org/10.1007/s11187-019-00210-4 started with Crowdcube and TechCrunch for ECF firms; consequently, the sample might include firms that successfully raised funds from other ECF platforms besides Crowdcube and Seedrs.

The literature has expanded its focus to post-fundraising outcomes and firm performance following a successful ECF campaign. Empirical evidence shows that several indicators, such as investor numbers, target capital, lead investors, shareholder structure, overfunding, and board characteristics, can impact post-fundraising outcomes. Only some studies have examined how ECF firms perform in the long run after their first public offering and which determinants drive their performance. Determinants of funding success and outcomes might influence firm performance, but their long-term effect is uncertain. Therefore, it is essential to explore whether they have a lasting impact.

2.2 Professional investors in ECF

ECF investors can be categorised into three groups: high net worth, sophisticated, and restricted (Signori & Vismara, 2018). An investor with a minimum annual income of £100,000 or net assets of £250,000 is defined as high net worth. However, the concept of a sophisticated investor is quite abstract as it is based on either the recognition of a third party or self-certification. An investor certified by a qualified firm in risk understanding regarding non-readily realisable investments is considered a sophisticated investor (Signori & Vismara, 2018). An investor who is a BA-network member, has at least two years of experience in the financial industry, or serves as a firm director with a minimum revenue of one million pounds sterling is also considered a sophisticated investor (Signori & Vismara, 2018). Investors who are categorised as neither high net worth nor sophisticated investors are retail investors. Signori and Vismara (2018) suggest that BAs and VCs can access and process information at lower costs and probably similarly influence portfolio firm outcomes. Therefore, following the literature, we categorise BAs and VCs as professional investors.

The number of professional investors interested in the ECF market has been growing for several reasons. First, professional investors invest in ECF firms to generate monetary returns (Fisher et al., 2017; Vismara, 2019). Considering a high-risk investment, startups can help professional investors reach a "winner-take-all market" situation where few firms can survive (Block et al., 2018). Second, technological advances have made it easier for investors to communicate with entrepreneurs, conduct due diligence, and manage portfolio firms (Block et al., 2018) through ECF platforms. The ECF platforms play a vital role as "financial intermediaries" in the traditional financial market, allowing investors and entrepreneurs to communicate easily and quickly without incurring costs. These platforms also conduct a screening process to eliminate unqualified startups, saving investors time and effort on screening and due diligence, especially for less experienced BAs/VCs. Third, professional investors are driven by the fear of being left behind owing to the development of innovative technologies and startups (Block et al., 2018). Startups have strengths in innovation and human

capital that professional investors are willing to possess. Fourth, professional investors consider investment in the ECF market as a strategy for diversification and seeking convenience (Wang et al., 2019). The same authors point out that some BAs are unwilling to contribute or provide guidance and support (i.e., hand-off BAs) because they hold shares of ECF firms to diversify their investment portfolios by having various assets. In contrast to traditional BAs offering support and guidance, these professional investors are not actively involved in managerial support. Especially, Wang et al. (2019) highlight that BAs investing in ECF firms during the public offering are those often holding passive investment motives, while those who show their preference during the private stage tend to keep in touch with entrepreneurs and are involved in managerial support and guidance like traditional BAs. Unlike professional investors who are interested in the ECF market for several reasons, retail investors' primary motive to invest in the ECF market is financial returns, though non-financial factors like helping others, fostering community, and trust also influence their decisions to invest in ECF firms (Cholakova & Clarysse, 2015).

The ECF literature highlights diverse results of the presence of professional investors and funding success. Kleinert et al. (2020) conclude that ECF firms backed by BAs and VCs attract more investors than non-backed firms. This effect is amplified by the presence of multiple investors prior to the campaign, resulting in a greater number of investors and an increase in the funds raised. Professional investors play an essential role as certifying agents confirming the quality of startups since they conduct screening and due diligence processes before any investment decisions (Kleinert et al., 2020). Besides, BAs and VCs risk their reputations if they invest in low-quality firms. Similarly, Fricke et al. (2021) report a higher chance of success for firms backed by VCs than non-backed firms. VC involvement creates a positive signal to new investors about the quality of the potential firm. The presence of reputable VCs amplifies this effect before the initial public offering. Not only VC but BA investments also improve the funding success. Lukkarinen and Schwienbacher (2023) report a positive impact of BAs and VCs on funding success measured by the total amount raised. Nonetheless, Donovan (2021) does not find evidence supporting the relationship between VC involvement and the capital raised.

Empirical evidence posits diverse results of the influence of professional investors on funding outcomes. Signori and Vismara (2018) find that the presence of professional investors reduces the probability of failure due to superior information and value-added services but has no significant influence on the likelihood of conducting SEOs. However, Hornuf et al. (2018) find that the presence of VCs in the initial offering improves the probability of SEOs and

increases the chances of failure. Nonetheless, they see no evidence of the impact of BAs on SEOs and the likelihood of failure.

Eldridge et al. (2021) are the first to examine how professional investors affect firm performance regarding innovation and growth. The study includes 230 companies that successfully raised funds from Crowdcube in 2013. Firm performance is collected up to four years after the first campaign between 2014 and 2017. The findings reveal that the presence of professional investors (i.e., BAs and VCs) is not a significant predictor of innovation performance, patent grants, growth opportunities, and return on assets (ROA). However, the limitation of this study is that the results are drawn from a small dataset with only four years of financial performance taken into account for the companies that successfully raised funds in 2013.

In the entrepreneurial finance literature, no conclusive evidence exists on how professional investors affect firm performance. For instance, Puri and Zarutskie (2012) find a positive relationship between VC investments and firm growth, indicating that VC-backed firms have a higher growth rate than non-backed ones. Despite a higher growth rate, VC-backed and non-VC-backed firms are not different from each other in profitability (Puri & Zarutskie, 2012). Notably, the authors conclude that VC-backed firms are more likely to survive than non-backed ones until the fifth year, starting from the investment time. After this point, the gap in marginal failure rates between VC-backed and non-VC-backed firms decreases significantly (Puri & Zarutskie, 2012). In contrast, Guo and Jiang (2013) highlight that a firm backed by VCs outperforms non-backed firms not only in growth rate (i.e., sales growth) but also in profitability, labour productivity, and R&D investment. Disentangling the good selection effect before VC investment from the value-added effect after VC investment, they find that VC-backed firms improve the return on sale (ROS), return on equity (ROE), and labour productivity after VC entry. Nevertheless, no evidence exists that the magnified sales growth and R&D investment improvement happens after VC involvement.

Similarly, Bonini et al. (2019) report that the presence of BAs, especially experienced BAs, in a deal improves BA-backed firm performance. The intensity of monitoring efforts and the structure of equity infusion is negatively correlated with firm performance and the likelihood of survival (Bonini et al., 2019). In other words, the link between BA participation and superior firm performance depends on BAs' experience and reputation. This idea is supported by Blaseg and Hornuf (2023), who conclude that there is a positive relationship between affiliation with well-known BAs and firm performance. These authors find that a famous BA can improve the chance of survival, web traffic, and sales.

VCs raise capital from certain partners and fund their portfolios of young and innovative firms through selective investments (Gompers & Lerner, 2000). According to Dutta and Folta (2016), VCs tend to inject money into specific industries where VCs can leverage their expertise and network. Besides, VCs tend to put more effort into the screening and due diligence processes since they must demonstrate competent behaviours to their fund providers at the very first steps of the investment process (Van Osnabrugge, 2000). As an intermediary between fund providers and entrepreneurial firms, VCs are constantly pressured to convince funders that they are investing in high-quality startups. Additionally, VCs are often willing to possess a high proportion of shares (i.e., higher voting rights) (Van Osnabrugge, 2000). More substantial control rights allow VCs to direct portfolio firms toward targeted innovation outcomes and higher financial payoffs (Dutta & Folta, 2016). The involvement of VCs provides better growth prospects for portfolio firms (Chemmanur & Chen, 2014) and exit strategies to realise profitable returns (Croce et al., 2018).

On the other hand, BAs are accredited investors who use their capital to fund young ventures, acting individually or in semi-formal networks (Drover et al., 2017; Wiltbank et al., 2009). BAs do not have time-constrained pressure since they use their own money to invest (Croce et al., 2018; Van Osnabrugge, 2000). This allows them to pursue a more relaxed governance approach with a reasonable amount of voting rights sufficient to control and move portfolio firms towards their expectation (Dutta & Folta, 2016). BAs prefer ex-post involvement in firm activities (Van Osnabrugge, 2000); they are open to experimentation and are more tolerant of innovative failure (Dutta & Folta, 2016).

In sum, the literature suggests several benefits of the presence of professional investors for ECF firms: (1) BAs and VCs) conduct screening and due diligence steps before investments, using their advantage of accurate information, expertise, and experience; (2) BAs and VCs tend to choose high-potential firms, which are less likely to fail and have more chance of raising further capital (Signori & Vismara, 2018); (3) BAs and VCs provide portfolio firms with mentorship, network accessibility, and third-party certification. To the extent the presence of professional investors benefits ECF firms, we hypothesise:

H1: ECF firms backed by professional investors exhibit higher (a) growth potential, (b) profitability, and (c) innovative performance than non-backed firms.

Nevertheless, various motives affect how professional investors treat their portfolio firms. Professional investors who fund their portfolio firms during the first ECF initial public offering are often passive investors who are less likely to offer portfolio firms managerial support, guidance, and value-added services (Wang et al., 2019). Therefore, professional investors may treat ECF firms differently than those in the traditional entrepreneurial market.

Only professional investors who contact portfolio firms through offline contacts tend to be involved actively in portfolio firms' activities (Wang et al., 2019). The same authors highlight that BAs who make investments during the private period are more likely to contact their portfolio firms offline. Apart from financial support, non-financial support from professional investors seems more invaluable for portfolio firms, which are often young and less experienced. Hence, if professional investors treat investment in ECF firms like passive investment, then firms backed by professional investors might perform similarly to the non-backed ones. Therefore, our alternative hypothesis 1:

H1a: ECF firms backed by professional investors do not exhibit lower (a) growth potential, (b) profitability, and (c) innovative performance than non-backed firms.

To differentiate the impacts of BAs and VCs, we compare BA-backed firms with VC-backed firms. First, VCs tend to put more effort into the screening and due diligence processes (Van Osnabrugge, 2000). By contrast, BAs do not have time-constrained pressure since they use their own money to invest (Croce et al., 2018; Van Osnabrugge, 2000). Second, VCs tend to firmly control portfolio firms by obtaining more substantial voting rights, whereas BAs often obtain weaker control rights (Van Osnabrugge, 2000).. Therefore, VCs often strongly influence their portfolio firms due to high voting rights, the pressure of time-oriented performance-based compensation, and their superior experience and networks compared to BAs. Hence, we expect VC-backed firms to outperform BA-backed firms.

H2: ECF firms backed by venture capitalists outperform ECF firms backed by business angels.

Nevertheless, time-oriented performance-based compensation constraint triggers a tendency for VCs to have high voting rights, which can create conflicts between VCs and entrepreneurs (Dutta & Folta, 2016). VCs may emphasise keeping their investors satisfied more than solely concentrating on portfolio companies. As a result, some management support could be given at the expense of the portfolio firms' interests. Furthermore, Dutta and Folta (2016) suggest that VCs seem less open to experimentation and have a low tolerance for early-stage failure, thus negatively affecting the probability of successful innovation. On the other hand, BAs tend to focus on a longer-term investment horizon and ex-post activities (Sapienza, 1992; Van Osnabrugge, 2000). Compared to VCs, BAs are more open to experimentation and early-stage innovation failures (Dutta & Folta, 2016). Therefore, our alternative hypothesis 2 *is:*

H2a: ECF firms backed by business angels outperform ECF firms backed by venture capitalists.

3. Co-investment

Co-investment refers to a phenomenon where investors of similar types or different types invest in a particular financing round of a startup (Manigart & Khosravi, 2023). In this study, syndications denote co-investments among investors of the same type, whereas BA&VC co-investments signify co-investments between BA(s) and VC(s). In the context of ECF, empirical evidence highlights a positive relationship between co-investment and funding success. For instance, Kleinert et al. (2020) find that the presence of different types of professional investors prior to the initial public offering predicts funding success. Startups receiving funding from various kinds of investors (i.e., BAs, VCs, and governments) before the first ECF campaign are more likely to achieve funding targets than those attracting a single investor (Kleinert et al., 2020). This is because multiple types of investors can provide startups with resources that complement each other, thus enhancing the effectiveness of startups during the growing phase.

In entrepreneurial literature, the participation of many investors in a specific funding round can affect startup performance differently. Some scholars have underscored the positive effect of co-investment on firm performance due to selection and treatment effects (Bonini et al., 2019; Croce et al., 2018). Each professional investor often conducts their own screening and due diligence process before investing. Thus, the potential growth of a firm can be assured by the co-investment of many professional investors as they successfully overcome strict evaluation processes (Kleinert et al., 2020). Regarding the treatment effect of professional investors, Bonini et al. (2019) report a positive relationship between co-investor numbers in an angel group and firm performance. According to Bonini et al. (2019), co-investing in the same project at the specific funding round often reduces the risk of portfolio firms and information asymmetry. It allows professional investors to share information and learn from other experienced investors. Startups can take advantage of substantial monetary (i.e., capital provided) and non-monetary contributions (i.e., industry insights, networks, and management experience) from co-investment to increase the likelihood of developing at a larger scale and speed, as well as receiving following funding rounds compared to solo investments (Bonini et al., 2019).

Regarding firms backed by BA&VC co-investment, Croce et al. (2018) conclude that these firms experience a higher funded amount and a higher chance of favoured outcomes, namely SEOs, M&A, or IPOs since BA(s) and VC(s) complement each other. VCs must demonstrate that their behaviours always align with the benefits of funders through screening and due diligence before making investment decisions. In light of time-constraint pressure from funders, VC(s) often offer a high-growth rate option. Meanwhile, BAs are free from the

pressure, so they tend to control portfolio firms through active involvement after the investment and focus on long-term performance. Hence, BA&VC-backed firms can benefit from balanced development strategies in the short and long run. In the post-fundraising period, BAs often play a vital role in supporting startups, while VCs are more concerned about monitoring and controlling portfolio firms (Harrison & Mason, 1992). BAs can join as non-executive directors in the portfolio firm's management board to provide assistance, whereas VCs can reduce the time involved in post-investment activities and focus on other investment opportunities (Harrison & Mason, 2000).

On the other hand, Di Lorenzo and Sabel (2023) posit that the positive impact of co-investment among corporate venture capitalists (CVCs) on firm performance depends on the investment period. They find that startups' revenues tend to increase in line with the rise of investor numbers in intermediate-stage (4 – 6 years) and late-stage (7 – 9 years) firms but not in the early-stage (1 – 3 years) firms. At the early stage, portfolio firms encounter the complexity of coordination with multiple CVCs and find it challenging to fully absorb all the knowledge provided by CVCs because these firms are less knowledge-intensive. However, once firms are more mature, they adapt to it quickly, leading to a positive impact on revenue (Di Lorenzo & Sabel, 2023). In contrast, firms backed by multiple CVCs experience an upward trend in the R&D intensity at the early stage, but then it reverses in the later stages. Multiple CVC investors require more R&D upskilling at the early stage due to the lower absorptive capacity of portfolio firms, but this requirement decreases over time when startups mature. Therefore, we anticipate that co-investment improve firm performance.

H3: Syndicated ECF firms or BA&VC co-invested firms outperform non-backed firms.

Nevertheless, co-investment has been argued to have adverse effects on firm performance. For instance, Cumming and Walz (2010) posit that syndicated firms have a lower probability of conducting SEOs. Goldfarb et al. (2013) highlight how different compositions of investors in co-investment affect firm performance. This study classifies co-investment into three groups: only-BA, only-VC, and BA&VC co-investments. These authors find that firms backed by only VCs see a higher probability of successful exit for large deals than BAs and VCs co-invested firms.

Additionally, BA&VC co-investment can bring some disadvantages to portfolio firms: different investment motives and expectations, administrative complexity, the fear of being swamped or overshadowed by VCs, and cost issues (Harrison & Mason, 2000). The differences in investment motives and expectations may cause conflicts between BAs and VCs. Consequently, it can make the decision-making process more complex and time-consuming. In some cases, BAs can lose their independence in decision-making and follow VCs' ideas

(Harrison & Mason, 2000). Moreover, Goldfarb et al. (2013) find that the presence of BAs may exacerbate the relationship between VCs and founder(s), as founder-friendly BAs can form coalitions with founders against VCs. Additionally, Hellmann et al. (2021) show that BAs and VCs are dynamic substitutes, and there are fewer transitions between BA and VC financing than traditionally assumed. Therefore, we hypothesise:

H3a: Syndicated ECF firms or BA&VC co-invested firms do not outperform non-backed firms.

3. Research design

3.1 Context

We focus on the UK ECF market, which accounts for the most significant volume of investments in the global ECF-based crowdfunding market (i.e., 36% of the worldwide market in 2020) (Ziegler et al., 2021). Therefore, it is an ideal market to examine how the ECF market operates. Besides, the UK's regulatory system is considered adequate and appropriate for ECF platform activities (Ziegler et al., 2021). Furthermore, the UK Companies Act 2006 requires all SMEs, even micro companies, to disclose their annual reports and accounts on the website known as UK Companies House and distribute those to members. This allows us to collect the required data for this study since all ECF firms are private companies.

Within the UK context, we focus on the Crowdcube, Seedrs, and SyndicateRoom platforms – among the UK's largest and most active ECF platforms (Signori & Vismara, 2018; Vismara, 2019; Walthoff-Borm et al., 2018). To be listed on these platforms, a campaign often undergoes several screening and due diligence steps to ensure they are qualified to raise funds from the public (Kleinert et al., 2022). Another essential feature is that these platforms operate based on the "All-or-nothing" model, which requires a firm to set out a funding target in advance, and the firm receives nothing in case of a failure to achieve it (Cumming et al., 2020).

We use Crowdcube, Seedrs, and SyndicateRoom platforms for two main reasons. First, they have a long history and account for a high investment volume compared to other platforms. This implies that we can track and assess firm performance over an extended duration while encompassing a broader spectrum of firms for analysis. Second, these platforms have developed a reputation, and most of the studies on ECF use data from these platforms (Coakley & Lazos, 2021; Rossi et al., 2023)

3.2 Sample and data collection

This study constructs an augmented dataset by manually collecting data from Crowdcube, Seedrs, SyndicateRoom, the UK Companies House, Crunchbase, Orbis and Wayback Machine databases. On the Crowdcube platform, we collect information about ECF firms and their first ECF campaigns, including the time of the first ECF campaign, the total

amount of capital raised, overfunding status, and offering structures. Besides, the Crowdcube platform allows users to access the company's website, social media pages, and information registered at Companies House. Unlike Crowdcube, information relating to the funded campaigns is unavailable from Seedrs and SyndicateRoom platforms, so we use the Wayback Machine database to track the campaigns. The Wayback Machine, which provides the website's history, is a commonly used online resource in ECF literature (Butticè et al., 2020; Rossi et al., 2023; Walthoff-Borm et al., 2018). We collect information related to firms and their campaigns from Seedrs and SyndicateRoom. Our sample includes all ECF campaigns conducted between 2011 and 2022.

Regarding the firm performance data, we collect company profiles such as company ID, address, status, establishment year, nature of business (SIC), previous company names, financial statements, and management boards from the UK Companies House website. Financial performance data is collected starting one year after the initial offering and going up to the recent years, for which financial statements are available on the UK Companies House website. We take into account the financial performance one year after the initial offering because it takes time for firms to take advantage of capital provided by professional investors (Bonini et al., 2019; Di Lorenzo & Sabel, 2023).

We also rely on Crunchbase, a database of startup companies, to collect information related to startup characteristics and relevant events (Signori & Vismara, 2018). This database is commonly used in crowdfunding research (Kleinert et al., 2022; Kleinert et al., 2020; Rossi et al., 2023; Signori & Vismara, 2018). We collect several investment characteristic data from this website, such as the presence of professional investors, investor demographics, funding rounds, and funding before and after the first ECF offering. Our sample does not include firms with missing data on firm performance or professional investors; therefore, the final sample consists of 1,058 companies that successfully raised funding through the ECF market. We collect the number of patent applications and the number of patents granted from the Orbis database.

3.3 Variables

This study estimates different dimensions of ECF firm performance: growth potential, profitability, and innovation. Table 1 reports the definitions for all variables used in this study. We use two proxies to measure growth potential: firm size ($size$) and employee numbers ($employee$). $Size$ is calculated as the natural logarithm of total assets, while $employee$ is the

natural logarithm of employee numbers plus 1[6]. Profitability is measured by the return on total assets (ROA). According to Companies House (2022), only large companies are required to disclose full accounts to Companies House, while the others have to disclose their balance sheets and the details depending on which group the firm belongs to. Consequently, the availability of financial data, especially the net income, might be limited due to this exemption. To tackle this issue, we calculate net income based on the difference between the retained earnings or the profit and loss accounts in the balance sheet in years *t* and *t-1*. Regarding innovation performance, we utilise two proxies: the number of granted patents ($patent$) (Eldridge et al., 2021; Walthoff-Borm et al., 2018) and the intangible assets ratio ($intangible$) (Walthoff-Borm et al., 2018).

We are interested in the performance of BA- and VC-backed ECF firms relative to non-backed firms. Therefore, we create dummy variables for professional investors' participation in the first ECF campaign, namely BA_only and VC_only, which is equal to 1 if the firm is backed by BAs and VCs, respectively, otherwise 0. We are also interested in how different forms of co-investments affect long-term performance. Thus, we create $coin\_dif$ which takes the value of 1 if it is a syndicated film and 0 otherwise. $Coin\_same$ equals 1 if it is a BA&VC co-invested firm; otherwise, 0.

Following the literature, we include several control variables in regression models. Regarding the characteristics of the first ECF campaign, we include a dummy $overfunding$, which takes the value of 1 if the firm received funding larger than its target amount and 0 otherwise. To control the size of the investment, we use $funded$, estimated as the natural logarithm of the amount of money a firm successfully raised in the first ECF campaign. Regarding firm characteristics, we include several control variables, such as firm age (Age), firm diversification (Div), and board structure (NED). Age is measured by the number of years in operation since conducting the first ECF campaign. Div stands for diversification, equal to 1 if the firm has more than one SIC code; otherwise, 0. NED is equal to 1 if there is at least one non-executive director on the managing board; otherwise, 0.

[6] Following Sievers, S., Mokwa, C. F., & Keienburg, G. (2013). The relevance of financial versus non-financial information for the valuation of venture capital-backed firms. *European Accounting Review*, *22*(3), 467-511.

Table 1. Variable definition
The table reports variable definitions for all variables used in this study.

Variable	Operationalisation	Sources
Dependent variables		
$size$	The natural logarithm of total assets	UK Companies House
$employee$	The natural logarithm of employee numbers plus 1	UK Companies House
ROA	ROA is the return on assets, which is calculated by net income divided by total assets	UK Companies House
$patent$	The natural logarithm of the granted patent numbers	Orbis database
$intangible$	The ratio of intangible assets scaled by total assets	Orbis database
Independent variables		
BA_only	If a firm is backed by BAs, it takes the value of 1; otherwise, 0	Crunchbase
VC_only	VC_only takes the value 1 if a firm receives funding from VCs; otherwise, 0	Crunchbase
$coin\_dif$	$coin\_dif$ takes the value for a BA&VC co-invested firm; otherwise, 0	Crunchbase
$coin\_same$	$coin\_same$ takes the value 1 for a syndicated firm; otherwise, 0	Crunchbase
Control variables		
Campaign characteristics		
$overfunding$	If an ECF campaign is overfunded, it takes the value 1; otherwise, 0	ECF platforms
$funded$	The natural logarithm of the amount raised in the first ECF campaign	ECF platforms and Crunchbase
Firm characteristics		
age	age is the number of years from the time of establishment to the time of conducting the first ECF campaign	UK Companies House
Div	Div is a dummy variable, which is set to 1 for a firm with more than one SIC code reported in the Overview section of the Companies House website; otherwise, 0	UK Companies House
NED	It is equal to 1 for a firm that includes at least one non-executive director; otherwise, 0	UK Companies House

3.4 Methods

This research employs a two-step approach to examine the impact of professional investors on firm performance. It starts with matching, a nonparametric preprocessing method before any regression analyses are conducted. According to Ho et al. (2007), matching conducted before parametric analysis reduces or eliminates the association between treated and covariates, resulting in minimal bias and improving efficiency. After matching, the treatment and control groups in the generated sample subset share the same background characteristics (Ho et al., 2007). This method of preprocessing data can help scholars avoid all dependence on the functional form, which often occurs when using parametric analysis. With a balanced sample, most scholars adopt a simple difference in means (DIM) to investigate the treatment effect. However, it does not work in some cases, especially when the assumption of independence between treatment and covariates is false (Ho et al., 2007). Therefore, they recommend conducting regression analysis using the matching sample rather than the raw data set.

In line with the literature (King & Nielsen, 2019; Rossi et al., 2023), this study uses the entropy balancing matching approach introduced by Hainmueller (2012). Among all matching methods, entropy matching improves the degree of covariate balance and accuracy of matching results compared to the nearest neighbour or propensity score matching. This matching approach can prevent losing several observations, a severe problem in studies of micro and SME firms with small sample sizes. Following the matching criteria mentioned by Walthoff-Borm et al. (2018), we match ECF firms backed by BAs, VCs, BAs & VCs, and more than one BA or VCs, respectively, with non-backed firms using three criteria: industry classification (SIC), campaign size (funded), and firm age.

After the matching phase, we employ a fixed effect regression model to examine the relationship between firm performance and the presence of professional investors at the first ECF offering. A set of four models is used to test hypotheses (H1a, H1b, H3a, H3b) mentioned in Sections 2.2 and 2.3, as follows:

$$DV_{it} = \beta_0 + \beta_1 IDV_{it} + \ + \beta_2 overfunding_{it} + \beta_3 funded_{it} + \ \beta_4 age_{it} + \ \beta_5 Div_{it} + \ \beta_6 NED_{it} + \ \varepsilon_{it}$$

where DV_{it} includes $size$, $employees$, ROA, $patent$, and $intangible$. IDV_{it} comprises BA_only, VC_only, coin_dif, and coin_same.

A series of tests are conducted to confirm the validity of the models. First, the Breusch-Pagan test is applied to check the heteroskedasticity issue in the models (Breusch & Pagan, 1979). Then, we consider the problem of the omitted variable by utilising the Ramsey RESET

test (Ramsey, 1969). Finally, the Variance Inflation Factors (VIF) test is used to examine the phenomenon of multi-collinearity of the model.

4. Results and Discussion

4.1 Descriptive statistics

Table 2. Descriptive statistics
This table reports descriptive statistics for all variables used in our study.

Panel A – Dependent variables

ECF firms	Variables	N	Mean	St. Dev.	Min	Max
BA-backed	size	302	7.017	2.283	0.137	10.79
firms	employee	253	2.621	1.380	0.000	5.583
	ROA	245	0.840	13.47	-31.62	187.4
	patent	305	0.230	1.535	0.000	15.00
	intangible	132	0.206	0.281	0.000	0.954
VC-backed	size	187	6.754	1.890	0.693	10.79
firms	employee	162	2.670	1.169	0.000	5.525
	ROA	154	1.118	17.47	-31.62	187.4
	patent	187	0.080	0.710	0.000	9.000
	intangible	111	0.170	0.222	0.000	0.942
Coin_dif	size	61	8.078	1.717	4.641	10.79
	employee	49	2.844	1.484	0.000	5.583
	ROA	56	-1.724	5.468	-31.62	6.567
	patent	61	0.049	0.218	0.000	1.000
	intangible	24	0.210	0.266	0.000	0.913
Coin_same	size	78	7.039	2.412	0.846	10.79
	employee	74	2.861	1.281	0.000	5.583
	ROA	70	2.173	23.85	-31.62	187.4
	patent	78	0.013	0.113	0.000	1.000
	intangible	36	0.227	0.296	0.000	0.859
Non-BA&/orVC backed	size	4,632	5.749	2.119	0.137	10.79
	employee	3,740	2.090	1.170	0.000	5.583
	ROA	3,351	3.252	23.99	-31.62	187.4
	patent	4,683	0.040	0.511	0.000	19.00
	intangible	1,634	0.258	0.296	0.000	0.976

Panel B – Main variables of interest

Variables	N	Dummy = 1 percentage
BA_only	5,236	5.830%
VC_only	5,236	3.570%
coin_dif	5,236	1.170%
coin_same	5,236	1.490%
		12.06%

Panel C – Control variables

Variables	N	Mean	St. Dev.	Min	Max	Dummy = 1 percentage
Campaign-specific						
overfunding	4,689					82.90%
funded	5,159	12.59	1.198	9.393	15.80	
Firm-specific						
age	5,230	3.533	3.603	0.000	45.00	
Div	5,230					19.80%
NED	5,230					7.400%

Variables are winsorised at the 1% and 99% levels.

Panel A, Table 2 provides descriptive statistics for all the dependent variables. In general, the average (mean) values of $size$, $employee$, and $patent$ show that firms backed by professional investors outperform non-backed firms. Firms with co-investment structures tend to be larger than those backed solely by BAs (7.017) and VCs (6.754), with non-backed firms being the smallest in size (5.749). Likewise, the $employee$ figures for $coin\_same$ (2.861) and $coin\_dif$ (2.844) are higher than those for BA-backed firms (2.621), VC-backed firms (2.67), and non-backed firms (2.09). Except for coin_same (0.013), all ECF firms receiving funds from professional investors have gained more patents than non-backed firms. However, regarding profitability, non-backed firms outperform those funded by professional investors. For instance, the mean ROA for non-backed firms is 3.252, higher than that of 1.118 and 0.840 for VC- and BA-backed firms, respectively. Also, another proxy for innovative performance follows the same trend, the mean $intangible$ value for non-backed firms is 0.2579, higher than the mean $intangible$ value of 0.2271 and 0.2095 for $coin\_same$ and $coin\_dif$ firms, respectively. Notably, VC-backed firms spent the least on innovative activities, with a mean $intangible$ value of 0.1697.

Panel B shows the descriptive statistics for the main variables of interest. The percentage of firms backed by professional investors, regardless of investor type, is around 12.06%, i.e., 5.83%, 3.57%, 1.17%, and 1.49% receive funding from BA(s), VC(s), BA&VC co-investments ($coin\_dif$), and syndicates ($coin\_same$), respectively. Therefore, most of the professional-backed firms in our sample are BA-backed firms.

Panel C reports descriptive statistics of campaign-specific and firm-specific control variables. Most firms accept additional investment ($overfunding$) when their campaigns reach funding targets, with an overfunding rate of 82.90%. This rate is consistent with other studies which report an overfunding rate of over 70% (Li et al., 2022; Mollick, 2014). In our sample, the amount of capital raised during their initial ECF campaigns varies considerably among firms. Regarding ECF firm-specific characteristics, the average age of 3.533 years indicates that young firms tend to raise funds through the ECF market. Approximately one-fifth

of firms pursue diversification strategies (Div), with more than one SIC code registered at the UK Companies House. Furthermore, only 7.40% of firms disclose information related to the presence of non-executive directors on the managing board (NED).

Table 3. Company status

This table reports the status of all ECF firms in the sample.

	BA-backed firms		VC-backed firms		BA&VC-backed firms		Non-backed firms	
Status	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Dissolved	12	19.35	7	18.42	4	30.77	238	23.24
Active	45	72.58	29	76.32	8	61.54	759	74.05
M&A	5	8.060	2	5.260	1	7.690	26	2.540
IPO	0	0.000	0	0.000	0	0.000	2	0.200
Total	62	100.0	38	100.0	13	100.0	1025	100.0

Table 3 shows the company status of the BA-backed, VC-backed, BA&VC-backed, and non-backed firms. The presence of professional investors fails to guarantee the survival of ECF firms since 19.35% of BA-backed, 18.42% of VC-backed, and 30.77% of BA&VC-backed firms dissolved over the sample period. This finding is different from that of Signori and Vismara (2018), which shows that none of the ECF firms backed by professional investors experienced failure over the sample period of 2011-2015. A more extended sample period of 2011-2022 reveals the strength of signals generated by professional investors and the relationship between these investors and their portfolio firms. The influence of professional investors probably diminishes over time as they engage in more deals with other startups. On the other hand, the average failure rate of professional-backed firms is lower than that of non-backed firms except for BA&VC-backed firms. Therefore, ECF firms that receive funding either from BA(s) or VC(s) experience a higher survival rate than non-backed ones. Consistent with Hornuf and Schwienbacher (2016), we find that the exit through IPO is not feasible for both professional-backed and non-backed ECF firms because of their small size. The professional-backed firms are more likely to undergo M&A than non-backed firms, indicating that ECF firms choose M&A as an exit strategy. Noticeably, the percentage of M&A for BA-backed firms (8.06%) is approximately one and a half times higher than that of VC-backed firms (5.26%), indicating that BA-backed firms might be more likely to achieve successful exit through M&A than VC-backed ones. This finding is contrary to Cumming and Zhang (2019), who state that BA-backed firms are less likely to achieve successful exits through IPO or M&A than VC-backed firms in the traditional financial markets. The contradictory results highlight the different effects of professional investors in the ECF market compared to those reported in the traditional financial markets.

Table 4 reports the sectoral distribution regarding professional-backed and non-backed firms based on the UK SIC codes. We find that the ECF market attracts firms from several sectors. Among non-backed firms, the majority of the firms belong to four sectors: manufacturing - C (21.76%); Information and communications - J (24.78%); wholesale and retail trade; repair of motor vehicles and motorcycles - G (13.85%); and professional, scientific and technical activities – M (8.29%). These four sectors account for approximately 70% of non-backed firms. Professional investors, however, concentrate on specific sectors in which they have expertise and experience. For instance, BA-backed firms operate in four main sectors: manufacturing - C (11.29%); Information and communications - J (30.65%); professional, scientific, and technical activities – M (9.68%), and administrative and support service activities – N (12.90%). VC-backed firms focus on three sectors: manufacturing - C (23.68%); Information and communications - J (39.47%); and other services – S (10.53%). Similarly, we also find four common sectors for BA&VC-backed firms, namely manufacturing - C (15.38%), information and communications - J (23.08%), financial and insurance activities - K (30.77%); and professional, scientific, and technical activities – M (15.38%). The finding for VC-backed firms is in line with Puri and Zarutskie (2012), who highlight that VC firms invest in high-tech and low-tech industries but mainly focus on some sectors such as computers, electronics, and telecom.

Table 4. Sectoral distribution

The table reports the sector distribution of the BA-backed, VC-backed, BA&VC-backed, and non-backed sub-samples based on the UK Standard Industrial Classification (SIC) codes. Each sector includes relevant industries grouped based on SIC codes[7].

Sectors	Sector	BA-backed firms		VC-backed firms		BA&VC-backed firms		Non-backed firms	
		Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
A	Agriculture, Forestry and Fishing	1	1.610	0	0.000	0	0.000	5	0.490
B	Mining and Quarrying	0	0.000	0	0.000	0	0.000	2	0.200
C	Manufacturing	7	11.29	9	23.68	2	15.38	223	21.76
D	Electricity, gas, steam and air conditioning supply	1	1.610	0	0.000	0	0.000	4	0.390
E	Water supply, sewerage, waste management and remediation activities	0	0.000	0	0.000	0	0.000	3	0.290
F	Construction	2	3.230	0	0.000	0	0.000	4	0.390
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	4	6.450	1	2.630	0	0.000	142	13.85
H	Transportation and storage	0	0.000	1	2.630	0	0.000	8	0.780
I	Accommodation and food service activities	3	4.840	1	2.630	0	0.000	50	4.880
J	Information and communication	19	30.65	15	39.47	3	23.08	254	24.78
K	Financial and insurance activities	5	8.060	3	7.890	4	30.77	66	6.440
L	Real estate activities	0	0.000	0	0.000	1	7.690	12	1.170
M	Professional, scientific and technical activities	6	9.680	2	5.260	2	15.38	85	8.290
N	Administrative and support service activities	8	12.90	1	2.630	1	7.690	71	6.930
O	Public administration and defence; compulsory social security	0	0.000	0	0.000	0	0.000	0	0.000
P	Education	0	0.000	0	0.000	0	0.000	16	1.560
Q	Human health and social work activities	2	3.230	0	0.000	0	0.000	13	1.270
R	Arts, entertainment and recreation	3	4.840	0	0.000	0	0.000	30	2.930
S	Other service activities	1	1.610	4	10.53	0	0.000	32	3.120
T	Activities of households as employers	0	0.000	1	2.630	0	0.000	1	0.100
U	Activities of extraterritorial organisations and bodies	0	0.000	0	0.000	0	0.000	4	0.390
	Total	62	100.0	38	100.0	13	100.0	1,025	100.0

[7] https://resources.companieshouse.gov.uk/sic/

Table 5: Pairwise correlations

The table presents the pairwise correlation matrix of the variables used in the empirical analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) size	1.000									
(2) employee	0.623*	1.000								
(3) ROA	-0.429*	-0.217*	1.000							
(4) patent	0.469*	-0.083	-0.335	1.000						
(5) Intangible	-0.202*	-0.276*	0.059	-0.225	1.000					
(6) overfunding	0.110*	0.087*	-0.214*	0.112	-0.061	1.000				
(7) funded	0.611*	0.548*	-0.326*	0.162	-0.210*	0.232*	1.000			
(8) age	0.280*	0.323*	-0.186*	0.056	-0.085	0.041	0.251*	1.000		
(9) Div	-0.020	-0.039	0.042	-0.436*	-0.147*	-0.056	-0.023	0.003	1.000	
(10) NED	0.103*	0.066	-0.039	-0.011	0.051	-0.029	0.109*	0.015	0.002	1.000

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

4.2 Results

4.2.1 Professional investors and firm performance

In this section, we examine whether BA-backed and VC-backed firms outperform non-backed firms and whether the impacts of BA-backed firms and VC-backed firms are distinctive. Table 6 reports the results of the relationship between the presence of professional investors and firm performance. Columns 1-5 (6-10) show the regression coefficients of BA (VC) investments on ECF firm performance.

For growth potential, BA-backed firms have superior growth prospects than non-backed firms, as shown in Columns 1 and 2. BA_only coefficients of $size$ and $employee$ are 0.5148 ($p < 0.01$) and 0.1872 ($p < 0.05$), respectively, which is roughly 67% higher than the average value of $size$ and 21% higher than the average value of $employee$ during the period, which indicates that monetary injections from professional investors might allow portfolio firms to scale up by investing more in assets ($size$) and human resources ($employee$). This finding is consistent with Levratto et al. (2018), who document a higher $employee$ growth rate for BA-backed firms. Nevertheless, the coefficients of $size$ (0.1383) and $employee$ (0.088) for VC-backed firms are insignificant (Columns 6 and 7), indicating that VC-backed firms are not different from non-backed firms in terms of growth prospects. Therefore, only BA-backed firms outperform non-backed ones in growth potential, partially supporting H1.

Regarding profitability, the presence of BAs is not a predictor of ROA, with the coefficient for BA_only being insignificant (Column 3). ECF firms backed by VCs witness approximately 186.11% ($p < 0.05$) more losses than those without receiving funds from VCs (Column 8). This finding is inconsistent with the other studies, which find either no relationship (Eldridge et al., 2021; Puri & Zarutskie, 2012; Rosenbusch et al., 2013) or a positive relationship between professional investors' investments and profitability (Guo & Jiang, 2013). In our sample, most of the BA-backed firms and VC-backed firms are under five years old at the time at which professional investors inject monetary contributions.[8] These young firms are at the developing stage; therefore, they might invest capital in assets and human resources. After the equity injections, these firms often experience a period of zero or low revenue and negative profitability (Bonini et al., 2019). Consequently, it supports the H1a.

Lastly, BA and VC investments are generally negatively associated with the innovative performance of portfolio firms. As shown in Column (9), VC-backed firms have 2.3% fewer granted patents ($p < 0.01$) compared to non-backed ones. However, we do not find statistically

[8] 72.58% of BA-backed and 73.68% of VC-backed firms are under five years old at the time of ECF investments.

significant results for BA-backed firms (Column 4). Despite the importance of innovative activities, it is not mandatory for ECF firms to patent all their innovation (Eldridge et al., 2021). Similarly, as in Columns (5) and (10), the presence of BAs and VCs is negatively related to Intangible, with the coefficients of BA_only and VC_only being -0.0577 ($p < 0.01$) and -0.0647 ($p < 0.01$), respectively. To put it another way, compared to non-backed firms, those backed by BAs (VCs) have an intangible assets ratio that is nearly 5.77% (6.50%) lower. Dutta and Folta (2016) explain that the conflicts between VCs and portfolio firms due to tight voting rights might reduce the likelihood of successful innovation. Despite some distinctive differences, BAs are anticipated to have the same impact on portfolio firms like VCs (Signori & Vismara, 2018). Following the same managerial styles, the BA groups treat their portfolio firms like VCs, linking to the same innovative outcome. Consequently, these results support H1b.

For campaign-specific control variables, the amount of money that a firm collects from the first ECF campaign ($funded$) positively influences $size$, $employee$, and $patent,$ whereas it is negatively associated with ROA and $intangbile$. Monetary injections from professional investors and retail investors, in fact, contribute to the growth potential of ECF firms, which are young and lack financial support. Financial support allows portfolio firms to invest in assets and human resources and granted patent numbers. However, raising a larger amount of capital does not necessarily lead to improved performance. This suggests that ECF firms may hastily focus on how to utilize the funds provided by their investors. Next, recall from Panel C of Table 2, the majority of ECF firms are overfunded by investors in their first initial offering, with an overfunding rate of 82.90%. Most firms accept additional investment ($overfunding$) when their campaigns reach funding targets, with an overfunding rate of 82.90%. Table 6 shows that $overfunding$ firms tend to be smaller in size and employee numbers and allocate more resources to intangible assets. According to Li et al. (2022), one of the main predictors of overfunding is the initial herd made visible by funding progress. Investors, especially retail investors, do not have enough time to evaluate their investments and decide to invest when seeing the explosive investment interest in a particular project. The bandwagon effect during the very early period of the funding process leads to overfunding (Li et al., 2022). Hence, overfunding is not a positive predictor of growth potential. Nonetheless, the overfunded ECF firms have more room to invest more money in assets and R&D.

In sum, we find that professional-backed firms have superior growth potential than non-backed firms. Regarding firm performance, we do not find any evidence that professional-backed firms outperform non-backed firms. Surprisingly, professional-backed firms perform worse than non-backed firms in terms of innovation. Moreover, ECF firms backed by VCs

experience more losses than non-backed firms. Hence, BAs and VCs seem to hold more passive involvement in this form of financing than in the traditional venture capital market. The results are in line with the findings of Wang et al. (2019) that professional investors who invest during the public launch period do not treat ECF firms like traditional offline investments.

Table 6. Regression on the relationship between professional investor participation and ECF firm performance

The table reports the results of fixed effect panel regressions of BA-backed and VC-backed firms compared to non-backed firms after conducting entropy matching. The dependent variable includes the natural logarithm of total assets ($size$), the natural logarithm of employee numbers ($Employee$), return on assets (ROA), granted patent numbers ($patent$), and the intangible assets ratio ($intangible$). Columns (1-5) show the results for BA-backed firms, while columns (6-10) report VC-backed firm performance. The robust standard error values are reported in parentheses.

VARIABLES	(1) size	(2) employee	(3) ROA	(4) patent	(5) intangible	(6) size	(7) employee	(8) ROA	(9) patent	(10) intangible
BA_only	0.5148***	0.1872**	-1.2429	0.0113	-0.0577***					
	(0.1135)	(0.0863)	(1.1843)	(0.0111)	(0.0201)					
VC_only						0.1383	0.0888	-1.8611**	-0.0229***	-0.0647***
						(0.1417)	(0.1153)	(0.8890)	(0.0039)	(0.0210)
overfunding	-0.9673***	-0.6153***	1.4068	0.0027	0.0010	-0.1475	0.0807	0.7089	0.0015	0.0800**
	(0.2122)	(0.1934)	(1.4572)	(0.0108)	(0.0470)	(0.1252)	(0.1108)	(1.1607)	(0.0029)	(0.0350)
funded	1.0773***	0.5176***	-1.3360*	0.0181***	-0.0600***	1.1020***	0.6767***	-0.7072*	0.0018	-0.0259**
	(0.0640)	(0.0535)	(0.7142)	(0.0061)	(0.0094)	(0.0750)	(0.0398)	(0.3988)	(0.0013)	(0.0105)
age	0.0447***	0.0556***	0.0372	0.0004	-0.0038	0.0320**	0.0232**	0.0882	0.0011	-0.0103***
	(0.0123)	(0.0082)	(0.0959)	(0.0024)	(0.0024)	(0.0128)	(0.0101)	(0.1159)	(0.0008)	(0.0026)
Div	-0.0193	-0.3285***	3.3571	-0.0036	0.0250	-0.0670	-0.1822**	0.0968	-0.0086	-0.0511**
	(0.1404)	(0.0969)	(3.6912)	(0.0111)	(0.0294)	(0.1464)	(0.0833)	(0.8729)	(0.0062)	(0.0243)
NED	0.6959***	0.4175***	0.5744	0.0099	-0.0501	0.8308***	0.2615**	0.5080	0.0415***	-0.0589
	(0.1327)	(0.1079)	(2.2725)	(0.0132)	(0.0386)	(0.1693)	(0.1328)	(1.9394)	(0.0149)	(0.0676)
Constant	-7.1306***	-4.0976***	18.1651**	-0.2251***	1.0754***	-8.1528***	-6.6885***	10.3619**	-0.0084	0.5595***
	(0.7874)	(0.6455)	(8.4634)	(0.0754)	(0.1281)	(0.9581)	(0.5104)	(5.1998)	(0.0166)	(0.1401)
Time-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,433	3,605	3,216	4,485	1,555	4,317	3,502	3,122	4,365	1,518
R-squared	0.4729	0.3713	0.0432	0.0939	0.3316	0.4224	0.3616	0.0315	0.0302	0.2756
Adj R2	0.469	0.365	0.0326	0.0866	0.316	0.418	0.356	0.0205	0.0222	0.259

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

To deeply understand the impact of BAs and VCs on ECF firm performance, we compare the mean differences between BA-backed and VC-backed firms and report the results in Table 7. The differences in mean between both groups are statistically insignificant, except for $patent$. This may imply that the impact of BAs and VCs on $size$, $employee$, ROA, and $intangible$ in the ECF market is not statistically distinctive. In the traditional entrepreneurial financial market, BAs or VCs provide financial support dependently or co-invest with other professional investors, but BAs and VCs invest along with other retail investors in the ECF market. It may decrease voting rights and the level of influence on portfolio firms. The differences between BAs and VCs may diminish if both of them pursue a passive investment strategy, which minimizes the managerial support and guidance for ECF firms (Wang et al., 2019). This finding is in line with Signori and Vismara (2018), who posit the similar influence of BAs and VCs on portfolio firms. On the other hand, we find that the mean value of $patent$ for BA-backed firms is higher than that for VC-backed firms, indicating that BA-backed firms have a higher number of patents granted than VC-backed firms, supporting the H2a. Without the time-oriented performance-based compensation, BAs are more open to experimentation and have a low tolerance for early-stage failure, thus improving the innovation performance of portfolio firms (Dutta & Folta, 2016). Therefore, we do not find evidence supporting the H2 and H2a, except for the proxy of $patent$, indicating that there is no difference in the impact on ECF firm performance between BAs and VCs in the ECF.

Table 7: BA-backed firms and VC-backed firm performance comparison.

This table compares BA-backed and VC-backed firm performance. Firm performance is winsorized at a 5% level. The significance level for the differences in mean between both groups is reported. The sample exclusively includes firms receiving funds from BAs or VCs. The treatment variable is BA_dum which takes the value of 1 if a firm receives monetary contributions from BAs; otherwise, it takes 0 (i.e., VC-backed firms).

size	BA-backed firms	VC-backed firms	Diff
Mean	7.1182	6.8551	
SD	2.1987	1.9446	
Observations	250	143	
employee	BA-backed firms	VC-backed firms	Diff
Mean	2.6820	2.7376	
SD	1.4270	1.2729	
Observations	216	118	
ROA	BA-backed firms	VC-backed firms	Diff
Mean	0.9602	0.3661	
SD	14.867	9.6536	

Observations	199	113	
patent	BA-backed firms	VC-backed firms	Diff
Mean	0.0435	0.0070	**
SD	0.2043	0.0836	
Observations	253	143	
intangible	BA-backed firms	VC-backed firms	Diff
Mean	0.1875	0.1823	
SD	0.2506	0.2394	
Observations	117	88	

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

4.2.2 Co-investment and firm performance

In Section 4.2.1, we compared the performance of firms backed by one BA or one VC with non-backed firms. In this section, we compare the performance of firms backed by more than one BA/VC and both BA and VC with non-backed firms and report results in Table 8. We do not find evidence supporting the impact of BA&VC co-investment on firm performance for all proxies. The co-investment between two types of investors who have different motives and expectations can create conflicts, so the decision-making process may be time-consuming and complicated (Harrison & Mason, 2000). Furthermore, the involvement of BAs typically signifies a stronger alignment between BAs and portfolio firms and exacerbates the relationship between VCs and founders (Goldfarb et al., 2013). In sum, our results support the alternative hypothesis, H3a. Nonetheless, we should approach this conclusion with caution due to the limited number of observations involving only 13 companies.

Regarding the syndicated firms, the results imply a worse performance in terms of innovation of VC-backed firms compared to non-backed ones (Columns 9 and 10). As found in section 4.2.1, the coefficients of $patent$ and $intangible$ are -0.0242 ($p < 0.01$) and -0.1055 ($p < 0.01$), respectively. A firm backed by VCs has 2.42% fewer patents and 10.55% less $intangible$ than non-backed ones. This is in line with the finding we highlighted in Section 4.2.1 about the relationship between BA_only and VC_only and innovative performance. It confirms the finding suggested by Wang et al. (2019) that professional investors who invest in ECF firms during the initial public offering treat ECF investment as a different asset class and prefer the convenience and hands-off nature of ECF. Hence, these findings also support the alternative hypothesis, H3a.

Table 8: Regression on the relationship between co-investments and ECF firm performance

The table reports the results of fixed effect panel regressions of BA&VC co-invested firms ($coin\_dif$) and syndicated firms ($coin\_same$). The dependent variable includes the natural logarithm of total assets ($size$), the natural logarithm of employee numbers ($Employee$), return on assets (ROA), granted patent numbers ($patent$), and the intangible assets ratio ($intangible$). Columns (1-5) show the results for BA&VC co-invested firms, while columns (6-10) report syndicated firm performance. The robust standard error values are reported in parentheses.

VARIABLES	(1) size	(2) employee	(3) ROA	(4) patent	(5) intangible	(6) size	(7) employee	(8) ROA	(9) patent	(10) intangible
coin_dif	0.1746	-0.2085	-4.2511	0.0426	0.0529					
	(0.2035)	(0.2087)	(3.1909)	(0.0370)	(0.0374)					
coin_same						0.1748	0.0494	-1.4704	-0.0242***	-0.1055***
						(0.1898)	(0.1364)	(1.5762)	(0.0075)	(0.0275)
overfunding	-0.1965	-0.1576	-0.7911	0.0329	0.2641***	-2.2178***	-1.7242***	1.4580	0.0048	0.1608***
	(0.1661)	(0.1786)	(1.5309)	(0.0223)	(0.0450)	(0.4379)	(0.3523)	(2.1160)	(0.0059)	(0.0352)
funded	0.4920***	0.4573***	0.4201	0.0111	-0.1085***	1.3931***	0.5447***	-0.9534	0.0031	-0.0052
	(0.1388)	(0.1215)	(1.7339)	(0.0094)	(0.0189)	(0.1012)	(0.0936)	(1.3461)	(0.0027)	(0.0152)
age	0.0997**	0.0052	0.3915	0.0171**	0.0142**	0.0382**	0.0522***	0.0820	0.0016*	0.0049
	(0.0456)	(0.0372)	(0.2940)	(0.0075)	(0.0067)	(0.0182)	(0.0161)	(0.1072)	(0.0008)	(0.0033)
Div	1.3196***	0.6767**	-0.7269	0.0294	0.0577	-0.0036	-0.1642	-1.7629	-0.0173**	-0.0768***
	(0.2088)	(0.2659)	(2.8774)	(0.0215)	(0.0547)	(0.1918)	(0.1402)	(1.4523)	(0.0088)	(0.0284)
NED	0.6767***	0.9626***	7.6567	-0.0506	0.2002***	1.3996***	0.7116***	0.3830	0.0325**	-0.0102
	(0.1915)	(0.1895)	(8.0670)	(0.0429)	(0.0386)	(0.2302)	(0.1526)	(2.8383)	(0.0141)	(0.0437)
Constant	0.2954	-3.5417**	-5.8612	-0.2232	1.4740***	-10.306***	-3.3488***	13.305	-0.0336	0.1613
	(1.8116)	(1.5957)	(22.943)	(0.1640)	(0.2618)	(1.3227)	(1.2812)	(17.534)	(0.0378)	(0.2020)
Time-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,232	3,432	3,064	4,281	1,460	4,235	3,443	3,065	4,284	1,466
R-squared	0.4695	0.4586	0.0880	0.1366	0.5485	0.4991	0.4467	0.0358	0.0382	0.4729
Adj R2	0.465	0.454	0.0775	0.129	0.538	0.495	0.441	0.0247	0.0301	0.460

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

4.2.3 Sub-sample analysis

a) The performance of startups and pre-existing firms

Following Bonini et al. (2019), we categorize the sample into two categories based on firm age. In particular, startups are defined as firms incorporated two years or less before the first ECF campaign, while the remaining firms not classified as startups are named pre-existing firms (Bonini et al., 2019). Table 9 presents the regression results examining the relationship between professional investments and firm performance, categorized by age (i.e., startups and pre-existing firms). The presence of BAs in startups does not impact the potential growth (Column 1), but it is positively associated with $size$ and $employees$ in pre-existing forms (Column 3). The coefficients of $size$ and $employee$ for pre-existing BA-backed firms are 0.6903 ($p < 0.01$) and 0.3160 ($p < 0.01$), indicating that pre-existing BA-backed firms are 100% larger in size and have 37.6% more employees than non-backed ones. Contrary to BAs, the involvement of VCs in startups is positively related to $size$ and $employee$, but their involvement does not impact the pre-existing firms. As shown in Columns (2) and (4), the coefficient values of $size$ and $employee$ for startups backed by VCs are 0.6929 ($p < 0.01$) and 0.9314 ($p < 0.01$), respectively, showing that these startups are 100% larger in size and 154% more employees than non-backed firms. The finding highlights that both BA(s) and VC(s) positively affect the firm's growth prospects, but their effect depends on the firm age. The involvement of BAs is a strong predictor of growth for more mature firms, while VC backing serves as a positive signal for startups.

On the other hand, BA-backed and VC-backed firms experience more losses than non-backed firms. Column 2 shows that startups backed by VCs experience severe losses in terms of ROA than non-backed firms, with approximately 340.4% ($p < 0.01$) lower than those without receiving funds from VCs. Likewise, Column (3) reports the negative relationship between BA involvement and ROA, with a decrease of ROA by nearly 199% ($p < 0.01$) in the presence of BAs in pre-existing firms. Noticeably, we do not find significant results for startups backed by BAs and pre-existing firms backed by VCs. These results are in line with the findings of H1b.

For innovative performance, the negative effect of VCs is confirmed in both groups of firms (i.e., startups and pre-existing), as shown in Columns (3) and (4). Consistent with the results in Section 4.2.1, startups and pre-existing firms receiving funding from VCs have fewer granted patents than non-backed firms, with 1.32% and 2.53% lower, respectively. Additionally, BA involvement does not affect the number of granted patents for both groups (Columns 1 and 2). Likewise, we also find a negative relationship between VC involvement and intangible for

both groups, while only pre-existing firms backed by BAs follow this trend. Consequently, the results support the H1b.

Table 9. Sub-sample regression by firm age

The table shows the fixed effect panel regression results on BA-backed and VC-backed firms by firm age. The dependent variable includes the natural logarithm of total assets ($size$), the natural logarithm of employee numbers ($Employee$), return on assets (ROA), granted patent numbers ($patent$), and the intangible assets ratio ($intangible$). Columns (1-2) present the firm performance of startups, whereas columns (3-4) report the firm performance of pre-existing. The robust standard errors are reported in parentheses.

Firm performance	Startups			Pre-existing		
	Obs	(1) BA_only	(2) VC_only	Obs	(3) BA_only	(4) VC_only
size	2,302	0.1912	0.6929***	2,322	0.6903***	-0.2275
		(0.1715)	(0.1607)		(0.1220)	(0.1487)
employee	1,776	0.0690	0.9314***	1,980	0.3160***	-0.1246
		(0.1047)	(0.1072)		(0.0836)	(0.1434)
ROA	1,535	1.6587	-3.4069*	1,837	-1.9895***	-1.4243
		(2.6848)	(1.8383)		(0.7457)	(1.1892)
patent	2,335	0.0047	-0.0132***	2,340	0.0103	-0.0253***
		(0.0102)	(0.0044)		(0.0151)	(0.0053)
intangible	689	0.0463	-0.1251***	970	-0.0737***	-0.0540**
		(0.0378)	(0.0265)		(0.0175)	(0.0211)

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

b) Short-term and long-term performance

We conduct a sub-sample analysis based on the financial years after the first ECF campaign to examine how professional investment effects evolve over time. The entire sample is separated into two groups representing periods: short-term and long-term firm performance. We include firm performance in the first three years after the initial offering into short-term performance and the remaining into long-term performance. Table 10 reports the regression results on the effect of professional investments on firm performance in two periods. Regarding $size$, the coefficient for BA-backed firms in the shortterm is 0.4745 ($p < 0.05$), indicating that the size of BA-backed firms is approximately 60.72% larger than non-backed firms. In the long term, those backed by BAs witness an increase in coefficient up to 0.6643 ($p < 0.01$), showing their superior firm size by 94.31% compared to non-backed ones. On the other hand, the coefficient of $employee$ for BA_only is 0.2542, indicating a higher number of employees by

28.94% than non-backed firms in the long term. However, we do not find a similar result for $employee$ in the short term. , The presence of BAs positively influences short-term innovative performance, leading to a 5% ($p < 0.1$) higher number of granted patents compared to firms without BAs.In the long term, this effect disappears and changes into a negative relationship with a coefficient of -0.0263 (i.e., 2.63% fewer granted patents). Similarly, we find a negative association between BA involvement and $intangible$ in the long term, with fairly 10% ($p < 0.01$) lower in $intangible$ than non-backed firms.

Regarding VC-backed firms, we do not find the difference between $size$, $employee$, and ROA in the short term and long term. Nevertheless, the presence of VCs negatively influences granted patent numbers in the short run and long run, with coefficients of -0.0270 ($p < 0.01$) and -0.0201 ($p < 0.01$), respectively. Similarly, the coefficient value of -0.0967 ($p < 0.01$) illustrates that VC participation leads to a decline in $intangible$ by 9.67%. Yet, we do not find evidence supporting the same effect in the short term.

Table 10. Sub-sample regression on different periods after the first ECF campaign

The table shows the fixed effect panel regression results on BA-backed and VC-backed ECF firms by financial periods after the first ECF campaign after conducting entropy matching. The dependent variable includes the natural logarithm of total assets ($size$), the natural logarithm of employee numbers ($Employee$), return on assets (ROA), granted patent numbers ($patent$), and the intangible assets ratio ($intangible$). Columns (1-2) present performance in the short term; columns (3-4) report performance in the long run. The robust standard errors are reported in parentheses.

Firm performance	First 03 years			Over 03 years		
	Obs	(1) BA_only	(2) VC_only	Obs	(3) BA_only	(4) VC_only
size	1,064	0.4745**	-0.1404	1,256	0.6643***	-0.3109
		(0.2002)	(0.1945)		(0.1657)	(0.1978)
employee	871	0.2004	-0.2275	1,109	0.2542**	-0.2020
		(0.1237)	(0.2029)		(0.1150)	(0.1665)
ROA	789	-2.2386	-1.4406	1,045	-0.3745	-1.0261
		(1.3666)	(3.5064)		(0.3877)	(0.9034)
patent	1067	0.0576*	-0.0270***	1,271	-0.0263***	-0.0201***
		(0.0316)	(0.0084)		(0.0077)	(0.0062)
intangible	447	-0.0387	-0.0084	522	-0.1006***	-0.0967***
		(0.0275)	(0.0319)		(0.0256)	(0.0261)

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

4.3 Robustness checks

To check the robustness of primary findings, we conduct additional analyses in terms of alternative measures for dependent variables and alternative matching approaches.

4.3.1 Alternative measures for dependent variables:

We use other proxies for firm performance commonly used in the literature to examine whether our main findings in Sections 4.2.1 and 4.2.2 remain valid. The first proxy is success, which is defined as an ECF firm successfully raising additional funds from equity financing or exiting through M&A or IPO (Cumming et al., 2019; Signori & Vismara, 2018). Following the literature, we create a dummy called $success$, which takes a value of 1 if a firm successfully attracts another equity financing round after its first initial public offering or conducts an M&A or IPO; otherwise, 0 (Cumming et al., 2019; Signori & Vismara, 2018). This proxy captures the possibility of attracting more investors or exiting through an M&A or IPO, in other words, a firm's potential growth. Regarding innovative performance, we utilize the number of patent applications in the form of logarithm as a proxy for innovation suggested in the literature (Vismara, 2018; Walthoff-Borm et al., 2018).

Table 11: The presence of professional investors and firm success

The table shows probit regression results on the relationship between the presence of BA_only, VC_only, $coin\_dif$, and $coin\_same$ and $success$. The dependent variable is $success$, which equals 1 once a firm successfully receives additional equity financing after the ECF initial offering or conducts an M&A or IPO; otherwise, it takes 0. The robust standard errors are reported in parentheses.

VARIABLES	(1) Success	(2) Success	(3) Success	(4) Success
BA_only	0.1692*			
	(0.0978)			
VC_only		0.2241		
		(0.1386)		
coin_dif			0.7601**	
			(0.2994)	
coin_same				0.3722
				(0.2528)
age	-0.0626***	-0.0620***	-0.0615***	-0.0620***
	(0.0069)	(0.0069)	(0.0069)	(0.0069)
Overfunding	0.0723	0.0781	0.0786	0.0733
	(0.0575)	(0.0577)	(0.0577)	(0.0575)
funded	0.3896***	0.3899***	0.3899***	0.3920***
	(0.0213)	(0.0214)	(0.0214)	(0.0213)
Div	0.1838***	0.1850***	0.1851***	0.1850***
	(0.0554)	(0.0553)	(0.0554)	(0.0553)
NED	0.1446*	0.1478*	0.1346	0.1367*
	(0.0822)	(0.0818)	(0.0826)	(0.0823)
Constant	-5.6298***	-5.7950***	-5.6052***	-5.6266***
	(0.8538)	(0.8799)	(0.8557)	(0.8553)
Observations	4,640	4,640	4,640	4,640
Pseudo-R-squared	0.1209	0.1209	0.1213	0.1208

. Table 11 reports the probit regression results of the association between the presence of professional investors and success. As shown in Columns (1) and (2), the involvement of BAs is positively related to success, with a coefficient of 0.1692 ($p < 0.1$), while that of VC does not impact firm success. This result is consistent with our main finding of H1a, indicating the positive effect of BAs and no impact of VCs on potential growth. On the other hand, in Column 3, BA&VC co-investment is a positive predictor of firm success ($p < 0.05$), which is contrary to the evidence in Section 4.2.2, where we find no relationship between BA&VC co-invested firms and firm growth. The limited observations from BA&VC co-invested firms may cause a difference in our results. However, consistent with our findings in Section 4.2.2, we find no relationship between syndicated structures and $success$ (Column 4).

. Table 12 shows the regression results of the relationship between the presence of professional investors and innovative performance. In line with primary results, we find a negative relationship between VCs and coin_same and the number of patent applications, with coefficients of -0.4167 ($p < 0.01$) and -0.3099 ($p < 0.1$). Likewise, we find that BA&VC co-investment and BA involvement do not impact the number of patent applications.

Table 12: The presence of professional investors and patent application numbers

The table shows the fixed effect panel regression results of the influence of BA_only, VC_only, $coin\_dif$, and $coin\_same$ on the number of patent applications after conducting entropy matching. The dependent variable is the number of patent applications. The robust standard errors are reported in parentheses.

	(1)	(2)	(3)	(4)
VARIABLES	Patent_app	Patent_app	Patent_app	Patent_app
BA_only	0.1782			
	(0.2204)			
VC_only		-0.4167***		
		(0.1235)		
coin_dif			0.3915	
			(0.3002)	
coin_same				-0.3099*
				(0.1821)
age	0.0495	0.0441	0.0548	0.0510
	(0.0676)	(0.0280)	(0.0427)	(0.0327)
Overfunding	0.1936	0.2167	0.1838	0.1241
	(0.2832)	(0.1581)	(0.1376)	(0.1169)
funded	0.1710	0.0280	0.1919*	-0.0164
	(0.1098)	(0.0579)	(0.1036)	(0.0613)
Div	-0.3396	-0.3070**	0.2375	-0.2324
	(0.2501)	(0.1420)	(0.1743)	(0.1622)
NED	-0.2206	0.4798**	-0.3047	0.2770*
	(0.2720)	(0.2076)	(0.2852)	(0.1565)
Constant	-2.1671	-0.2312	-2.8717*	0.3341
	(1.4278)	(0.8096)	(1.5756)	(0.7915)
Observations	1,744	1,744	1,744	1,744
R-squared	0.1418	0.0697	0.2654	0.0808
Adj R2	0.124	0.0506	0.250	0.0619

4.3.2 Nearest neighbour matching approach

Following literature (Engel & Keilbach, 2007; Islam et al., 2018), we also apply another matching approach, nearest neighbour matching, to examine whether the results are sensitive to the matching approaches. Table 13 shows the results of professional-backed firm performance using the nearest neighbour matching approach based on the same criteria, namely industry classification (SIC), firm age, and campaign size. Consistent with the primary results in Section 4.2.1, we find a positive relationship between BAs and growth potential, with coefficients of 0.8287 ($p < 0.01$) for $size$ and 0.3900 ($p < 0.01$) for $employee$. BA involvement is negatively associated with intangible ($p < 0.1$). The presence of VCs, however, leads to a decrease in ROA and innovative performance (Column 2). The BA&VC co-invested firms have

larger $size$, more $patent$, and higher $intangible$ but lower ROA than non-backed firms at a 10% significance level. Due to the limited number of BA&VC firms, the results are sensitive to the matching approaches used.. We confirm consistent results of the negative relationship between $coin\_same$ and innovation at 1% level.

Table 13. Professional-backed firm performance using the nearest neighbour matching approach.

The table shows the relationship between the presence of professional investors and ECF firm performance after conducting the nearest neighbour approach. The dependent variables are asset turnover (ATO), the natural logarithm of employee number ($Employee$), the natural logarithm of sales revenue ($Revenue$), and return on assets (ROA). Huber-White heteroscedasticity consistent standard errors are reported in parentheses.

Variables	Obs	(1) BA_only	Obs	(2) VC_only	Obs	(3) coin_dif	Obs	(4) coin_same
Size	3,606	0.8287***	4,318	1.0598	4,234	1.3284*	4,237	0.0207
		(0.1714)		(0.1872)		(0.1640)		(0.0207)
Employee	3,606	0.3900***	3,505	0.7011	3,434	0.4218	3,445	0.1377
		(0.0792)		(0.1655)		(0.0912)		(0.2647)
ROA	3,216	-2.0165	3,123	-2.9953**	3,064	-4.2156*	3,065	-1.6193
		(1.2561)		(1.2171)		(0.6042)		(2.5141)
Patent	4,486	0.0225	4,366	-0.0127***	4,282	0.0008*	4,285	-0.1249***
		(0.0157)		(0.0017)		(0.0067)		(0.0017)
Intangible	1,555	-0.0466*	1,519	-0.1011***	1,461	0.2250*	1,467	-0.2225***
		(0.0315)		(0.0291)		(0.0877)		(0.0097)

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

4.3.3. The influence of the Covid-19 pandemic

Due to the COVID-19 pandemic, firm financial performance might be adversely affected, which could impact our conclusions. To determine whether our primary results remain consistent, we exclude the period affected by COVID-19 from our analysis. Empirical evidence often determines COVID-19 pandemic occurred between 2020 and 2021 (Cumming & Reardon, 2023; Vu & Christian, 2024). Following this, we exclude all financial performance after the year 2020 in the sample, in other words, the sample only includes firm performance up to the year 2019. Table 14 reports the regression results of the presence of professional investors and firm performance, excluding the period of the COVID-19 pandemic. We find consistent results with primary findings when excluding the period of 2020-2021.

Table 14: Professional investor participation and ECF firm performance before and after the COVID-19 pandemic.

The table shows the fixed effect panel regression results on BA-backed, VC-backed, syndicated, and BA&VC co-invested ECF firms, excluding the period of the COVID-19 pandemic after conducting entropy matching. The dependent variables are the natural logarithm of total assets (size), the natural logarithm of employee numbers ($Employee$), return on assets (ROA), the number of granted patents

($patent$), and the intangible assets ratio ($intangible$). Columns (1-2) present performance in the short term; columns (3-4) report performance in the long run. The robust standard errors are reported in parentheses.

Variables	Obs.	(1) BA_only	(2) VC_only	(3) coin_dif	(4) coin_same
size	3,040	0.5335***	0.1168	-0.1600	0.0894
		(0.1430)	(0.1801)	(0.2264)	(0.2386)
Employee	2,291	0.2730***	0.0429	-0.2959	0.1344
		(0.1058)	(0.1620)	(0.2468)	(0.1727)
ROA	2,217	-1.2738	-1.6508	-8.5803	-1.8778
		(1.7838)	(1.2790)	(5.4364)	(1.8287)
Patent	3,071	0.0117	-0.0270***	0.0218	-0.0189**
		(0.0139)	(0.0054)	(0.0384)	(0.0074)
Intangible	1,057	-0.0481**	-0.0053***	0.0911	-0.0841***
		(0.0243)	(0.0245)	(0.0558)	(0.0309)

5. Conclusion

In this paper, we explore the role of professional investors (i.e., BAs and VCs) and co-investment structures in the post-fundraising performance of ECF firms that successfully raised funds on ECF platforms. We investigate the differential impacts of BAs and VCs on their portfolio firms in terms of financial and non-financial aspects. Additionally, we differentiate the effects of investment structures, namely syndication and BA-VC-co-investments, on ECF firm performance. We base our hypotheses on the sample of 1,034 ECF firms with the first successful ECF offerings on the three largest ECF platforms in the UK (i.e., Crowdcube, Seedrs, and SyndicateRoom) between 2011 and 2022.

Our results show that BA-backed and VC-backed firms generally do not outperform non-backed firms in the ECF market. We find that BA-backed firms outperform non-backed firms regarding growth opportunities measured by two proxies, namely *size* and $employee$. Importantly, this effect is moderated by the firm age at the time of investment. BAs significantly enhance the growth opportunities of pre-existing firms (over two years old) but have no significant influence on startups. Meanwhile, VC involvement tends to boost the growth prospects of startups but has no impact on more mature firms. The presence of professional investors, on the other hand, does not guarantee the profitability of portfolio firms; in fact, those backed by professional investors experience more losses than non-backed firms. In terms of innovative performance, firms backed by BAs have a higher number of granted patents than non-backed firms in the short term, but this effect disappears in the long term. The presence of VCs is negatively associated with innovation performance proxied by $patent$ and $intangible$.

In addition, we do not find evidence of the relationship between coin_dif and firm performance, indicating that firms backed by both BAs and VCs are not different from non-backed firms. Non-backed firms outperform syndicated firms in the granted patent numbers and the intangible assets ratio.

Our results posit some implications. First, financial and non-financial support from professional investors is crucial for long-term development, especially in the ECF market with a high level of risk and information asymmetry. However, each firm can decide to go with specific types of investment, depending on firm-specific and campaign-specific characteristics. Second, firms need to proceed with caution when choosing professional investors, as inexperienced investors can lead to poor performance, especially for BA investments.

Our study has a few limitations. First, we do not examine the impact of corporate venture capitalists (CVC) on firm performance because of limited data. CVCs are also professional investors in the ECF market. CVCs differ from VCs in several aspects (Drover et al., 2017) and thus affect firm performance differently. Second, we exclusively focus on the first ECF post-fundraising performance rather than later funding rounds. Professional investors might invest in later rounds instead of first offering. Finally, our conclusion regarding the impact of BA&VC co-investment on firm performance is based on limited observations; therefore, we suggest future research using additional data.

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