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RSEARCH ARTICLE

Entrepreneurial finance and the survival of equity-funded firms in crisis periods: the case of COVID-19

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Abstract This study investigates the resilience of 13,786 UK entrepreneurial firms that received equity financing before COVID-19, with 653 becoming insolvent and 6254 securing guaranteed loans during the pandemic. Utilising the resource-based view (RBV) and signalling theories, we hypothesise that equity-backed firms have sufficient resources to withstand crises, varying by investor type and involvement. We compare the bankruptcy risk of these firms during COVID-19 to the pre-COVID period, considering investor type, deal history and financial and non-financial factors. Results show similar insolvency rates during COVID-19 compared to pre-COVID, but firms backed by active investors are less likely to become insolvent during crises. We examine the characteristics of loan recipients, financing combinations and insolvency risk, finding that companies using COVID loans were generally more prone to insolvency, except those backed by active investor types. Our findings offer insights into the role of equity financing across various investor types in venture survival during crises, with policy implications.

Plain English Summary This study examines how well UK companies with equity financing before the COVID-19 pandemic managed to survive during the pandemic. It examines different types of investors, such as venture capital (VC), business angels, government VC, foreign VC, equity crowdfunding platforms and individual investors. The study suggests that companies with equity backing had enough resources to get through the pandemic, but this varied depending on the type of investor. It analyses the risk of these companies going bankrupt during the pandemic compared to before it, considering factors such as the type of investor and the history of their deals. Additionally, it examines how some companies used government-guaranteed loans and how this affected their risk of insolvency. These findings provide insights into how different types of equity financing can help companies survive during crises. The results have important policy implications relating to the design of loan guarantee schemes and convertible loan schemes that can be targeted at equity-backed companies.

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1 Introduction

Entrepreneurial finance plays a pivotal role in supporting high-growth enterprises that significantly influence economic expansion, productivity and the diffusion of innovative technologies, which can yield extensive long-term benefits for the economy. These enterprises are instrumental in fostering the development of emergent and transformative sectors such as artificial intelligence, clean energy, life sciences and financial innovation. However, this vital segment is characterised by a high propensity for failure and is plagued by substantial information asymmetries, leading to 'market failures' in securing financing across various stages of venture development (Wilson et al., 2018, 2019). During periods of economic shock and crisis, heightened uncertainty severely impedes the activities of entrepreneurs and financial actors, including banks and investors (Block & Sandner, 2009; Brown et al., 2020; Conti et al., 2019; McMullen & Shepherd, 2006; Packard et al., 2017). Due to COVID-19, small firms postponed investments (Thorgren & Williams, 2020), increased bootstrap financing (Block et al., 2018) and experienced a significant decline in entrepreneurial and innovation activities (Brown et al., 2020). Cowling et al. (2020) discovered that 8.6% of small businesses lacked cash reserves, putting them in immediate danger, whilst 61% were vulnerable in the medium term, lacking cash reserves or retained profits to withstand an extended lockdown.[1]

However, equity-funded firms are set up with large cash reserves, low levels of debt and the expert oversight of equity investors with a view to surviving long development periods at lower than break-even levels of revenue. This provides some immunity to changing economic and demand conditions. Several studies attest to the resilience of equity-funded enterprises during economic crises and downturns, but with a focus on venture capital (VC) and private equity funds (Bernstein et al., 2019; Gompers et al., 2021, 2022; Lavery & Wilson, 2024; Manigart et al., 2002a, b; Wilson & Wright, 2013). A study looking at the resilience of other types of investors is absent and our paper fills this gap by examining the spectrum of equity finance investors. Equity investments can originate from diverse investor types, including domestic and foreign VC, business angels, government VC, equity crowdfunding and individual investors, each possessing distinct characteristics and advantages. One important distinction is how actively involved is the investor in the governance and development of the invested company and how these investor types differ in the resource that they can provide or access to support investees. Consequently, we build on Barney's (1991) resource-based view (RBV) by documenting that various investor types bring different levels of monitoring, support and resources to help survival and unveil the sources of resilience of equity-funded companies during the crises. Moreover, the pandemic brought sudden and abrupt changes to the business landscape, imposed operational restrictions on firms and rapidly evolving government regulations, resulting in a far more extensive impact on businesses compared to previous economic downturns. This provides a novel setting in which to examine the survival of firms with heterogeneous equity funding.

Pandemic-induced economic downturns disrupt supply chains, diminished demand and created a pervasive environment of uncertainty that adversely affects the financial stability of both businesses and investors (Brown & Rocha, 2020; Brown et al., 2020). Unlike previous crises, however, the COVID period was marked by significant government intervention aimed at mitigating the impact on business.[2] The

[1] The structural issues in the UK were highlighted in Lee et al. (2015) who note that limited access to financing for innovative firms and credit rationing that affected small- and medium-sized enterprises (SMEs) and the economy as a whole.

[2] The UK government addressed the pandemic with interventions like the Coronavirus Job Retention Scheme, covering furloughed employees' salaries and costing £143.2bn. Government-backed business loan schemes provided £81.2bn in loans to businesses, preventing the failure of viable companies through the Coronavirus Business Interruption Loan Scheme, Coronavirus Large Business Interruption Loan Scheme and Bounce Back Loan Scheme. These interventions supported SMEs and stabilised the economy during credit shortages, covering 94% of SME lending early in the pandemic. Quickly designed and launched, the schemes bypassed usual credit checks and used 'self-certification' for eligibility. The Future Fund offered convertible loans to select UK companies struggling to raise equity financing due to COVID-19, managed by the British Business Bank. Temporary changes to insolvency legislation (Corporate Insolvency and Governance Act 2020) delayed the insolvency process for some firms, ending on October 1, 2021.

policy aimed to prevent a liquidity crisis, business failures and job losses, whilst maintaining the 'creative destruction' mechanism essential for innovation and resource reallocation (Dorr et al., 2022; Demmou et al., 2021; Gambirage et al., 2023). The pandemic led to unprecedented interventions, including substantial government-guaranteed loans to businesses (Cowling et al., 2023a), with minimal additional support for equity financing. Consequently, many equity-backed firms took on debt, i.e. government guaranteed loans. These loans were often issued without standard credit checks, based on self-certified eligibility (Cowling et al., 2023b).[3] For early-stage equity-financed firms and those with smaller equity investors, these loans were acquired to enhance liquidity and survival prospects (Dorr et al., 2022; Gambirage et al., 2023) and, in some cases, helped firms attract additional equity investment (Kazembalaghi et al., 2024). However, the impact of government intervention on the process of creative destruction for equity-funded companies in the UK has not been explored in detail.

Under normal economic conditions, investors mitigate high levels of uncertainty and agency problems through rigorous screening, monitoring and robust control mechanisms (Kaplan & Stromberg, 2001). However, equity investors typically engage in these activities only through close relational interactions and physical proximity, often necessitating face-to-face meetings with their portfolio firms (De Clercq & Sapienza, 2006). Consequently, the social distancing measures imposed during the pandemic may lead to a phenomenon of 'financial distancing' (Brown & Rocha, 2020; Howell et al., 2020). The behaviour of different investor types during the pandemic, particularly in terms of survival rates, will significantly influence entrepreneurial dynamism and inform policy interventions for future crises (Savio et al., 2024). Some preliminary studies have found that, during the COVID-19 crisis, companies with the active investors that provide additional resource and expertise to their portfolio firms tend to achieve more successful exits (Kacer et al., 2024a) and exhibit lower default rates on loans (Kacer et al., 2024b). The role of active investors on the pattern of insolvencies has not been investigated.

This study attempts to fill gaps in the literature outlined above and builds upon previous findings on insolvency patterns (Dorr et al., 2022; Demmou et al., 2021; Gambirage et al., 2023) to examine the extent to which the active involvement of various investor types in equity-backed firms mitigate the impact of the COVID-19 crisis and examines the effectiveness of government interventions for these firms, specifically guaranteed loans. The objective of this study is to assess the effects of the pandemic on insolvencies of equity-backed firms at various developmental stages and across different investor categories. The authors have unique access to firm-level data on the UK loan guarantee schemes and comprehensive data on equity-funded companies, encompassing both large publicised and smaller unpublicised equity deals.

The analysis yielded several interesting findings. Our estimated models predicting insolvency incorporate a range of variables reflecting pre-COVID performance, financial health (risk) and equity deal history, controlling for a wide range of non-financial, sector and location variables, combined to produce a strong predictive accuracy (AUC 0.72) and useful insights into the failure characteristics of equity-backed firms. When controlling for all firm characteristics, there is no evidence of an insolvency gap during the COVID period in contrast to findings from other countries (Dorr et al., 2022; Wang et al., 2020). This suggests that equity-funded companies with characteristics similar to those of the pre-COVID period did not have a higher (or lower) insolvency rate. However, the exceptions are firms backed by active investors, which have a lower insolvency rate in the COVID period with the odds of insolvency being 24% smaller. There is weak evidence that the potential insolvency gap is driven by companies funded by government VC. The estimated risk models have utility for practitioners and investors that have an interest in risk scoring (Altman et al., 2010) and/or tracking the risk profile of this sub-set of firms.

The loan guarantee schemes were designed to help firms survive the early stages of COVID, so the expectation is that having a loan would reduce insolvency risk. However, for this sub-sample of the company population, we find a positive sign for the COVID loan dummy variable. Equity-backed firms with COVID loans appear to have a higher risk of failure, controlling for firm characteristics and pre-COVID risk. This result

[3] The loan schemes have been criticised for promoting adverse selection and moral hazard during the pandemic.

is robust, even after controlling for selection bias. The tests for the selection of the loan scheme involved estimating multivariate models that determined the probability of receiving a loan. We investigate interactions with investor types, and the effect of COVID loans on insolvency is reversed (cancelled out) for active investor types, again robust to self-selection bias. This effect is mostly driven by business angels and government VC. This model was extended to profile recipients of additional equity deals and firms with loans and deals.

Thus, an important finding is that amongst equity-backed firms, risky companies self-select COVID loans (Wilson et al., 2023). In terms of the likelihood of having a COVID loan, companies funded by equity crowdfunding are more likely to acquire a loan (also there is some evidence for business angels), whereas domestic and foreign VC are less likely than other investor types. However, with respect to follow-on equity funding, compared to the reference group consisting mainly of individual investors, companies funded by VC and business angels are more likely to receive additional equity (other investor types are not significantly different). Moreover, business angels and equity crowdfunding are more likely to have a combination of both COVID loan and additional equity injections.

In summary, this study focuses on a critical group of small, growing and innovative businesses susceptible to market failures in both the provision of debt and equity finance and makes several contributions to the existing literature. Firstly, the study contributes to the bankruptcy prediction literature by estimating failure models specific to equity-backed firms (Altman et al., 2010). It adds to other findings (Manigart et al., 2002a, b; Wilson & Wright, 2013) by providing novel evidence of the impact of different types of equity investors on the pattern of insolvency amongst equity-financed companies in the UK. To the best of our knowledge, this study is the first to investigate the impact of the COVID-19 crisis and government intervention on the pattern of insolvencies of equity-funded companies in the UK. Secondly, the research builds on theory to contribute to the emerging literature on firm resilience and failure during times of crisis, in contrast to the findings of Dorr et al. (2022) in the German context and Wang et al. (2020) in the USA, which both demonstrate that policy interventions can result in a backlog of insolvencies, or an 'insolvency-gap', with significant negative consequences for economic dynamism. Our results suggest that this is not the case in the UK. Thirdly, our results contribute to the literature on the design of future loan guarantee schemes since we document the self-selection of risky companies into the COVID loan schemes, and that these companies with COVID loans are less likely to survive. Finally, we build on the resource-based view (Barney, 1991) and contribute to this theory by demonstrating that active investors are an important source of resilience in equity-funded companies during crises.

The remainder of this paper is organised as follows. In Section 2, we discuss relevant literature and develop our hypotheses in Section 3 and Section 4 discusses the data and the methodology used to test the hypotheses. We present the results and robustness tests in Section 5. In Section 6, we discuss our findings, and the last Section 7 concludes the paper. Additional analysis and empirical evidence on insolvency patterns and trends in equity investments is provided in the supplementary appendix.

2 Characteristics of main investor types

Studies of equity-backed companies focus almost exclusively on the activities of formal VC funds, and 'announced' deals and therefore provide detailed information on the investor(s)-investee(s). However, a unique aspect of our analysis is that we consider a diverse range of investor types, from large established funds to individual equity investors and digital platforms. Specifically, we focus on VC, both domestic and foreign, business angels, government VC, equity crowdfunding and individual investors. In the next section, we describe the characteristics of each investor type, and we are interested in the extent of their active involvement and resilience of their investees in the face of crises. Business resilience can be discussed within the RBV framework that refers to 'dynamic capability',[4] i.e. accessing, utilising and reconfiguring resources to adapt to changing environments and conditions.

[4] Dynamic capability is defined as 'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments' (Teece et al., 1997).

2.1 Venture capital

VC includes both early- and late-stage investments (Cumming & Walz, 2010). In exchange for shares, these funds provide capital and management expertise to the venture to create value and consequently generate capital gains on exit (Caselli & Negri, 2018). VCs do not invest randomly and select investees by continuously screening the market in order to find good investment opportunities and then undertake rigorous due diligence and compile evidence or act on credible 'signals' of the quality and viability of the business, confidence in the entrepreneur's expertise and ability to deliver (Higgins & Gulati, 2006). Once invested, VCs are actively involved in the business by providing expertise and close monitoring. VC funds build expertise (Manigart et al., 2002b) by managing successive portfolios of ventures to exit. For an investee, having a VC relationship helps the company build a reputation overcoming aspects of the liability of newness (Ragozzino & Blevins, 2016).

VC-backed firms are typically knowledge-intensive, involved in the developing of new technologies and innovation, and can take many years to commercialise (Gantenbein et al., 2013). Therefore, VC provides sufficient funds to cover the years of cumulative losses. Consequently these investees have resource and 'built-in' resilience, insulated from the adverse effects of crises due to having large cash reserves and limited amounts of debt to service. Moreover, during COVID, innovative and potential high growth companies were better placed to be able to adapt quickly to changing working practices and to the new and evolving supply and distribution channels. Indeed, although many companies experienced significant declines in demand for their products/services or the inability to adapt and service demand during COVID, others witnessed explosive increases in demand, particularly the emerging technologies supported by VC (e.g. life sciences, biotechnology, digital and information technology, education technology, data analytics and artificial intelligence).

The empirical literature indicates that VC investors showed resilience during past crises (Gompers et al., 2020). For instance, Buchner et al. (2014) discovered that VC-backed firms experienced smaller declines in employment and sales than non-VC-backed firms during the financial crisis, attributing this to the monitoring, strategic guidance and financial support from VC firms. Gompers et al., (2020, 2021) surveyed over 1000 VCs in the USA to investigate the impact of COVID-19 on VCs and their investees and found that approximately 48% of portfolio companies were negatively affected by the pandemic. However, VCs adapted by offering additional support and dedicating more time to guiding their portfolio companies during the crisis.

The expectation, therefore, is that many VC-backed firms may well be immune from the initial negative effects of downturns and crises. The portfolio investees with high growth potential that experience difficulties get financial and other support from their 'active' investors to weather crises. However, when VC investments fall short of expectations, decision-makers face a dilemma: they continue to hope for improvement (Guler, 2007) or abandon the project and recognise losses (Li & Chi, 2013). Given the high failure rate of VC projects (Puri & Zarutskie, 2012), investors must often decide on abandonment or liquidation, requiring expertise. The finite lifespan of VC funds necessitates exiting investments within a set period, limiting time and motivation to sustain underperforming ventures ('living dead' or 'zombie' cases) through additional funding (Ragozzino & Blevins, 2016). After a certain cumulative investment or number of funding rounds, VCs decide whether to continue financing or shut down their business (Ragozzino & Blevins, 2016). Each investee has a threshold investment level and duration at which the VC reassesses the decision to continue or abandon. Thus, VCs understand that not all ventures succeed, and in economic crises focus their attention on the 'support or abandon' decision.

Private equity, a distinct subset of VC, is often associated with the funding of more established companies taking majority ownership (buyouts) or is involved in funding the growth stages of ventures (Lavery & Wilson, 2024). These investors accumulate expertise and valuable networks that can be transferred across their portfolio firms. These investors can be a source of distinctive skills and tacit knowledge (Castanias & Helfat, 2001) and can provide complementary resources and capabilities (Zahra & Filatotchev, 2004) that may be missing in the existing management teams of their portfolio companies and/or transfer this expertise across their portfolio firms. Private equity, like VCs, undertakes extensive and costly selection and screening processes of potential

target investees (Kaplan & Stromberg, 2001; Gompers et. al., 2020; Wilson et al., 2022) to identify the 'right' target firms with potential for value creation. Private equity-backed firms are resilient in crises due to proactive management and strategic collaboration with management teams to enhance efficiency. These traits enable them to adapt quickly by injecting capital, facilitating debt financing or restructuring through extensive networks. Their financial resources and expertise in renegotiating finance help manage cash flow and withstand economic downturns. Operationally, they identify cost-saving opportunities, restructure operations and optimise processes, ensuring agility in tough markets. Often specialising in restructuring underperforming companies (Cohn et al., 2022; Wilson et al., 2022), they offer valuable expertise and connections during periods of financial distress or operational challenges.

There are several studies that examine the resilience of private equity-backed firms in crises (Bernstein et al., 2019; Wilson et al., 2012) than comparable firms. Moreover, in a survey of private equity investors and investees during the COVID-19, Gompers et al. (2022) found that private equity managers were heavily involved in the operations, governance and financing of their portfolio companies, particularly those that were the hardest hit by the pandemic. Lavery and Wilson (2024) find that private equity-backed firms were more resilient and outperformed closely matched industry peers during the pandemic which is attributed to the private equity investors' adept selection of target firms coupled with active support mechanisms during the crisis.

2.2 Business angels

Business angels are typically high-net-worth individuals that allocate capital to early-stage ventures (Van Osnabrugge and Robinson, 2000), conducting due diligence and oversight, often through informal methods, and leveraging personal connections with founders. Business angels are successful entrepreneurs or professionals who, akin to venture capitalists, actively oversee and monitor their investments. Beyond providing financial support, they offer invaluable experience, mentorship and networking opportunities. Unlike VC funds, business angels invest their *personal wealth*, which provides them with strong incentives to safeguard and enhance their assets, thereby aligning their actions accordingly. Agency theory posits that business angels encounter distinct incentives and constraints, as they are principals in their investments and bear all associated risks (Edelman et al., 2017). Due to information asymmetries, business angels implement control and supervisory mechanisms by closely monitoring entrepreneurial firms (Shane & Cable, 2002). However, there is some heterogeneity amongst business angels in that some have a large range of investments whilst other are more focussed on a limited portfolio with more personal, 'hands-on', connections. Overall, we expect business angels to have active involvement in their invested business.

During the COVID-19 pandemic and other crises, business angels played a crucial role in supporting their investee companies through financial support to help navigate liquidity challenges. Surveys showed business angels continued investing during the early stages of COVID-19 and planned to keep investing (Mason & Botelho, 2021). Business angels offered valuable strategic advice and mentorship to help companies pivot their business models, adapt to new market conditions and identify new opportunities (Mason & Botelho, 2024). Moreover, business angels are able to leverage their relationships with banks and extensive business networks to support investees. A 2020 British Business Bank survey of over 650 business angels revealed their selective engagement with portfolios during the crisis, supporting firms in achieving growth milestones, surviving and leveraging new opportunities (British Business Bank, 2020).

2.3 Government venture capital

Government VC funds are established and utilised within the framework of policy interventions and socioeconomic goals (Colombo et al., 2016). These interventions address 'market failure' arising from informational asymmetries between investors and opportunities, leading to funding shortages for firms at specific developmental stages, emerging industries, or localities (Colombo et al., 2016). Government VC investments aim to correct these imbalances by investing in businesses deemed too risky for other financiers, fostering innovation and growth with broader economic and regional benefits (Wilson et al., 2019) and advancing socioeconomic goals such as diversity, sustainability and other environmental,

social and governance (ESG) objectives. This contrasts with specialised investors, such as professional VC funds or business angels, who support only rigorously selected companies due to limited resources and high return expectations (Alperovych et al., 2020).

Government can play an important role in screening for opportunities and identifying potential investees. Government early-stage funding and the associated due diligence can signal credibility to attract further investment. Government interventions have sought to bridge second equity gaps (Mason, 2016; Wilson et al., 2018) through tax policies, regional funds or targeting 'priority sectors' such as CleanTech and DeepTech, supporting regional development and job creation (Alperovych et al., 2020; Leleux & Surlemont, 2003). Previous literature shows that government VC funds place extra effort even in troubled companies to overcome the short-term effects of crisis and to avoid firm closures (Alperovych et al., 2015; Croce et al., 2019). Government, as an investor, maintain close connections with the portfolio of invested companies.

2.4 Foreign (overseas) investors

Equity financing, particularly through foreign VC investors, encompasses the provision of essential resources, financial capital, managerial expertise and technological knowledge. These foreign VCs systematically select investee targets, predominantly focusing on later-stage ventures following extensive screening and rigorous due diligence to identify the most promising opportunities. Foreign VC investors complement the value-adding activities of local venture capitalists by imparting insights into international markets and establishing connections with global customers, suppliers and executives (Diego & Diez Vial, 2024; Mäkelä & Maula, 2005). Additionally, they create synergies with other investments, thereby enhancing the overall value proposition (Humphery-Jenner & Suchard, 2013). In times of crisis, these networks are vital as they offer strategic guidance, access to new markets and connections with potential partners and customers, thereby helping SMEs diversify and stabilise their operations.

The involvement of foreign VC funding often indicates a venture's potential for global scalability. Empirical research suggests that international syndicates significantly contribute to the growth of their portfolio companies (Devigne et al., 2013), despite the inherent challenges posed by geographic and cultural distances in information collection and monitoring (Dai et al., 2012). During crises, these syndications become crucial as they provide additional financial and managerial support, leveraging local VCs' knowledge and networks to navigate the challenging environment (Diego & Diez Vial, 2024). Moreover, during crises, the ability to access international capital markets can be a lifeline, providing necessary funding and enhancing the credibility and visibility of the investee companies. From the RBV perspective, we expect firms funded by foreign VCs to have access to the financial and other resources to mitigate the impact of crisis on development and survival.

2.5 Equity crowdfunding

Equity crowdfunding refers to investment via an internet-based platform by smaller investors. Compared to VC and angel investing, equity crowdfunding is a relatively young method of investing, which has evolved rapidly in the last decade (Kazembalaghi et al., 2024). Like professional investors (business angels and VCs), equity crowdfunding platforms are typically used by smaller, younger firms with substantial information asymmetry issues.

Drover et al. (2017) show that firms that complete successful crowdfunding campaigns on established platforms are more likely to attract VC because of the diligence for subsequent financing. Specifically, a startup with successful crowdfunding gains certification from a crowd, enhancing its appeal to professional investors (Herve & Schwienbacher, 2018). Equity crowdfunding acts as a commercialisation pretest, where a successful campaign reduces information asymmetry, suggesting that VCs believe that the project is promising, thus encouraging their investment. Unlike professional investors, equity crowdfunding platforms employ contractual covenants less frequently, such as liquidation preferences, to protect their investments (Hornuf & Schwienbacher, 2016). Brown et al. (2018) note that equity crowdfunding is generally preferred to other forms of equity

financing because it involves weaker control rights requirements.

As mentioned earlier, crowdfunding is a relatively new method of funding innovative start-ups, and we are not aware of any literature on behaviour during crisis before the pandemic. Equity crowdfunding platforms saw an unexpected increase in investment activities during the COVID-19 crisis (Kazembalaghi et al., 2024). This growth is attributed to enhanced due diligence processes prior to listing ventures on digital platforms, which attract higher-quality firms. Additionally, big data analytics improved due diligence, drawing more professional investors (VCs and business angels) to digital platforms during the COVID period. The usual in-person due diligence practices were disrupted by lockdown. Kazembalaghi et al. (2024) examined the interaction between public support mechanisms and equity finance dynamics during the pandemic. They focus on 660 early stage and innovative 'seed funding' equity crowdfunding campaigns listed on a UK platform. The authors suggest that these ventures use government loan guarantee schemes loans, providing a liquidity certification effect that helps equity investors manage risk for ventures lacking credit information. Consequently, these ventures secured equity following funding, aiding in recapitalisation and improving gearing ratios (Kazembalaghi et al., 2024, p. 3). Thus, loan guarantee schemes support improved equity funding and the performance of seed firms during the COVID period. These findings align with the literature that highlights the positive impact of digitalisation on entrepreneurial finance, creating new financial avenues that complement traditional intermediaries (Bertoni et al., 2022).

As opposed to VC or business angels who gain profit if the venture is successful, this means that if the investor exits via an IPO or trade sale, the equity crowdfunding platforms gain a fee if the fundraising is successful, which means that if the minimum funding threshold is reached (Hornuf & Schwienbacher, 2016). Another difference is that equity crowdfunding is open to greater investors' bases as the investors do not have to be accredited (Hornuf & Schwienbacher, 2016). However, lower minimum investment requirements result in more dispersed ownership which prevents added value in the form of investor mentoring, coaching or active involvement. From this perspective, the investors investing via equity crowdfunding platforms are passive investors. The previous research reported that companies with equity crowdfunding investors experienced higher loan default rate of COVID loans (Kacer et al., 2024a), or less successful exits when compared with other investor types (Kacer et al., 2024b).

2.6 Individual investors

Many new start-ups are funded by founders and a network of informal investors prior to attracting more formal VC. They are often classified as friends, family members or business owning colleagues. Individual investor usually has less money to invest; therefore, multiple individual investors may be needed to meet the financing goals of the business. Moreover, these investors may have no relevant industry experience, business skills or guidance to contribute to the business. In the UK, individuals are often attracted to invest in small, high-risk companies through the Enterprise Investment Scheme (EIS) which offers significant tax reliefs[5] to individual investors. Individuals can invest directly in EIS-qualifying companies or through an EIS fund. These types of individual investors are less likely to be actively involved and/or have the financial resource, networks and relevant business expertise to provide significant additional support through crises periods. Moreover, EIS eligible businesses are high risk and subject to a higher failure probability than other equity-funded firms. If the investment fails, EIS investors can offset losses against their income or capital gains tax. Song and Schwienbacher (2024) suggest that the success rate of businesses funded by individuals is a function of the initial number of investors and the quality of the entrepreneurial team. This is also determinant of follow-on funding and the likelihood of achieving growth.

During the COVID-19 pandemic, firms funded by individual equity investors faced significant challenges. A survey conducted in October 2020 (EISA 2020) revealed that a high proportion of these companies faced increased risks of insolvency, with over 50% of firms seeing a deterioration in their risk

[5] To qualify for these reliefs, the investor must not be connected to the company (e.g. as an employee or director) and must hold the shares for a minimum of 3 years.

profile. However, EIS investment levels increased significantly into 2021. Despite initial challenges, some firms managed to adapt by leveraging the support and flexibility provided by their investors but overall, the expectation is that firms funded by these types of investors are more vulnerable to financial problems in crises. At the same time, many of the firms backed by individual investors are small, with a low asset base, few creditors and/or low levels of debt. These firms are less likely to be subject to insolvency proceedings but more likely close voluntarily when they become unviable. However, the individual equity investors are passive investors.

2.7 Summary

In summary, professional VC funds and experienced business angels are known for their active support of portfolio companies, providing financial and 'relational' capital, strategic guidance, operational support and networking to ensure survival and growth (Gompers et al., 2016). VC involvement enhances access to resources, knowledge and contacts, which are essential to resilience and growth. However, not all equity investors are actively involved in a firm or have access to expertise and resources. Equity finance is often provided by informal networks of small private individual investors, and this large subsample of firms was included in the study. Thus, investor types vary in formality, the range and specialisations of their portfolio of investees, their investment time horizons and the extent to which they are *actively engaged* in supporting their investees with resources and expertise in addition to the provision of finance. Overall, we categorise VCs, foreign VCs, business angels and government VC as being more actively involved in the governance and resourcing of their investees than the other investor types. On the other hand, investors investing via equity crowdfunding platforms or small private individuals are classified as passive investors in the study.

3 Hypotheses development

Drawing on the resource-based view (RBV) of firms' dynamic capabilities and resilience, our analysis examines firms' survival and failure in crises. Resilience, as defined in economics literature, entails firms' effective resource utilisation to rebuild, recover or cope with disruptions (Dormady et al., 2019; Rose, 2004; Graveline & Grémont, 2017). Additionally, sorting theories by Eeckhout and Kircher (2011) offer insights into investor selection and continuation decisions.

Equity finance, termed 'patient capital', provides necessary funding for 5 to 10 years to cover innovation, development and financial losses due to the risks and uncertainties of new product development and market entry (Lerner & Nanda, 2020). Therefore, firms with equity backing before COVID should have adequate capital reserves, making the crisis period largely irrelevant. Those that require further investment rounds during this period are likely to receive it. However, evidence indicates that some early-stage ventures struggle to raise additional funds amid COVID-induced uncertainty (Brown et al., 2020). Moreover, VCs acknowledge that not all ventures will succeed, and after a certain level of cumulative investment, decide whether to continue financing or close the business (Ragozzino & Blevins, 2016).

Resource-based theories emphasise the importance of a firm's resources and capabilities (Zahra & Filatotchev, 2004) in maintaining business resilience in response to external shocks and challenges. These theories posit that a firm's ability to withstand and recover from disruptions is closely linked to its specific resources and how effectively it can utilise them. Firms that receive backing from established and experienced investors benefit from such backing. Some investors possess a pool of managerial expertise and can leverage their business networks and strong ties with banks and credit providers to provide additional funding and resources when an investee faces challenges (Lavery et al., 2023).

Equity-funded firms are anticipated to be resilient during crises because of investor diligence in selecting and resourcing high-potential targets (Lavery & Wilson, 2024). Pascal et al. (2013) and Modl (2020) note that experienced investors excel in their discerning selection decisions. High-quality founders favour experienced investors for their value-adding activities and the sorting process that matches investors and startups based on specific traits (Gompers et al., 2020). Investors typically seek significant future returns, making optimal investment decisions crucial for both returns and personal rewards (Wright

& Robbie, 1998). When deciding whether to continue or abandon a venture, investors assess its performance, risks and expected returns. If a venture underperforms or poses excessive risks, the investor may abandon it based on portfolio strategy, investment horizon and risk tolerance. Thus, when investments do not meet expectations, decision-makers face a liquidation dilemma: they may persevere to allow for potential improvement and enhance commitment (Guler, 2007) or terminate the project, accepting certain losses (Li & Chi, 2013).

The COVID-19 crisis could have led to financial distress and failure of viable firms without support. For equity-backed firms, we do not anticipate a change in insolvency rates due to COVID-19, because these firms are likely to have sufficient financial resources or can obtain additional equity. This is especially true for ventures with recent equity investments: the higher the sunk costs and cumulative investment, or the extent of R&D, the more likely they are to receive support during the crisis. We control for cumulative equity investments and the timing of investment rounds before COVID-19. Firms that face operational issues are supported by their investors, whereas equity investors do not extend the lifespan of unviable ventures. Although other studies demonstrated general resilience of firms funded by venture capital or private equity (Lavery & Wilson, 2024), or explored resilience of whole entrepreneurial ecosystems (Roundy et al., 2017), the resilience has not been demonstrated for other investor types such as business angels or government venture capital. Moreover, we explore resilience in terms of insolvent exits. This leads to the following hypothesis:

H1: Equity-funded companies experience a similar incidence of insolvent exits during the COVID period as compared to the pre-COVID period.

Our study focuses on the role of active investors. It includes various investor types that provide equity across all investment stages, differing in their active involvement in governance (principal-agent relationship) and the resources they contribute. Active investors include VC, business angels, government VC and foreign VC, whilst passive investors include equity crowdfunding and individual private investors.

The active investors such VCs engage in extensive and costly selection processes to identify promising targets with specific characteristics (Gompers et al., 2016). They invest in strong prospects, anticipating that these firms will not break even or generate profits for several years, sometimes up to 10–12 years (Gantenbein et al., 2013). Thus, we do not expect the insolvency patterns of VC-backed firms to increase during crises. Similarly, business angels maintain a close principal-agent relationship, often holding significant financial stakes and personal relationships with founders and directors. Because they are highly networked, business angels are likely to have robust connections with banks and financial institutions. Mason and Botelho (2021) provide evidence that business angels supported their investees during the COVID-19 period by additional follow-on investments. In this line, we expect viable firms backed by business angels to secure financial support to weather a crisis. On the other hand, government VC funds invest in achieving broader policy objectives, complementing other measures such as tax advantages for investors, regional funds, ESG goals and infrastructure development (e.g. science parks, innovation hubs and accelerators) to foster innovation, growth and a dynamic economy. Importantly, some firms funded by government VC funds may be somewhat weaker—otherwise, they would have been targeted by private VC investors in the first place. Firms backed by government venture funds are expected to receive support during crises. As professional VCs, foreign VCs invest in later-stage ventures with scale-up potential and clear exit strategies, suggesting resilience through the crisis, as well.

The passive investors are not expected to offer many of the above benefits. The equity crowd funding model targets start-up and early-stage funding, with ownership dispersed amongst the crowd despite the presence of a lead investor. Shareholders can influence governance, but the principal-agent relationship is less direct than hands-on VCs or business angels. Equity crowdfunded ventures are prone to higher failure rates owing to market saturation, inexperienced founders, inadequate due diligence, limited post-funding support and high expectations from numerous small investors, making them vulnerable to economic changes. However, this does not imply a higher failure rate than during normal periods, just higher failure rate of these companies in general, when compared to other investor types. Finally, firms supported by individual investors are the most vulnerable, anticipating the highest failure rate during the crisis. Thus, we expect that impact of

the COVID-19 crisis on insolvent exit rates will differ based on the extent of active involvement.

This leads to the following hypothesis:

H2: During the COVID crisis, firms backed by active investors have a lower likelihood of insolvent exits, when compared to passive investor types.

We propose that a subset of equity-backed firms struggled during the COVID-19 period, facing difficulties or inability to raise additional equity. Information asymmetries between investors and investees, which worsen during crises, hinder small, growing and innovative companies from securing financing (Gompers & Lerner, 2004). For early-stage ventures, due diligence does not fully reveal long-term prospects and business valuations (Wilson et al., 2019), making them reliant on credible signals of venture quality and the entrepreneur's expertise (Higgins & Gulati, 2006). Ventures with weaker signals were less likely to obtain additional equity during COVID-19 and resorted to alternative funding for liquidity and survival.

We suggest that equity-backed firms that do not have active support from their investors because of perceived risk are more likely to utilise (select into) guaranteed loan schemes to help ride the COVID period. For some firms, accessing loan financing may be a strategy to bolster finances as a means of attracting additional equity. In this respect, Kazembalaghi et al. (2024) suggest the 'liquidity certification effect' of acquiring a guaranteed COVID loan aided seed equity crowdfunded firm in securing additional equity finance. For others, guaranteed loans were an option to attempt to secure survival-pending recovery and/or to refinance debt. However, there are potential disadvantages to the loan guarantee schemes. The indiscriminate lending, particularly the Bounce Back Loan Scheme, added additional 'noise' for lenders resulting in adverse selection by lenders (Gai et al., 2016) and moral hazard. Lenders have a 100% guarantee of losses, and borrowers have low interest rates and limited credit checks.

It is plausible that companies lacking financing and nearing failure before the COVID-19 pandemic would seize guaranteed loan opportunities to enhance their survival prospects, particularly under lenient conditions. The funds can refinance existing high-interest bank loans and release collateral. For viable firms needing financial help to weather temporary lockdown-induced difficulties and reduced economic activity, the COVID loan can act as a bridge. However, for non-viable companies, COVID loans may merely postpone their inevitable collapse until the funds are depleted. Moreover, once external support is withdrawn, companies burdened with additional debt and creditors are likely to go bankrupt, increasing their insolvencies.

Consequently, guaranteed loans were likely advanced to unviable businesses, increasing their insolvency risk through creditor action. Our third hypothesis was as follows:

H3: Equity-funded firms with guaranteed loans have a higher insolvency rate during the COVID-19 crisis.

Wilson et al. (2023) demonstrated that riskier companies self-select into the COVID loans, ceteris paribus. However, we expect that screening and due diligence would filter out companies that are excessively risky. Investors differ in their quality of screening and level of due diligence. The active investors are expected to filter out companies with unviable business ideas or in a precarious financial situation. Moreover, after they invest into a company, these investors are more likely to ensure that their investees can service loan payments before taking on the debt and/or provide additional financial support to avoid default. Consequently, companies funded by active investors would benefit more from having a guaranteed COVID loan under favourable terms, when compared to companies funded predominantly by more passive investors.

Therefore, we expect the impact of COVID loan on the likelihood of insolvent exit to be moderated by active investor type, leading to the fourth hypothesis:

H4: Firms with a COVID loan backed by active investors will experience lower insolvency rate, when compared with companies funded by more passive investors.

4 Data and methodology

4.1 Sample selection

For our empirical analysis, we construct a database containing firm- and deal-level data on equity-funded companies in the UK. The equity deal data, sourced from the Beauhurst database, include equity

deals from 2011 to the present,[6] detailing deal value, company evolution stage, funding round, investor identity and the industry sector. To identify equity-funded companies that were active at the start of the COVID-19 period, we compiled data on firms that received equity finance before the pandemic and tracked all insolvent exits using data from the Office of National Statistics (ONS). Additionally, we have exclusive access to data on the COVID guaranteed loan schemes,[7] detailing loans granted to each company, and payment history, covering all administered loans. Furthermore, we can identify equity-backed firms that received additional equity finance during the COVID-19 period (April 1, 2020, to March 31, 2023), allowing us to pinpoint the sub-sample that received both loan and equity finance.

For our analysis, we selected firms with at least one round of equity finance before the pandemic, specifically on or before March 31, 2020, resulting in 20,053 equity-backed companies. Panel A of Table 1 presents the sample-selection criteria. We excluded 2,492 companies lacking financial accounts in the 3 years before March 31, 2020; 392 companies already in insolvency; 896 companies with missing values for key variables; 220 Northern Ireland companies; 2,009 holding companies due to complex financial structures and inability to link the equity funding and/or COVID loan to a specific subsidiary; and 258 companies without completed equity deals. These restrictions produced a sample of active firms during the COVID period that was used for our estimations. During this period, 653 firms entered the legal insolvency stage (bankruptcy). Of the 13,786 companies analysed, 6234 (45%) acquired guaranteed loans (COVID loans).

We then examine insolvency risk and the pandemic, referencing Dorr et al. (2022), by using comparable firms from the pre-crisis period without policy intervention as a control group. Following similar sample selection steps, we created a 3-year pre-COVID historical control sample of equity-backed firms starting from Q2 2017, comprising 12,033 firms, with 8531 meeting the selection criteria. During this pre-crisis period, 466 firms entered insolvency. Panel B of Table 1 details the sample-selection process.

4.2 Methodology and variables

To test our hypotheses, we estimated several multivariate binary logistic regression models that determine failure (exit). Logistic regression is a conditional probability function, where the probability of failure is determined by a set of several covariates and the respective vectors of coefficients α_k that measure the effect of covariates on the probability of failure. Subscript i represents each firm. Baseline regression in this study was estimated using the following equation:

$$P(y_i = 1|\Omega) = 1/\left\{1 + \exp\left[-\left(\alpha_0 + \text{COVID}_i^T\alpha_1 + \text{Investor\_types}_i^T\alpha_2 + \text{Equity\_deals\_variables}_i^T\alpha_3 + \text{Financial\_ratios}_i^T\alpha_4 + \text{Non\_financial\_variables}_i^T\alpha_5 + \text{Fixed\_effects}_i^T\alpha_6\right)\right]\right\} \quad (1)$$

where y_i is an indicator of an insolvent exit following the last available financial account.[8]

COVID_i is the vector that captures COVID-related main independent variables. The content differed

[6] The data provider Beauhurst defines the equity funding as follows: 'When we talk about equity investment, we are referring to the issuance and sale of new shares by a company to fund its growth. To us, the mere sale of existing shares does not constitute equity investment. When existing shares are bought, that money goes to whichever shareholders have sold shares – not to the company.' (available at https://help.beauhurst.com/en/articles/8879510-what-are-the-beauhurst-tracking-triggers#h_00e8159c99, accessed 10/6/2024).

[7] The COVID loan portfolio is drawn from the Information Management System of the COVID loan guarantee scheme administered by the British Business Bank (Business Interruption Loan Scheme(s), Bounce Back Loan Scheme).

[8] Because insolvency is a legal process that can proceed through many steps and alternate routes, it is not possible to measure the outcome (insolvency) in a 'time to failure' context. Indeed, the insolvency process (liquidation) can continue long after the business has ceased trading. Hence, we use the discrete time, where the last full filing of accounts is used as the date of closure of the business.

Table 1 Sample selection steps

		Insolvent Companies	COVID loans
Panel A: Main estimation sample (COVID period)			
Companies with at least one equity deal before 31/3/2020	20,053		
Less			
Companies without last available accounts between 1/4/2017 and 31/3/2020	− 2492		
Companies that became insolvent before 31/3/2020	− 392		
Companies with missing values for explanatory variables	− 896		
Companies with missing values for dependent variable (Northern Ireland)	− 220		
Holding companies	− 2009		
Zero total investment	− 258		
Final estimation sample	13,786	653	6234
Panel B: Historical control sample		Insolvent Companies	
Companies with at least one equity deal before 31/3/2017	12,033		
Less			
Companies without last available accounts between 1/4/2014 and 31/3/2017	− 1139		
Companies that became insolvent before 31/3/2017	− 199		
Companies with missing values for explanatory variables	− 504		
Companies with missing values for dependent variable (Northern Ireland)	− 154		
Holding companies	− 1326		
Zero total investment	− 180		
Final estimation sample	8531	466	

The table shows the steps involved in the preparation of the company level samples employed in the first part of the study. Panel A shows how the main COVID period sample was constructed. This sample includes all eligible companies with an equity deal at the beginning of the COVID period, i.e. as of 31st March of 2020. Panel B shows how the historical control sample has been constructed. The historical control sample includes all eligible companies that had an equity investor as of the 31st of March 2017. In each of these two samples, every observation corresponds to one company. The sample created by appending the two samples (the combined sample) has been used for quantification of differences in failure rates in the pre-COVID and COVID period. The main estimation sample was employed to quantify differences in failure rates for companies with and without a COVID loan

based on the hypotheses tested. Our models include either an indicator of the COVID period (Hypothesis 1) or interaction between the COVID period and active investor (Hypothesis 2). The COVID period is equal to unity in the COVID period (financial accounts submitted from April 2017 to March 2020) and zero in the pre-COVID period (accounts submitted from April 2014 to March 2017). The active investor is equal to unity if the company is funded by either a VC, business angel, government VC or foreign VC investor, and it is equal to zero otherwise. Next, we construct an indicator of firms that obtained a COVID loan (Hypothesis 3), and the interaction between the COVID loan and active investor (Hypotheses 4). The COVID loan indicator equals unity if a company has at least one COVID loan and zero otherwise.

The vector investor types are investor-type indicators. We generated indicators for the most frequent investor types (VC, business angels, government

VC, foreign VC and equity crowdfunding).[9],[10] We add a series of control variables known to affect the likelihood of insolvency. These control variables are classified into four categories: equity deal variables, firm-level financial ratios, non-financial variables and fixed effects (sectors and region).

The first category encompasses the characteristics of equity deals. We control for the investment stage, as research indicates that early-stage SMEs (a proxy for age) are more prone to market exit (Kale & Arditi, 1998) and sensitive to macroeconomic conditions (Bonaccorsi di Patti & Gobbi, 2001) and monetary policies. Announced deals pertain to larger ventures with higher deal and investment values and better long-term prospects (Mohamed & Schwienbacher, 2016), resulting in a lower bankruptcy rate. We assess the 'signals of quality' in entrepreneurial firms by evaluating venture capitalists' previous engagements. Following Ragozzino and Bevins (2016), we generate variables related to the history of deals for equity-backed firms, including the number of investment rounds, cumulative investment amount, investment purpose (R&D or job creation) and time span since the first and last deals. The number of rounds and cumulative investments by previous equity backers signal survival and growth potential, whilst recent rounds indicate recent appraisals, due diligence and valuations. We capture additional deal information by including the investment round, the time from the first deal and the time from the last deal. Companies with more funding rounds are presumed to be less likely to fail, whereas those farthest from their last deal may be more prone to insolvency. We also account for investment purposes (R&D and job creation) without assuming their direction of impact on insolvency. Additionally, we consider a potential non-linear (quadratic) relationship between the total accumulated investment and insolvency. A threshold investment level likely exists where ventures achieve commercialisation and revenue generation; failing this, investors may cut losses, withdraw funding, liquidate assets or transfer intellectual property and technology. We control for this using a quadratic specification.

The second category encompasses the variables associated with a company's financial ratios. They represent important dimensions of a firm's financial performance: liquidity (working capital to total assets, current assets to total assets), leverage (current liabilities to total liabilities, short-term and long-term debt to total assets) and profitability (profit and loss account reserve to total assets). We conjecture that better financial performance, described by higher liquidity, lower leverage and greater profitability, reduces the likelihood of insolvency, as widely evidenced in the failure prediction literature.

Following a well-established literature strand (Altman et al., 2010), we employ a comprehensive set of non-financial characteristics, including company size (measured by total assets),[11] indicators of asset charges and indicators of no debt. Smaller firms are expected to be more prone to insolvency than larger firms due to variable cash flows, weaker customer and supplier relationships, and limited access to financial resources compared to larger firms (Muzi et al., 2023). Companies with pledged collateral are more likely to fail (Cowling et al., 2023b), whereas those without significant creditors (debt) face a lower likelihood (Wilson et al., 2023). A key determinant of insolvent exits is the ex ante credit risk score at the last available financial year-end.[12] We also included an indicator for firms without risk scores. Credit score information helps control companies' financial health before the crisis; a higher score indicates worse creditworthiness and

[9] In our analysis, we focus on the most frequent investor types. There are other investor types in our data such as corporate venture capital, accelerators, private investment vehicles, charities and not-for-profit companies, family offices and bank venture capital but their lower frequencies do not warrant separate analysis. Moreover, about 70% of equity deals are funded by investors with an undisclosed identity. We assume these are private individuals who differ from business angels in that although they are higher net worth individuals, they are not actively investing in a portfolio of ventures. Nevertheless, even these undisclosed deals fund issuance of new equity to support growth of the companies. This group of the private individual investors, along with other investor types not included amongst the ones analysed in the paper, serves as a reference group.

[10] Although we use the interactions with the active investor indicator to test some of our hypothesis, we do not include the 'main effect' of the active investor, due to perfect multicollinearity with the investor types.

[11] We allow for non-linear relationship between the company size and insolvency. This is because such a relationship has been reported in the literature (see for instance Altman et al., 2010), but also because the non-monotonous relationship has been detected during (unreported) preliminary bi-variate analysis.

[12] The details of the risk score are presented in the Appendix A3.

higher insolvency risk (Dorr et al., 2022). Finally, for the fourth category, we include the top-level industry sector (based on the detailed descriptor in the equity deals database) and location fixed effects.

5 Empirical results

5.1 Descriptive statistics

Table 2 presents descriptive statistics of explanatory variables from our analysis. Panel A includes statistics for the entire sample and the means for both pre-COVID and COVID samples. The final column reports the difference-in-means test between these periods. Approximately 18% of companies in the sample were funded by VC investors, a figure consistent with the pre-COVID sample but significantly different in the COVID sample when it was 19%. Business angels funded about 14% of the sample, with 15% in the pre-COVID sample and 14% in the COVID sample. Government VC funding was received by approximately 7% in both samples, although the difference is statistically significant. Foreign VC funded 7% of companies on average, matching the pre-COVID subsample and showing a statistically significant increase to 8% in the COVID sample.[13] Overall, active investors funded 30% of companies in the sample, with the figure in the pre-COVID sample being 31%. Equity crowdfunding investors invested in 8% of the companies, with similar percentages in both samples. Although there are statistical differences for some other control variables between the two subsamples, overall, the pre-COVID and COVID samples are similar, although the time since the last deal increased during the COVID period, indicating a drop in early-stage investment activity.

Panel B presents the descriptive statistics for the COVID sample and subsets of companies that received or did not receive COVID loans. Notably, a smaller percentage of companies backed by active investors such as VC, business angels and foreign VC investors utilised guaranteed loan facilities during the pandemic. The differences between the other characteristics are minimal, with some exceptions. Firms without prior debt were less likely to take COVID loans, whereas those with asset charges and more short-term debt were more inclined, possibly for refinancing. This subset of firms has a shorter time since the last deal, indicating that they were younger. Additionally, firms that received equity funding for R&D were less likely to use COVID loans. The multivariate profile of loan recipients is examined later.

5.2 Main results

Table 3 shows the impact of the COVID-19 crisis on the insolvency likelihood of equity-funded companies. Model specifications (1–8) predict the insolvency likelihood using various investor and investee characteristics and controls. The COVID period dummy variable is crucial for distinguishing between pre-crisis (0) and COVID (1) periods. Model (1) includes only the COVID period dummy, showing a generally lower insolvency likelihood during COVID owing to policy interventions, noted as an insolvency gap (Fig. 1, Appendix A2). Adding investor type (model 2) reveals significant and positive coefficients for business angels, and government VC fund-backed ventures, and equity crowdfunding, which are more likely to exit via bankruptcy both before and during the crisis, when compared to the reference group of other and individual private investors. The modelling strategy then incorporates additional firm-specific and control variables, considering the value, rounds and stages of deals pre-COVID in model (3).

The equity crowdfunding investor type maintains a significant positive coefficient, whilst the foreign VC indicator is significantly negative, lowering failure risk, compared to the reference group. The time since the first deal is strongly negative, suggesting that longer-established ventures are less likely to face bankruptcy. However, ventures with more investment rounds and later stages have slightly higher exit risk. Ventures with greater R&D investment are less likely to become insolvent. Including a quadratic term for total cumulative investment yields significant results, indicating that companies with investment rounds totalling over £5 m face higher insolvency risk. This supports the 'waning momentum' concept proposed by Ragozzino and Blevins (2016), and signals negatively to potential investors. We propose that crises

[13] The sum of proportions for the indicated investor types is less than 100% because as mentioned earlier, there are other investor types, with the largest group being the small private undisclosed investors. The frequencies of companies with specific investor types, broken down by having COVID loans, are reported in Appendix A5.

Table 2 Descriptive statistics

Panel A: Full sample	Whole sample					Pre-COVID period	COVID period	
	(*N* = 22,317)					(*N* = 8531)	(*N* = 13,786)	Difference
Variable name	Mean	SD	Min	Median	Max	Mean	Mean	Significance
Venture capital (VC)	0.18	0.39	0.00	0.00	1.00	0.18	0.19	**
Business angel	0.14	0.35	0.00	0.00	1.00	0.15	0.14	*
Government VC	0.07	0.25	0.00	0.00	1.00	0.07	0.07	**
Foreign VC	0.07	0.26	0.00	0.00	1.00	0.07	0.08	***
Equity crowdfunding	0.08	0.28	0.00	0.00	1.00	0.08	0.09	
Active investor	0.30	0.46	0.00	0.00	1.00	0.31	0.30	
Seed stage of investment	0.56	0.50	0.00	1.00	1.00	0.56	0.56	
Venture stage of investment	0.31	0.46	0.00	0.00	1.00	0.31	0.30	
Growth stage of investment	0.08	0.27	0.00	0.00	1.00	0.08	0.07	*
Established stage of investment	0.06	0.23	0.00	0.00	1.00	0.05	0.06	**
Number of rounds	2.29	1.73	1.00	2.00	16.00	2.13	2.38	***
Announced deal	0.39	0.49	0.00	0.00	1.00	0.39	0.38	
LN (total investment)	12.80	1.82	6.06	12.69	21.00	12.66	12.88	***
Time from first deal (days)	1276.65	837.49	0.00	1131.00	3377.00	1023.29	1433.43	***
Time from last deal (days)	777.70	726.79	0.00	533.00	3373.00	628.17	870.23	***
Investment purpose (R&D)	0.04	0.21	0.00	0.00	1.00	0.02	0.06	***
Investment purpose (job creation)	0.04	0.20	0.00	0.00	1.00	0.02	0.05	***
Working capital to total assets	−0.11	1.09	−2.99	0.21	1.00	−0.09	−0.12	*
Current assets to total assets	0.76	0.30	0.01	0.92	1.00	0.75	0.76	
Current liabilities to total liabilities	0.82	0.29	0.10	1.00	1.00	0.82	0.82	
Profit/loss account reserve to total assets	−1.36	1.72	−4.05	−0.73	0.98	−1.45	−1.30	***
Short- and long-term debt to total assets	0.16	0.28	0.00	0.00	0.82	0.16	0.16	
LN (total assets £m)	12.42	2.20	0.00	12.55	23.63	12.34	12.47	***
Indicator of charge on assets	0.07	0.26	0.00	0.00	1.00	0.08	0.07	
Indicator of no debt	0.50	0.50	0.00	0.00	1.00	0.51	0.49	***
Ex ante risk score	0.03	0.03	0.00	0.02	0.68	0.03	0.03	***
Missing risk score	0.04	0.21	0.00	0.00	1.00	0.04	0.05	***
Panel B: COVID period sample	COVID period					No COVID loan	COVID loan	
	(*N* = 13,786)					(*N* = 7552)	(*N* = 6234)	Difference
Variable name	Mean	SD	Min	Median	Max	Mean	Mean	Significance
Venture capital (VC)	0.19	0.39	0.00	0.00	1.00	0.23	0.14	***

Table 2 (continued)

Business angel	0.14	0.34	0.00	0.00	1.00	0.15	0.12	***
Government VC	0.07	0.25	0.00	0.00	1.00	0.07	0.06	
Foreign VC	0.08	0.27	0.00	0.00	1.00	0.11	0.04	***
Equity crowdfunding	0.09	0.28	0.00	0.00	1.00	0.07	0.10	***
Active investor	0.30	0.46	0.00	0.00	1.00	0.34	0.25	***
Seed stage of investment	0.56	0.50	0.00	1.00	1.00	0.56	0.57	*
Venture stage of investment	0.30	0.46	0.00	0.00	1.00	0.29	0.32	***
Growth stage of investment	0.07	0.26	0.00	0.00	1.00	0.09	0.06	***
Established stage of investment	0.06	0.23	0.00	0.00	1.00	0.06	0.05	***
Number of rounds	2.38	1.84	1.00	2.00	16.00	2.43	2.32	***
Announced deal	0.38	0.49	0.00	0.00	1.00	0.42	0.34	***
LN (total investment)	12.88	1.85	8.21	12.79	21.00	13.09	12.63	***
Time from first deal (days)	1433.43	907.02	0.00	1295.50	3377.00	1516.40	1332.92	***
Time from last deal (days)	870.23	800.93	0.00	606.00	3373.00	940.64	784.94	***
Investment purpose (R&D)	0.06	0.23	0.00	0.00	1.00	0.07	0.04	***
Investment purpose (job creation)	0.05	0.23	0.00	0.00	1.00	0.05	0.05	
Working capital to total assets	−0.12	1.12	−2.99	0.22	1.00	−0.12	−0.11	
Current assets to total assets	0.76	0.31	0.01	0.92	1.00	0.77	0.74	***
Current liabilities to total liabilities	0.82	0.29	0.10	1.00	1.00	0.83	0.81	***
Profit/loss account reserve to total assets	−1.30	1.74	−4.05	−0.67	0.98	−1.41	−1.17	***
Short- and long-term debt to total assets	0.16	0.27	0.00	0.00	0.82	0.14	0.19	***
LN (total assets £m)	12.47	2.26	0.00	12.63	23.63	12.45	12.49	
Indicator of charge on assets	0.07	0.26	0.00	0.00	1.00	0.06	0.09	***
Indicator of no debt	0.49	0.50	0.00	0.00	1.00	0.56	0.39	***
Ex ante risk score	0.03	0.03	0.00	0.02	0.68	0.03	0.03	***
Missing risk score	0.05	0.21	0.00	0.00	1.00	0.06	0.04	***

This table shows summary statistics for variables included in our sample. All the variables are defined in Appendix in Table A1. We provide means, standard deviations, minimum, median and maximum for the full sample of 22,317 observations (panel A) and for the COVID period sample of 13,786 companies (panel B). In the full sample, we provide the means for the pre-COVID and COVID period subsamples, along with the test of difference in means for the two subsamples in the last column. For the COVID period sample, we provide the means for the subsamples based on COVID loans, along with the test of difference

Table 3 Insolvency prediction models using pre-COVID and COVID period sample

	(1) Insolvency	(2) Insolvency	(3) Insolvency	(4) Insolvency	(5) Insolvency	(6) Insolvency	(7) Insolvency	(8) Insolvency
COVID period indicator	−0.150**	−0.147**	−0.117*	−0.0876	−0.0922	−0.0972	−0.0896	−0.000659
	(−2.41)	(−2.36)	(−1.77)	(−1.31)	(−1.37)	(−1.44)	(−1.32)	(−0.01)
Venture capital (VC)		0.113	−0.0956	−0.0403	−0.0222	0.00369	0.0182	0.0935
		(1.29)	(−0.96)	(−0.40)	(−0.21)	(0.04)	(0.17)	(0.85)
Business angel		0.194**	0.0221	0.0741	0.0406	0.0411	0.0701	0.128
		(2.19)	(0.23)	(0.77)	(0.41)	(0.42)	(0.70)	(1.24)
Government VC		0.264**	0.193	0.156	0.182	0.214*	0.0616	0.0962
		(2.36)	(1.61)	(1.29)	(1.49)	(1.72)	(0.47)	(0.72)
Foreign VC		−0.211	−0.296**	−0.297**	−0.344**	−0.246*	−0.210	−0.192
		(−1.59)	(−2.18)	(−2.16)	(−2.42)	(−1.73)	(−1.47)	(−1.33)
Equity crowd-funding		0.640***	0.487***	0.489***	0.467***	0.382***	0.421***	0.389***
		(7.22)	(4.57)	(4.54)	(4.32)	(3.47)	(3.82)	(3.46)
COVID period × active investor								−0.277**
								(−2.25)
Venture stage of investment			0.180**	0.195**	0.0838	0.0882	0.0809	0.0806
			(2.38)	(2.54)	(1.05)	(1.10)	(1.00)	(1.00)
Growth stage of investment			0.167	0.214*	0.0772	0.0568	0.0338	0.0234
			(1.34)	(1.67)	(0.57)	(0.42)	(0.25)	(0.17)
Established stage of investment			−0.253	−0.235	−0.309*	−0.367**	−0.414**	−0.414**
			(−1.48)	(−1.34)	(−1.74)	(−2.05)	(−2.31)	(−2.31)
Number of rounds			0.0873***	0.0743**	0.0606**	0.0773**	0.0799***	0.0790***
			(2.93)	(2.51)	(2.04)	(2.56)	(2.64)	(2.62)
Announced deal			−0.00786	−0.0241	0.0133	0.0486	0.00402	0.0572
			(−0.08)	(−0.25)	(0.14)	(0.49)	(0.04)	(0.55)
LN (total investment)			0.903***	0.920***	0.660**	0.694**	0.716***	0.705**
			(3.58)	(3.62)	(2.40)	(2.53)	(2.61)	(2.57)
LN (total investment) squared			−0.0293***	−0.0294***	−0.0221**	−0.0228**	−0.0232**	−0.0227**
			(−3.01)	(−3.01)	(−2.05)	(−2.12)	(−2.15)	(−2.11)
Time from first deal (days)			−0.000175**	−0.000223***	−0.000224***	−0.000235***	−0.000240***	−0.000230***
			(−2.14)	(−2.71)	(−2.68)	(−2.76)	(−2.83)	(−2.71)
Time from last deal (days)			0.0000396	0.0000194	0.0000367	0.0000554	0.0000457	0.0000404
			(0.46)	(0.22)	(0.41)	(0.62)	(0.51)	(0.45)
Investment purpose (R&D)			−0.341**	−0.311*	−0.332**	−0.254	−0.272	−0.258
			(−2.10)	(−1.90)	(−1.97)	(−1.50)	(−1.61)	(−1.52)
Investment purpose (job creation)			−0.0378	0.00153	−0.0401	−0.0247	−0.0571	−0.0287
			(−0.24)	(0.01)	(−0.25)	(−0.16)	(−0.36)	(−0.18)
Working capital to total assets				−0.0902***	−0.142***	−0.131***	−0.129***	−0.130***

Table 3 (continued)

	(1) Insolvency	(2) Insolvency	(3) Insolvency	(4) Insolvency	(5) Insolvency	(6) Insolvency	(7) Insolvency	(8) Insolvency
				(−2.62)	(−3.71)	(−3.43)	(−3.37)	(−3.38)
Current assets to total assets				−0.569***	−0.532***	−0.441***	−0.419***	−0.419***
				(−5.91)	(−5.21)	(−4.14)	(−3.90)	(−3.91)
Current liabilities to total liabilities				0.463**	0.227	0.209	0.198	0.198
				(2.55)	(1.16)	(1.04)	(0.99)	(0.98)
Profit/loss account reserve to total assets				−0.0448*	−0.0974***	−0.121***	−0.126***	−0.125***
				(−1.90)	(−3.36)	(−4.15)	(−4.30)	(−4.27)
Short- and long-term debt to total assets				1.074***	0.410**	0.401**	0.381*	0.376*
				(5.96)	(2.09)	(2.00)	(1.89)	(1.87)
LN (total assets £m)					0.920***	0.906***	0.894***	0.889***
					(4.43)	(4.33)	(4.26)	(4.25)
LN (total assets) squared					−0.0343***	−0.0341***	−0.0335***	−0.0333***
					(−4.11)	(−4.06)	(−3.98)	(−3.97)
Indicator of charge on assets					0.178*	0.197*	0.175	0.170
					(1.66)	(1.84)	(1.62)	(1.58)
Indicator of no debt					−0.328***	−0.257***	−0.237***	−0.240***
					(−3.91)	(−3.02)	(−2.77)	(−2.80)
Ex ante risk score					6.603***	5.469***	5.598***	5.598***
					(8.25)	(6.75)	(6.89)	(6.88)
Missing risk score					0.0295	0.152	0.177	0.181
					(0.17)	(0.85)	(0.99)	(1.01)
Constant	−2.851***	−2.982***	−9.675***	−10.07***	−13.77***	−13.99***	−14.33***	−14.28***
	(−59.84)	(−57.23)	(−5.90)	(−6.06)	(−7.04)	(−7.17)	(−7.34)	(−7.31)
Industry sector indicators	No	No	No	No	No	Yes	Yes	Yes
Regional indicators	No	No	No	No	No	No	Yes	Yes
Number of observations	22,317	22,317	22,317	22,317	22,317	22,317	22,317	22,317
Number of insolvencies	1119	1119	1119	1119	1119	1119	1119	1119
McFadden pseudo-R^2	0.000650	0.00827	0.0214	0.0367	0.0587	0.0729	0.0764	0.0770
Area under ROC curve (AUC)	0.518	0.562	0.619	0.655	0.697	0.714	0.718	0.719

The table shows the estimation results for the models predicting insolvent exit using the pre-COVID and COVID period sample. The dependent variable is the indicator of the insolvent exit in the 3-year period either from 1st of April 2017 to 31st of March 2020 (pre-COVID historical control subsample), or from 1st of April 2020 to 31st of March 2023 (COVID-period subsample). The variables of interests are the indicator of the COVID period (equals one if the observation comes from the COVID period subsample and zero otherwise) and the interaction term between the indicator of COVID period and the indicator of active investor types. The models are estimated using logistic regression. The statistical significance is indicated with asterisks where the *, ** and *** denote significance at 10%, 5% and 1% significance levels. The corresponding *t*-statistics are computed using robust standard errors. The variables are defined in the Appendix in table A1

may induce 'sorting behaviour' amongst investors, leading to a reassessment of portfolio firm prospects and accelerating decisions to withdraw support from some ventures, making it challenging for them to secure further equity market investments.

Models 4–7 incorporate firm-specific financial and non-financial variables along with the ex-ante credit risk score, which reflects the firm's pre-COVID financial health and strongly predicts insolvency outcomes. Insolvency risk shows a non-linear relationship with total assets, modelled as a quadratic term in log assets, corroborating previous findings (Altman et al., 2010). Low-asset companies avoid liquidation, but insolvency risk rises with asset values up to £600,000, after which it declines. Traditional predictors of SME insolvency indicate that firms with higher liquidity, profitability and lower leverage or those without debt are less likely to become insolvent. Conversely, companies with higher ex ante risk scores exhibit increased insolvency rates.

Of particular interest and to support hypothesis H1, the coefficient of the COVID period is not statistically significant in the models with a richer set of explanatory variables. This suggests that the equity-funded companies, with similar characteristics as pre-COVID, did not have a higher insolvency rate during the 3-year window from April 2020 to the end of March 2023 when compared with the pre-COVID period.

In terms of active investor types, the results of the model with the largest set of explanatory variables (model 8) suggest that funding from VC, business angels, government VC or foreign VC investors (main effects) does not seem to impact the likelihood of insolvency when compared to the reference group of other and individual private investors. However, the presence of equity crowdfunding investors is associated with a higher probability of insolvency. In economic terms, the odds of insolvency is 48% higher for equity crowdfunded companies (main effect), with the coefficient being significant at the 1% significance level.[14]

To test hypothesis H2, we include interaction term between the COVID period and active investors, allowing us to examine whether the active investor types influence the effect of the COVID crisis on the likelihood of insolvency amongst equity-funded companies. The results support H2, indicating that the presence of the active investors does affect the probability of insolvency during the COVID-19 crisis. Economically, the odds of insolvency during the crisis period is 24% smaller ((exp(−0.277)−1)*100%) for companies funded by active investors than during the pre-COVID period (model 8, Table 3).

Next, we test hypothesis H3 and investigate the impact of government loan guarantee scheme(s) on the likelihood of the insolvency of equity-funded companies. The results presented in Table 4 show a significant positive coefficient of COVID loans at the 1% level across all model specifications, which indicates that companies with a COVID loan are, on average, more likely to experience insolvent exit when compared to companies without these loans. The main effect is relatively strong in that, all else being equal, the odds of insolvent exit are higher by 52% ((exp(0.420)−1)×100%) for a company with a COVID loan (model 7 in Table 4).

To examine the last hypothesis (H4), we include the interaction between COVID loan and active investor types (model 8 in Table 4). The results show that the interaction between COVID loans and active investors is negative and statistically significant, which supports hypothesis H4. In economic terms, for companies with COVID loans, the odds of insolvency is lower by 36% smaller ((exp(−0.450)−1)*100%) for companies funded by active investors, when compared to companies backed by passive investors.

Interestingly, if we add the main effect of the COVID loan (0.562) and the interaction (−0.450), we observe, that for companies funded by active investors, the adverse effect of COVID loans on insolvency (compared to companies without a guaranteed loan), substantially decreases, with the odds of insolvency being higher by only 12% ((exp(0.562–0.450)−1)×100%), but this difference is not statistically significant.[15]

[14] In the binary logistic regression, the exponentiated coefficients are interpreted as odds ratios. Therefore, for instance, the economic impact of the equity crowdfunding investor on insolvency is computed as (exp(0.389)−1)*100%=48% (model 8, Table 3). It is interpreted as 48% increase in odds of insolvency relative to companies funded by other investors (such as corporate VC, accelerators, private investment vehicles, charities and not-for-profit companies, family offices, bank VC or private individual investors with undisclosed identity).

[15] To test this, we used a test of linear restrictions where we tested a null hypothesis whether the sum of the two coefficients—for the COVID loan and the interaction between the COVID loan and the active investor—is equal to zero. The *p*-value of the test statistic was 0.46, suggesting the null hypothesis cannot be rejected.

Table 4 Insolvency prediction models using COVID period sample

	(1) Insolvency	(2) Insolvency	(3) Insolvency	(4) Insolvency	(5) Insolvency	(6) Insolvency	(7) Insolvency	(8) Insolvency
COVID loan indicator	0.642***	0.632***	0.636***	0.628***	0.490***	0.428***	0.420***	0.562***
	(7.84)	(7.57)	(7.38)	(7.16)	(5.32)	(4.57)	(4.49)	(5.17)
Venture capital (VC)		0.129	−0.0437	−0.00132	0.00228	0.0326	0.0294	0.130
		(1.11)	(−0.32)	(−0.01)	(0.02)	(0.23)	(0.21)	(0.89)
Business angel		0.186	0.0711	0.0976	0.0722	0.0655	0.0899	0.200
		(1.60)	(0.55)	(0.75)	(0.55)	(0.50)	(0.68)	(1.39)
Government VC		−0.0418	−0.0374	−0.0451	−0.0123	0.0183	−0.0689	0.00509
		(−0.25)	(−0.21)	(−0.25)	(−0.07)	(0.10)	(−0.37)	(0.03)
Foreign VC		−0.0551	−0.181	−0.169	−0.225	−0.155	−0.116	−0.143
		(−0.32)	(−1.01)	(−0.94)	(−1.21)	(−0.84)	(−0.62)	(−0.76)
Equity crowd-funding		0.706***	0.611***	0.603***	0.588***	0.498***	0.536***	0.474***
		(6.30)	(4.35)	(4.25)	(4.13)	(3.46)	(3.71)	(3.23)
COVID loan × active investor								−0.450***
								(−2.65)
Venture stage of investment			0.0746	0.119	0.0468	0.0626	0.0572	0.0637
			(0.74)	(1.15)	(0.44)	(0.59)	(0.54)	(0.60)
Growth stage of investment			0.101	0.203	0.107	0.111	0.0899	0.0907
			(0.60)	(1.17)	(0.60)	(0.62)	(0.50)	(0.50)
Established stage of investment			−0.537**	−0.451*	−0.481*	−0.515**	−0.566**	−0.550**
			(−2.22)	(−1.83)	(−1.93)	(−2.05)	(−2.24)	(−2.18)
Number of rounds			0.0686*	0.0485	0.0454	0.0598	0.0621	0.0639*
			(1.88)	(1.31)	(1.21)	(1.58)	(1.63)	(1.68)
Announced deal			−0.104	−0.114	−0.0798	−0.0469	−0.0858	0.00866
			(−0.78)	(−0.84)	(−0.59)	(−0.34)	(−0.63)	(0.06)
LN (total investment)			0.508	0.512	0.365	0.397	0.422	0.491
			(1.58)	(1.58)	(1.03)	(1.12)	(1.20)	(1.38)
LN (total investment) squared			−0.0137	−0.0138	−0.0107	−0.0115	−0.0120	−0.0148
			(−1.10)	(−1.10)	(−0.76)	(−0.82)	(−0.86)	(−1.05)
Time from first deal (days)			−0.000182*	−0.000227**	−0.000228**	−0.000243**	−0.000250**	−0.000248**
			(−1.85)	(−2.27)	(−2.24)	(−2.36)	(−2.43)	(−2.40)
Time from last deal (days)			0.0000966	0.0000831	0.0000843	0.0000941	0.0000846	0.0000827
			(0.92)	(0.78)	(0.78)	(0.86)	(0.77)	(0.75)
Investment purpose (R&D)			−0.129	−0.105	−0.127	−0.0619	−0.0796	−0.109
			(−0.68)	(−0.56)	(−0.66)	(−0.32)	(−0.41)	(−0.56)
Investment purpose (job creation)			−0.0585	−0.0189	−0.0292	−0.00568	−0.0233	0.00352
			(−0.32)	(−0.10)	(−0.16)	(−0.03)	(−0.13)	(0.02)
Working capital to total assets				−0.0978**	−0.150***	−0.147***	−0.145***	−0.140***
				(−2.15)	(−3.01)	(−2.95)	(−2.92)	(−2.82)

Table 4 (continued)

	(1) Insolvency	(2) Insolvency	(3) Insolvency	(4) Insolvency	(5) Insolvency	(6) Insolvency	(7) Insolvency	(8) Insolvency
Current assets to total assets				−0.487***	−0.451***	−0.375***	−0.358**	−0.368***
				(−3.83)	(−3.39)	(−2.68)	(−2.55)	(−2.61)
Current liabilities to total liabilities				0.0100	−0.204	−0.193	−0.200	−0.205
				(0.04)	(−0.79)	(−0.74)	(−0.76)	(−0.78)
Profit/loss account reserve to total assets				−0.0995***	−0.132***	−0.147***	−0.151***	−0.153***
				(−3.19)	(−3.55)	(−3.95)	(−4.04)	(−4.09)
Short- and long-term debt to total assets				0.343	−0.116	−0.114	−0.126	−0.127
				(1.40)	(−0.44)	(−0.43)	(−0.48)	(−0.48)
LN (total assets £m)					0.703***	0.724***	0.712***	0.687***
					(2.94)	(2.98)	(2.92)	(2.83)
LN (total assets) squared					−0.0260***	−0.0270***	−0.0265***	−0.0256**
					(−2.63)	(−2.70)	(−2.64)	(−2.56)
Indicator of charge on assets					−0.0278	0.00868	−0.0129	−0.00922
					(−0.18)	(0.06)	(−0.09)	(−0.06)
Indicator of no debt					−0.216**	−0.172	−0.158	−0.156
					(−2.00)	(−1.57)	(−1.44)	(−1.43)
Ex ante risk score					5.399***	4.108***	4.248***	4.303***
					(5.46)	(4.06)	(4.22)	(4.25)
Missing risk score					0.0640	0.179	0.208	0.220
					(0.30)	(0.82)	(0.96)	(1.01)
Constant	−3.338***	−3.463***	−7.606***	−7.434***	−10.48***	−10.86***	−11.19***	−11.55***
	(−52.79)	(−49.66)	(−3.65)	(−3.52)	(−4.33)	(−4.49)	(−4.64)	(−4.76)
Industry sector indicators	No	No	No	No	No	Yes	Yes	Yes
Regional indicators	No	No	No	No	No	No	Yes	Yes
Number of observations	13,786	13,786	13,786	13,786	13,786	13,786	13,786	13,786
Number of insolvencies	653	653	653	653	653	653	653	653
McFadden pseudo-R^2	0.0120	0.0203	0.0301	0.0418	0.0541	0.0658	0.0690	0.0704
Area under ROC curve (AUC)	0.579	0.611	0.645	0.669	0.695	0.707	0.711	0.712

The table shows the estimation results for the insolvency prediction models using the COVID period sample. The dependent variable is the indicator of the insolvent exit in the 3-year period from 1st of April 2020 to 31st of March 2023 (equals one if the company experienced an insolvent exit during the period and zero otherwise). The variables of interest are the indicator of the COVID loan (equals one if the company has a loan under any of the three COVID loan guarantee schemes and zero otherwise) and the interaction term between the indicator of COVID loan and the indicator of active investor types. The models are estimated using logistic regression. The statistical significance is indicated with asterisks where the *, ** and *** denote significance at 10%, 5% and 1% significance levels. The corresponding *t*-statistics are computed using robust standard errors. The variables are defined in the Appendix in Table A1

5.3 Additional analysis and robustness checks

We perform additional analyses and robustness checks to verify our results regarding government intervention through the COVID loan scheme. The main analysis reveals that equity-funded companies with a COVID loan are more likely to face insolvency than those without, indicating that loans increased some firms' likelihood of insolvency, contrary to policy objectives. A primary concern in the literature is potential selection bias. Specifically, the positive correlation between COVID loans and insolvency might stem from financially constrained companies being more likely to take loans. Furthermore, examining the multivariate profile of equity-funded firms that opted for debt finance during the COVID period is insightful. To address the selection and endogeneity issues, we start by estimating selection equations. Next, we address the endogeneity issue due to observed and unobserved confounders, and we conclude the section with additional analyses to elucidate the main drivers behind the effect of COVID loan on insolvency.

5.3.1 Profile of the companies with COVID loan, additional equity or both

To profile our sample of equity-backed companies that chose (or did not) to utilise COVID loan schemes, we estimate a logit model (1 = receiving COVID loan, 0 = not receiving COVID loan) using a specification similar to Eq. (1). Additionally, we identify firms that received an equity deal during the COVID period and analyse their characteristics. We also profile firms that have received both equity and guaranteed loans.

The first set of results related to predictors of COVID loans are presented in Table 5 (columns 1–3). Firms funded by business angel investors and equity crowdfunding platforms are more likely to access preferential loan financing compared to the reference group. Equity crowdfunding-funded firms with dispersed shareholders and selective criteria are less likely to provide additional resources during a crisis given the expectations for seed ventures. Business angels, as high net worth individuals, are likely to have strong reputations and relationships with banks, facilitating access to finance. Firms backed by VC and foreign VC funds are less likely to seek loan financing, supporting the idea that these funds invest more in developed companies and support them financially during crises. Government VC-backed ventures do not differ from the reference group (other investor types or small private undisclosed investors) in terms of COVID loan uptake.

The results indicate that companies investing in R&D are less likely to seek financing than those that increase their workforce. Similar to VC and foreign VC investors, R&D investment may indicate pre-commercialisation, whilst employment growth suggests active trading and a need for working capital, making firms eligible for COVID loans. In particular, a higher ex ante risk score strongly predicts loan acquisition, implying that financially vulnerable firms accessed loans (no credit checks resulted in adverse selection). Despite having reserves that are likely intended for development rather than liquidity, these firms exhibit lower liquidity and higher working capital needs. Firm size also shows a non-linear effect; smaller firms have a higher demand for COVID loans until they reach approximately £225 k in assets, after which the demand decreases. Companies with existing debt and asset charges are more likely to access loans, refinance at lower costs and remove asset charges. Therefore, these firms do not create additional financial resources and are prone to failure.

Additional models that determine the likelihood of additional rounds of equity during the COVID period are reported in columns (4)–(6). In model 4, nearly all investor types (except government VC) are associated with providing additional equity for some firms compared to reference group. When we add control variables (5) and regional and industry fixed effects (6), we find that VCs and business angels are most likely to provide equity injections, and those firms that have received more rounds of investment receive support. We found an inverted U-shape relationship between additional equity and cumulative investment with a threshold of £19.4 m. Firms that had a recent deal (pre-COVID) did not require additional funds.

The results for firms that acquired both loans and equity are interesting (models 7–9). Both business angels- and equity crowdfunding-backed firms are more likely to have both forms of finance. This may provide support for the 'liquidity certification' effects, uncovered in Kazembalaghi et al. (2024). Moreover, we expect business angels to have strong relationships with the investee bank, and it is rational to take a low-price loan for liquidity purposes or to refinance existing debt.

Table 5 Profile of the companies with a COVID loan, an additional equity funding and both the COVID loan and additional funding (selection models)

Dependent variable	(1) COVID loan indicator	(2) COVID loan indicator	(3) COVID loan indicator	(4) Add. funding indicator	(5) Add. funding indicator	(6) Add. funding indicator	(7) COVID loan + Add. funding indicator	(8) COVID loan + Add. funding indicator	(9) COVID loan + Add. funding indicator
Venture capital (VC)	−0.461***	−0.150**	−0.123*	0.560***	0.130*	0.148**	0.0755	−0.0618	−0.0414
	(−8.84)	(−2.29)	(−1.84)	(11.04)	(1.91)	(2.14)	(1.15)	(−0.77)	(−0.51)
Business angel	0.0553	0.118*	0.147**	0.588***	0.277***	0.251***	0.439***	0.236***	0.232***
	(0.98)	(1.79)	(2.22)	(10.78)	(4.09)	(3.63)	(6.61)	(3.03)	(2.93)
Government VC	0.118	0.105	0.119	0.0480	0.112	0.0255	0.0670	0.0618	0.0682
	(1.59)	(1.26)	(1.36)	(0.68)	(1.25)	(0.26)	(0.75)	(0.60)	(0.62)
Foreign VC	−0.940***	−0.592***	−0.496***	0.249***	−0.00501	−0.0876	−0.590***	−0.446***	−0.444***
	(−11.46)	(−6.52)	(−5.43)	(3.42)	(−0.06)	(−1.00)	(−5.63)	(−3.99)	(−3.94)
Equity crowdfunding	0.396***	0.393***	0.307***	0.465***	0.0569	0.105	0.665***	0.338***	0.311***
	(6.26)	(5.10)	(3.90)	(7.42)	(0.69)	(1.26)	(9.46)	(3.81)	(3.45)
Venture stage of investment		0.310***	0.298***		−0.121**	−0.106*		0.145**	0.149**
		(6.39)	(6.04)		(−2.22)	(−1.91)		(2.36)	(2.39)
Growth stage of investment		0.0676	0.00311		−0.530***	−0.472***		−0.0801	−0.0774
		(0.78)	(0.04)		(−5.07)	(−4.47)		(−0.65)	(−0.62)
Established stage of investment		−0.102	−0.233**		−0.886***	−0.808***		−0.777***	−0.775***
		(−1.11)	(−2.48)		(−7.46)	(−6.64)		(−4.88)	(−4.82)
Number of rounds		0.0561***	0.0721***		0.115***	0.103***		0.140***	0.138***
		(2.66)	(3.38)		(5.22)	(4.59)		(5.79)	(5.68)
Announced deal		−0.124**	−0.0960		−0.104	−0.141**		−0.127	−0.135*
		(−2.03)	(−1.54)		(−1.53)	(−2.04)		(−1.60)	(−1.69)
LN (total investment)		0.903***	0.907***		0.736***	0.716***		1.744***	1.727***
		(6.10)	(6.08)		(4.60)	(4.44)		(7.70)	(7.61)
LN (total investment) squared		−0.0431***	−0.0421***		−0.0207***	−0.0211***		−0.0666***	−0.0661***
		(−7.21)	(−7.00)		(−3.34)	(−3.38)		(−7.64)	(−7.56)
Time from first deal (days)		−0.0000318	−0.0000484		−0.000343***	−0.000328***		−0.000312***	−0.000306***
		(−0.63)	(−0.95)		(−6.49)	(−6.10)		(−5.13)	(−4.98)
Time from last deal (days)		−0.000339***	−0.000340***		−0.00145***	−0.00145***		−0.00115***	−0.00115***
		(−6.44)	(−6.36)		(−20.08)	(−19.97)		(−13.96)	(−13.82)
Investment purpose (R&D)		−0.365***	−0.297***		0.169*	0.144		−0.250**	−0.222**
		(−3.91)	(−3.17)		(1.85)	(1.56)		(−2.36)	(−2.07)

Table 5 (continued)

Dependent variable	(1) COVID loan indicator	(2) COVID loan indicator	(3) COVID loan indicator	(4) Add. funding indicator	(5) Add. funding indicator	(6) Add. funding indicator	(7) COVID loan + Add. funding indicator	(8) COVID loan + Add. funding indicator	(9) COVID loan + Add. funding indicator
Investment purpose (job creation)		0.329***	0.311***		0.0178	0.0235		0.232**	0.220**
		(3.65)	(3.40)		(0.19)	(0.25)		(2.30)	(2.16)
Working capital to total assets		−0.117***	−0.114***		0.142***	0.136***		0.0228	0.0196
		(−4.62)	(−4.44)		(5.02)	(4.76)		(0.68)	(0.58)
Current assets to total assets		−0.159**	−0.133*		−0.0205	−0.0167		−0.217**	−0.200**
		(−2.34)	(−1.91)		(−0.26)	(−0.21)		(−2.45)	(−2.22)
Current liabilities to total liabilities		0.912***	0.881***		−0.0130	0.0651		0.335**	0.375**
		(7.29)	(6.91)		(−0.09)	(0.45)		(2.06)	(2.29)
Profit/loss account reserve to total assets		0.0738***	0.0534***		−0.0752***	−0.0654***		−0.0516***	−0.0557***
		(4.65)	(3.31)		(−4.36)	(−3.77)		(−2.59)	(−2.77)
Short- and long-term debt to total assets		0.709***	0.683***		−0.0201	0.0476		0.174	0.209
		(5.30)	(5.02)		(−0.13)	(0.31)		(1.02)	(1.22)
LN (total assets £m)		1.678***	1.682***		0.189*	0.186*		0.815***	0.806***
		(12.02)	(11.86)		(1.88)	(1.81)		(4.07)	(4.01)
LN (total assets) squared		−0.0674***	−0.0678***		−0.00500	−0.00419		−0.0324***	−0.0317***
		(−12.03)	(−11.93)		(−1.21)	(−1.00)		(−4.02)	(−3.92)
Indicator of charge on assets		0.471***	0.463***		−0.103	−0.0801		0.264***	0.270***
		(6.12)	(5.94)		(−1.20)	(−0.92)		(2.83)	(2.89)
Indicator of no debt		−0.762***	−0.706***		0.136**	0.0950		−0.339***	−0.331***
		(−15.46)	(−14.07)		(2.39)	(1.64)		(−5.30)	(−5.11)
Ex ante risk score		4.197***	2.616***		1.287*	1.631**		3.199***	2.432***
		(5.67)	(3.50)		(1.77)	(2.16)		(4.03)	(2.99)
Missing risk score		−0.201**	−0.252***		0.0974	0.151		−0.0975	−0.0667
		(−2.15)	(−2.64)		(0.97)	(1.48)		(−0.81)	(−0.54)
Constant	−0.0945***	−14.97***	−15.19***	−0.907***	−7.203***	−7.322***	−1.694***	−17.21***	−17.35***
	(−4.66)	(−13.98)	(−14.08)	(−40.86)	(−7.05)	(−7.11)	(−61.13)	(−10.79)	(−10.91)
Industry sector indicators	No	No	Yes	No	No	Yes	No	No	Yes
Regional indicators	No	No	Yes	No	No	Yes	No	No	Yes
Number of observations	13,786	13,786	13,786	13,786	13,786	13,786	13,786	13,786	13,786

Table 5 (continued)

Dependent variable	(1) COVID loan indicator	(2) COVID loan indicator	(3) COVID loan indicator	(4) Add. funding indicator	(5) Add. funding indicator	(6) Add. funding indicator	(7) COVID loan + Add. funding indicator	(8) COVID loan + Add. funding indicator	(9) COVID loan + Add. funding indicator
Companies with COVID loan/funding/both	6234	6234	6234	4756	4756	4756	2356	2356	2356
McFadden pseudo-R^2	0.0213	0.114	0.130	0.0303	0.235	0.246	0.0136	0.145	0.149
Area under ROC curve (AUC)	0.569	0.722	0.738	0.591	0.820	0.825	0.564	0.769	0.773

The table shows the estimation results for the models quantifying differences between various groups of companies using the COVID period sample. In models 1–3, the dependent variable is the indicator of COVID loan (equals one if the company has a loan under any of the three COVID loan guarantee schemes and zero otherwise). In models 4–6, the dependent variable is the indicator of additional equity funding in the 3-year period from 1st of April 2020 to 31st of March 2023 (equals one if the company received the additional equity funding, and zero otherwise). In models 7–9, the dependent variable is the indicator of both the COVID loan and additional equity funding. The models are estimated using logistic regression. The statistical significance is indicated with asterisks where the *, ** and *** denote significance at 10%, 5% and 1% significance levels. The corresponding z-statistics are computed using robust standard errors. The variables are defined in the Appendix in Table A1

Table 6 Selection

	Heckman selection model			Matching			
	1st stage	2nd stage		Without replacement		With replacement	
Dependent variable	COVID loan	Insolvency	Insolvency	Insolvency	Insolvency	Insolvency	Insolvency
COVID loan		0.0811**	0.0808**	0.419***	0.570***	0.313***	0.389***
		(2.41)	(2.40)	(3.95)	(4.66)	(3.63)	(4.01)
COVID loan × active investor			−0.0177**		−0.510**		−0.304*
			(−2.30)		(−2.53)		(−1.71)
Instrument	1.573***						
	(5.73)						
Inverse mills ratio (lambda)		−0.0387*	−0.0356*				
		(−1.88)	(−1.73)				
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,786	13,786	13,786	9932	9932	12,438	12,438

The table shows the relevant results for the models that take potential non-random selection into account. Firstly, we use Heckman two-stage selection approach. In the first step, we estimate probit model where the dependent variable is the COVID loan. Here, following Bertoni et al. (2022), we use number of guaranteed loans divided by number of companies in each region as instrument. In the second stage, we include the inverse Mills ratios into the linear probability controlling for potential self-selection. The inverse Mills ratios were computed using the predicted values based on the probit model. The full set of control variables is included but not reported for the sake of brevity. Secondly, we present the main estimation results for the models re-estimated using the matched samples. We used coarsened exact matching with and without replacement, employing the variables that exhibited significant differences in means (measured by Rubin's B) between the companies with and without COVID loans. The statistical significance of the individual estimated coefficients is based on robust standard errors and is indicated with asterisks (*, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively). The variables are defined in Appendix in Table A1

5.3.2 Selection bias and endogeneity problem

The purpose of the policy intervention was to provide a financial buffer to help companies survive the COVID period in the face of severe challenges. However, it is likely that riskier firms self-select loan schemes and/or acquire loans, and creditors increase the likelihood of insolvent exit. To address the potential self-selection bias (endogeneity) in the insolvency model, we use Heckman's (1979) two-stage analysis, as shown in Table 6. The first-stage models employ COVID loans as the dependent variable. Lennox et al. (2012) emphasise the need for 'exclusion restrictions' in the Heckman procedure to avoid biased coefficients from multicollinearity. This restriction requires that at least one variable in the selection model be excluded from the performance model. To meet this requirement, we include an instrument in our selection model that is independent of the outcome equation but related to access to the COVID loan.

Following Bertoni et al. (2023), we constructed a regional instrumental variable representing the uptake of guaranteed loans, calculated as the ratio of guaranteed loans to the number of companies in each region. The theoretical basis for this instrument lies in the local nature of small business lending, which depends on loan providers' locations. Companies in regions with more loan providers are more likely to receive guaranteed loans, providing exogenous variation that does not affect insolvency (Bertoni et al., 2023). We estimate a first-stage instrumental probit regression, with a second-stage main regression similar to Eq. 1, using the inverse Mills ratio (IMR) from the first stage to control for selection bias in the second stage. In Table 6, model 1 presents the first-stage regression results, whilst models 2 and 3 show the second-stage results with and without the interaction term, respectively. The instrument's coefficient is significantly and positively related to the likelihood of accessing COVID loans. The IMR coefficient is significant at 10% in models 2 and 3, suggesting that sample selection might drive our results and indicating the importance of adjusting for endogeneity due to unobservable variables. However, the main results remain qualitatively similar.

Second, to further control for potential selection bias, we used Coarsened Exact Matching (CEM)[16] (Iacus et al., 2012) with and without replacement.[17] The idea of matching is to find firm observations that are reasonably comparable, thereby adjusting the distribution of pretreatment covariates by either excluding and/or re-weighting observations. The goal is to quasi-randomise the treatment assignment by ex post balancing of treatment and control groups in terms of relevant characteristics that explain selection into treatment (COVID loans). The second part of Table 6 shows that the coefficient of COVID loan is positive and statistically significant, which confirms that our findings are robust to observable sample selection bias.

5.3.3 Additional analyses

When testing hypothesis H2, we found that the active investor types experience lower insolvency rates during the COVID period, when compared to companies with passive investors. Our data allows us to test the moderating effect of each investor type—so instead of the interaction between the COVID period and active investors (as in Table 3, model 8), we include interaction between the COVID period and each investor type. The results (Table 7, model 1) suggest that the effect of the active investors on the insolvencies during the COVID period (H2) is driven by government VC.

Similarly, when testing hypothesis H4, we found that companies with a COVID loan that are backed by active investors are less likely to be insolvent when compared to companies with the combination of COVID loan and passive investors. Therefore, we estimate models where we included the

[16] We employed the variables that exhibited significant differences in means (measured by Rubin's B) between the companies with and without COVID loans. For matching, we follow Imbens and Wooldridge (2009) and we used those variables where the Cohen's *d* was greater than 0.2 in absolute value.

[17] In the former case, one control company (without a COVID loan) can be used for more than one treated company (with a COVID loan), whereas in the latter case, one control company can be matched only to one treated company.

interactions between the COVID loan and specific investor types. The results are presented in Table 7, model 2, and suggest that the moderating effect of active investors on COVID loan and insolvency is driven predominantly by business angels and government VC.

Finally, we explore the impact of additional equity funding during the first year of the COVID pandemic, on subsequent insolvencies. The results reported in Appendix A4 suggest that companies with a COVID loan that secured the additional equity funding during the first year of the COVID pandemic experienced lower likelihood of insolvent exit.

6 Discussion

Using a unique dataset on UK equity-funded companies, we evaluate the consequences of the COVID-19 pandemic and related policy measures, particularly guaranteed loans, on their insolvency outcomes. The results show that generally, the insolvency incidence of equity-backed firms did not differ significantly from those experienced in normal economic periods. This stability is attributed to the involvement of equity funders who act as patient (financial resources) and active investors (expertise), as well as government intervention. Thus, we provide empirical evidence that equity-funded companies were resilient during the pandemic, consistent with results presented in Gompers et al. (2022) or Lavery and Wilson (2024), albeit our results are broader in that they involve other active investors such as business angels and government VC.

The results uncover interesting variations in the insolvency risk of equity-funded companies during the pandemic, differentiating by investor type activity. Specifically, the outcomes of the study reveal that firms funded by active investors are likely to experience a lower likelihood of insolvent exit during pandemic. The effect seems to be driven by companies backed by government VC. This may be due to the tendency of government VC to invest in riskier ventures and pursue wider objectives; the additional support provided during periods of uncertainty is less discriminatory across

Table 7 Insolvency prediction models using the interactions with investor types

	(1) Insolvency	(2) Insolvency
COVID period indicator	−0.0511	
	(−0.63)	
COVID loan indicator		0.584***
		(5.16)
COVID period × venture capital	−0.145	
	(−0.81)	
COVID period × business angel	−0.0235	
	(−0.13)	
COVID period × government VC	−0.451*	
	(−1.93)	
COVID period × foreign VC	0.119	
	(0.42)	
COVID period × equity crowdfunding	0.191	
	(1.01)	
COVID loan × venture capital		0.173
		(0.73)
COVID loan × business angel		−0.726***
		(−3.05)
COVID loan × government VC		−0.746**
		(−2.15)
COVID loan × foreign VC		0.259
		(0.72)
COVID loan × equity crowdfunding		−0.274
		(−1.17)
Control variables	Yes	Yes
Number of observations	22,317	13,786
Number of insolvencies	1119	653
McFadden pseudo-R^2	0.0771	0.0726
Area under ROC curve (AUC)	0.718	0.715

The table shows the estimation results for the models predicting insolvent exit, and using the interaction terms of investor types with the indicator of COVID period (model 1), or interaction terms between the investor types and COVID loan (model 2). Otherwise, the model specification is the same as in Table 3, model 7 (model 1), or in Table 4, model 7 (model 2). The coefficients of the control variables are not reported for the sake of brevity. The models are estimated using logistic regression. The statistical significance is indicated with asterisks where the *, ** and *** denote significance at 10%, 5% and 1% significance levels. The corresponding *t*-statistics are computed using robust standard errors. The variables are defined in the Appendix in Table A1

their investees (Alperovych et al., 2020; Leleux & Surlemont, 2003). In line with earlier findings reported in Kacer et al., (2024a, b), we confirm that equity crowdfunded companies experience higher insolvency rates than other investor types, both before and during the COVID period. The increased insolvency rate may be explained by the higher risk of start-ups, diverse investor base, weaker control rights (Brown et al., 2018) or the less frequent use of contractual covenants (Hornuf & Schwienbacher, 2016). These findings contribute to the RBV literature (Dormady et al., 2019; Rose, 2004; Graveline & Grémont, 2017) by finding that active investor-types bring different levels of monitoring, support and resources to help survival and unveils the resilience of equity-funded companies during the COVID-19 crisis.

Whilst previous research on the COVID period has emphasised the effectiveness of guaranteed loans for SMEs, during the early stages of the pandemic (Wilson et al., 2023), our analysis suggests that equity-backed companies that received COVID loans were, on average, more likely to experience insolvency compared to those that did not receive such loans, even after accounting for self-selection bias. We suggest that the additional debt burden for less viable firms that could not raise additional equity led to default and insolvency actions by banks and other creditors. Interestingly, this effect was much smaller for companies backed by active investors, especially business angels and government VC. These investors conduct superior screening of potential targets and are able to filter out non-viable firms. Our results extend those of Kacer et al. (2024b). Moreover, due to active involvement, they are more likely to ensure that their investees could service payment on the loan before taking on the debt and/or provide additional financial support to avoid default. Additionally, business angels are more inclined to utilise government-guaranteed loans to safeguard their investment whilst maintaining their reputation with banks.

Moreover, we investigate signalling and selection. Our findings point to companies funded by equity crowdfunding acquiring guaranteed loans to signal their financial health to potential crowd investors. These results are consistent with a 'liquidity certification effect' provided by a COVID loan (Kazembalaghi et al., 2024). We suggest that the array of policy interventions enabled all companies to endure the immediate crisis, with the loan guarantee schemes providing liquidity and serving as a positive signal, allowing firms on equity crowdfunding platforms to secure additional equity investments and facilitating survival and growth. Firms receiving COVID loans[18] that had risk-priced interest rates and were risk-screened could have benefited from this signalling effect. However, the Bounce Back Loan Scheme was characterised by an unsystematic and indiscriminate lending approach. With a low interest rate and a maximum loan amount of £50 k, repayable over up to 10 years and the inclusion of a 100% loan guarantee and limited credit checks, the scheme encouraged a scattergun-lending approach. Whilst these loans were crucial for small owner-managed firms and unincorporated businesses during the pandemic, they were insufficient for innovative and high-growth businesses in the pre-commercialisation stage that required equity. Notably, most of the equity-backed companies that acquired a loan obtained the maximum loan amount (66%), indicating financial constraints. The loan size (max £50,000) was insufficient for survival of some companies. Moreover, for investors and lenders, Bounce Back Loan Scheme lending distorted credit information and signalling for some segments.

The Bounce Back Loan Scheme allowed banks to transfer the risk of existing loans to the loan guarantee schemes, and new lenders could expand their client base with a minimal risk of loss. We conclude that there was a significant *adverse selection* in the loan scheme, attracting high-risk obligors who saw a chance of survival. However, once these funds were exhausted and other support mechanisms were withdrawn, the riskier companies faced additional debt and creditor actions, resulting in bankruptcy and increased insolvencies. The COVID loan only temporarily delayed company failure. Our analysis shows that firms with pre-COVID short-term debt were likely using guaranteed loans to refinance at lower interest rates without significantly increasing the firms' liquidity. Our additional results provide evidence that the increased insolvencies were driven by companies with loans under the Bounce Back Loan Scheme (see Appendix A6). The increased riskiness of BBLS loans in terms of the COVID loan defaults has been demonstrated in Kacer et al. (2024b) and we extend this finding to insolvent exits.

[18] COVID Business Interruption Loan Scheme (CBILS).

7 Conclusion

7.1 Policy and practical implications

Our study suggests implications for policy and practice. Importantly, there are implications for the design of the parameters of Loan Guarantee schemes (eligibility, interest rate and the guarantee coverage), which, we suggest, could be more fine-tuned to target different sectors, avoid adverse selection and incentivise lenders to minimise default/fraud by risk scoring and scrutiny. For equity investors, considering investments, this would provide a useful information. Moreover, 'convertible loans', as used in the Future Fund, may have application for a wider range of equity-backed firms in the UK and lessons can be learned from evaluations of the Future Fund intervention.

Moreover, from an economic perspective, insolvent failures can be viewed as a part of the competitive process of 'creative destruction', reallocating resources to more efficient, innovative and growing businesses (Legrand, 2017). There was concern that the large-scale intervention through the loan scheme could distort the competitive process, sustaining non-viable firms (Dorr et al., 2022). We find that COVID loans *did not* prolong the life of unviable *equity-funded* businesses as the pandemic eased but actually expedited the liquidation process for the sub-set of non-viable firms, releasing resources for redeployment elsewhere.

The analysis may have value for practitioners. The estimated insolvency risk models, specific to the characteristics of equity-funded firms, can be applied and updated to allocate risk ratings and rankings to individual firms and therefore have real time relevance, and at the same time provide insights for potential investors and policy makers. These models could be developed further in future work to include founder and board characteristics and test predictive accuracy.

7.2 Limitations and future research avenues

Our analysis has some limitations, primarily due to identity of equity investors. Namely, besides large and announced deals from large investors, we cover smaller unannounced deals, as well. Many equity deals are funded by investors with an undisclosed identity. These are private individuals, predominantly, but a more detailed examination of shareholder records may uncover a richer profile of investor types. In future research, this analysis will aid our understanding of characteristics of the small undisclosed investors.

In our study, we classify investors based on their level of involvement as active and passive, but we have not taken into account the degree and nature of this involvement. For instance, some investors, such as business angels, prefer informal involvement whilst other, such as VC funds, require formal representation on company board. Future studies could extend our work in line with this idea and profile evolving board characteristics.

A significant limitation that might restrict generalisation of our results is the focus on the UK. Firstly, broadening the analysis to an international sample would yield valuable insights. Moreover, the COVID period in the UK coincided with Brexit, yet another source of uncertainty, and it is difficult to completely disentangle the two. However, it would be interesting to see if the results would hold in other type of crises or other jurisdictions.

Finally, future research could explore the characteristics of loan guarantee schemes recipients, including business directors and founders. In sum, our study has started to explore a research agenda that expands the understanding of entrepreneurial finance. It includes the role and actions of a broader range of equity investors and the impact on businesses receiving investments during crisis times.

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Data Availability The data used for this research comes from the sources mentioned in the text.

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