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The performance of private equity portfolio companies during the COVID-19 pandemic☆

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ABSTRACT

We study the performance of PE-backed companies during the COVID-19 pandemic. Our findings suggest that, on average, PE-backed firms were more resilient compared to closely matched industry peers during the pandemic. However, this outperformance is of a smaller magnitude than during the pre-pandemic non-crisis period, suggesting that the outperformance is driven by investor selection of target firms ex ante, rather than active support mechanisms. The outperformance during the pandemic is found to be insignificant among firms which were the most vulnerable at the onset of the pandemic, and firms in the most exposed industries. These more vulnerable firms appear to have been less active in obtaining additional financing during the pandemic, and consequently, suffered a significantly higher incidence of distress. However, non-PE-backed firms in distress had a higher incidence of liquidation, while PE-owned firms more often negotiated formally with creditors to continue trading. Our analysis shines light on the role of PE investors during a large, exogenous shock, and suggests that, in the case of the pandemic, their adept target selection may help to explain the outperformance more so than their actions to protect vulnerable firms in a crisis.

1. Introduction

Private equity (PE)-backed firms have previously been shown to be more resilient in the face of economic uncertainty and downturns, and specifically through the 2008 financial crisis (Wilson et al., 2012; Bernstein et al., 2019). In this study, we examine the performance of PE-backed firms during the recent COVID-19 pandemic. COVID-19 represented a significant exogenous shock to the global economy and economic activity and perhaps the largest ever collapse in UK economic activity. The UK saw a GDP decline of 25.1% in April 2020 followed by a deep recession (−9.9% GDP, 2020). Although economic activity revived over the spring and summer of 2020 as the economy reopened, further lockdowns during the autumn and winter of 2020/21 saw economic activity fall again, and the recovery has been slow.

The pandemic period was characterized by a significant and unprecedented level of policy intervention in response to the impact on business and society. The UK government initiated a range of interventions in response to the pandemic. Initially the focus was on introducing measures to protect livelihoods and jobs, whereby the Coronavirus Job Retention Scheme (CJRS) offered grants to

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cover a proportion of the salaries of furloughed staff. A range of business loan schemes, with the government acting as guarantor, were launched providing some £80bn in guaranteed loans to businesses of all sizes. The Coronavirus Business Interruption Loan Scheme (CBILS), Bounce Back Loan Scheme (BBLS) and the Covid-19 Corporate Financing Facility (CCFF), amongst others, were aimed at providing finance to help prevent otherwise viable businesses from failing. Moreover, the government introduced some permanent and temporary changes to insolvency legislation (i.e. the Corporate Insolvency and Governance Act 2020).[1]

There are both similarities and significant differences in the impact of the pandemic and other downturns, such as the global financial crisis, on economic activity and businesses. Both crises share uncertainty as a major factor, but the financial crisis resulted from imbalances between the financial sector and real economy and saw a significant contraction in money and credit. There were no such imbalances before the COVID-19 downturn, which resulted from a global health crisis. While during other downturns, businesses have often been able to predict and forecast issues they may face, (e.g. downturn in demand, access to finance and cost of capital, supply chain issues), the pandemic was an exogenous shock to the economy and working practices. The sudden and abrupt changes to the business landscape, the restrictions on how firms could operate, and rapidly changing government regulation meant that the impact on firms were far more wide ranging during the pandemic than other downturns. Moreover, the abundance of government support and liquidity made available to firms, coupled with increased creditor forbearance, distinguishes the pandemic from the financial crisis. Thus, the nature of the crisis was different, but the timing and severity was also unique. The rapid spread of new virus variants continually changed the business landscape due to lockdowns and restrictions. As a result, given the systematic differences in nature and timing compared to previous downturns, the COVID-19 pandemic provides a unique setting for studying firm ownership and performance.

The pandemic had significant implications for PE investors and how they conduct their business. Travel restrictions disrupted the due diligence process, preventing on-site visits, and video call meetings can hamper an investor's ability to accurately gauge team dynamics and culture. From a PE fund perspective, survey evidence suggests that investors had a greater intensity of interaction with their portfolio companies during the pandemic and that investment horizons were extended (Gompers et al., 2022). In wider financial markets, credit markets cooled as lender caution increased amidst market uncertainty, and unsurprisingly, the number of PE buyouts completed globally in 2020 fell by 28% from 2019 (see Fig. 1).

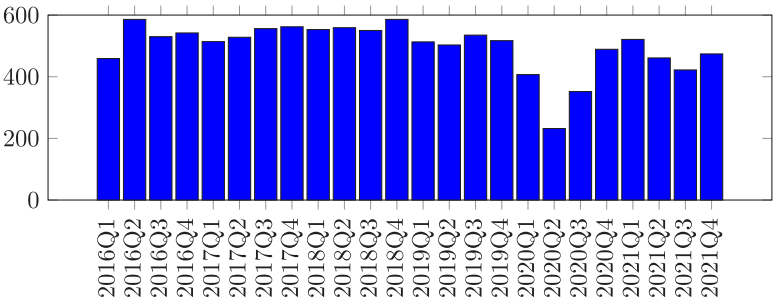
Unsurprisingly, firms' operating performance and corporate hiring declined during the pandemic (Campello et al., 2020; Fahlenbrach et al., 2021). However, when the pandemic hit, some firms were better able to finance an unanticipated cash flow shortfall, and these firms had greater financial flexibility (Fahlenbrach et al., 2021). On the other hand, firms with a higher degree of leverage and less cash holdings enjoy less flexibility, and unanticipated shocks to their cash flow can have more severe repercussions for their financial health. Indeed, Fahlenbrach et al. (2021) show that firms which had lower financial flexibility experienced weaker operating performance and lower stock returns compared to other firms. Similarly, some industries were more exposed to the consequences of the pandemic than others. There was a supply shock due to government-mandated lockdowns which caused production to fall for industries dependent on employees being on-site and close to one other. There was also a demand shock as demand fell in industries where customers have to interact with the firm and its employees in-person (Papanikolaou and Schmidt, 2022; Fahlenbrach et al., 2021).

There are two competing hypotheses concerning PE firms and their role in mitigating constraints during the pandemic period. First, PE firms may have focused their efforts on weaker firms and on those in more exposed industries, and the outperformance of PE-backed firms may be strongest amongst these companies. Bernstein et al. (2019) posit that PE investors are well-networked with strong ties with banks and providers of credit, and have financial resources (e.g. dry powder) with which they can provide additional funding to companies. PE investors have pools of managerial expertise (e.g. 'operating partners', Gompers et al. (2023)) that can be deployed to assist their current portfolio companies during times of need. This supports the hypothesis that PE-backed firms will be more resilient to economic downturns compared to other firms. Bernstein et al. (2019) show that the positive impact of PE ownership on firm investment during the global financial crisis is stronger in companies which were ex-ante more likely to be constrained during the crisis, and that these firms particularly benefited from debt issuances to alleviate financing constraints. That is, PE investors appear to have been able to help those who needed it the most.

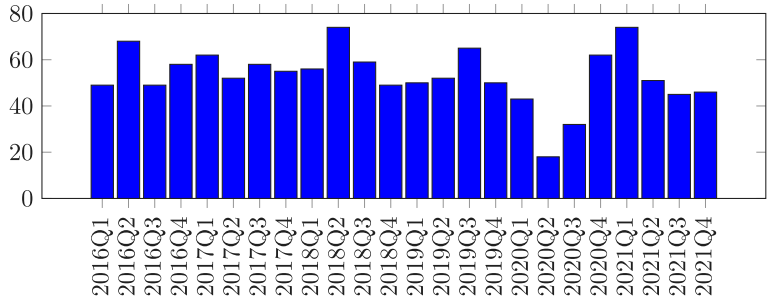
However, a second perspective may reflect the exogenous nature of the shock. The global financial crisis was a credit crisis, with a widespread reduction in lending being the primary direct impact on businesses. In this case, PE investors were able to directly alleviate the primary effect of the crisis and help firms by injecting additional equity or by accessing credit, whereas other firms struggled to do so. In turn, constrained PE-backed firms could then outperform their peers (Bernstein et al., 2019). However, the exogenous shock of the pandemic, coupled with widespread policy intervention, may have reduced the ability of PE investors to provide something above and beyond what other non-PE-backed firms were able to access. Consequently, there may have been cases where PE firms "cut their losses" on their weakest portfolio firms, or those most exposed to the pandemic, and instead focused their attention on firms which they deemed to be more manageable and "treatable".

A further dimension on the interpretation of performance differentials versus non-PE-backed firms relates to the selection of portfolio firms by PE investors (Kaplan and Strömberg, 2004; Cohn et al., 2022; Wilson et al., 2022a). It is recognized that private equity investors implement rigorous due diligence protocol to identify targets with potential growth and value augmentation prospects. Investors engage in thorough selection and vetting procedures to discern the 'ideal' target, with attributes that signal

[1] The latter introduced measures to give companies the 'breathing space' to maximize their chance of survival; measures to temporarily suspend parts of insolvency law to allow companies to continue trading through the pandemic without the threat of liability for wrongful trading; and measures to protect companies from creditor action. Of relevance were changes to the process for establishing 'Company Voluntary Arrangements' and the 'cram out' procedure (discussed later). Moreover, there were temporary easements on company filing requirements and annual general meetings.



(a) Global buyouts



(b) UK buyouts

Fig. 1. The number of PE buyouts over time. These charts show the number of PE buyouts of global companies and of UK companies each quarter from 2016Q1 to 2021Q4. Data comes from S&P Capital IQ.

investment viability and the potential to achieve growth and value creation within the (limited) PE holding period (Kaplan and Strömberg, 2004; Gompers et al., 2016). It is relevant, therefore, to examine the performance differential of PE portfolio firms in non-crisis periods as a benchmark. This would help to illuminate whether any PE outperformance during a crisis period is attributable to active support and crisis management, or whether PE investors are adept at selecting and developing firms which have stronger prospects ex ante.

In this paper we study the performance and resilience of PE-backed firms during the COVID-19 pandemic. Using a sample of over 800 UK companies which were under PE ownership at the onset of the COVID-19 pandemic, we study the ensuing performance of these companies during the pandemic relative to matched non-PE-backed firms. We match PE-owned firms to controls across a number of observable characteristics, such as industry, size, profitability, and leverage (Boucly et al., 2011; Bernstein et al., 2019; Cohn et al., 2021). We compare company performance during the pandemic across several measures including sales, assets, employment, and earnings. We find significant evidence of outperformance of PE-backed firms during the COVID-19 pandemic. For example, sponsored firms increased their sales by around 5% relative to control firms. We find that their employment and earnings were likewise more resilient during the pandemic. Importantly, when we examine the timing of the effect, PE-backed and matched control firms are similar during the pre-pandemic period. However, at the onset of the pandemic in 2020, we see considerable divergence in the two groups of firms across performance and growth variables. These results are robust to a battery of robustness checks including controlling for a range of pre-pandemic observable firm controls, and making several adjustments to our matching technique. In particular, we tighten and loosen the matching bandwidths used, and use alternative matching parameters. In other checks, we control for attrition bias, control for UK government support during the pandemic in the way of various COVID support loans which were issued to firms, and finally, tighten our selection of firms which are PE-backed at the onset of the pandemic. We continue to find that, on average, PE-backed firms outperform during the pandemic period. However, we find that the performance differential between PE-backed firms and matched controls during the pandemic is not superior to that in the benign pre-pandemic period. This suggests that an important mechanism driving the outperformance appears to be PE investors' skill in selecting firms which have better prospects ex ante.

Of course, the impact of the pandemic was not homogeneous across all types of firms and industries, with empirical evidence supporting this (Campello et al., 2020; Fahlenbrach et al., 2021; Barry et al., 2022). When we study the cross-section, we uncover interesting results. The outperformance of PE-backed firms is not being driven by the most vulnerable and exposed firms, but by firms which were better-performing prior to the pandemic, and had greater financial flexibility, and operated in industries which were less exposed to the pandemic. Indeed, the most vulnerable and exposed firms do not outperform. This finding is robust across many definitions of firm vulnerability and industry exposure. The results suggest that PE investors were less able to alleviate

constraints facing the worst-affected firms during the pandemic and that their selection of target firms, to some extent, accounts for the positive pandemic performance differential of their other portfolio firms. This contrasts with evidence from the global financial crisis, where PE firms were able to help credit-starved firms access external financing, directly mitigating the primary consequence of the downturn (Bernstein et al., 2019). However, the exogenous shock of the pandemic, and considerable policy intervention, appears to have reduced the ability of PE investors to provide something above and beyond what other firms were able to access.

We then explore other potential mechanisms through which PE-backed firms may be able to outperform during the pandemic period. PE investors typically help their portfolio through three dimensions: Operational engineering, governance engineering, and financial engineering (Gompers et al., 2016; Gryglewicz and Mayer, 2023). We test various channels and find strong evidence of a financial engineering channel at play, and some weaker evidence of operational changes helping firms outperform. Our results suggest that PE-backed firms had better access to both equity and debt financing, particularly the latter. When we study the cross-section of firms, we find that the positive impact of PE ownership on equity and debt issuance during the pandemic is concentrated in firms which were in less vulnerable positions at the onset of the pandemic. Where the most vulnerable firms are concerned, they do not appear to have superior access to external financing during the pandemic. This suggests that PE investors may have "cut their losses" and been less active with their most exposed portfolio firms.

Finally, we study incidence of financial distress throughout the pandemic period. Using data gathered on all UK company insolvency filings at Companies House and formal notices in the London/Edinburgh Gazettes from 1998 to 2022, we track the incidence of distress among PE-backed companies and matched control firms and examine whether the probability of PE-backed firms filing for insolvency increases or decreases during the pandemic period relative to matched non-PE-backed firms. We document that PE-backed firms which were more vulnerable at the onset of the pandemic, or which operate in more exposed industries, were significantly more likely to enter into distress during the pandemic. The probability of more vulnerable PE-backed firms entering into insolvency increases by around 1 to 2 percentage points in the pandemic period relative to control firms. Firms which were less vulnerable were no more likely to enter into distress.

However, we find differences in the restructuring of distressed firms between both samples of firms. PE-backed firms have a considerably lower incidence of liquidation suggesting PE investors are proactive in negotiating with creditors through Company Voluntary Arrangements (CVA), whereby the owners/directors maintain control over the firm, to keep distressed portfolio companies trading relative to other owners. While PE owners may manage financial distress at a lower cost (see Hotchkiss et al. (2021) and Hartman-Glaser et al. (2023)), we provide an example where we are able to see this process "in action" during a real crisis.

The CVA process is rarely used by other private companies because of the complexities, legal process and expertise required. Moreover, CVA's can be blocked by one creditor, and this is often HM Revenue & Customs, acting on behalf of the taxpayer. During the pandemic period a new process was introduced in the UK known as 'cram down' whereby the blocking actions of a creditor could be challenged in court and potentially ruled out by a judge. It is interesting, therefore that PE firms were actively using this process to protect their assets and increase survival chances. This appears to suggest that PE investors may be faster at adopting new law or regulations relative to other forms of ownership, which is another dimension of the operational expertise PE firms can bring to the table during times of distress.

In summary, our findings suggest that, while, on average, PE-backed firms outperformed closely matched industry peers during the pandemic, the average outperformance is considerably lower than that during the pre-pandemic period. What is more, the most vulnerable and exposed firms did not outperform matched peers. These firms appear to have been less active in obtaining external financing during the pandemic, and consequently, suffered a significantly higher incidence of distress. However, PE-owned firms in distress were more likely to settle out of court and to continue trading relative to non-PE-backed firms. Our findings suggest that the outperformance of PE-backed firms during the pandemic may have been related to investors' ex ante selection of target firms, rather than active support and crisis management.

Our paper is related to an extensive body of research which studies how PE ownership impacts firm behavior and outcomes (see for example Kaplan (1989), Harris et al. (2005), Boucly et al. (2011), Acharya et al. (2013), Cohn et al. (2014), Bernstein et al. (2017), Lerner et al. (2019), Eaton et al. (2020), Cohn et al. (2021) and Fracassi et al. (2022)). In particular, we relate to a smaller body of literature exploring the performance of PE-backed firms during economic downturns (Wilson et al., 2012; Bernstein et al., 2019). We also contribute to the literature which is building an understanding of firm dynamics and performance during the COVID-19 pandemic (Campello et al., 2020; Fahlenbrach et al., 2021; Papanikolaou and Schmidt, 2022).

2. Data

2.1. Private equity buyouts

Our data on PE buyouts comes from S&P Capital IQ and from Pitchbook, each of which have been widely used in recent PE literature (see for example Faccio and Hsu (2017), Bernstein et al. (2019), Braun et al. (2020), Fuchs et al. (2021) and Fracassi et al. (2022)). We take all PE buyouts, excluding venture capital deals, follow-on rounds of financing of the same portfolio company by the same PE investor, and excluding bolt-on acquisitions. Moreover, we only include deals which have been completed, and where a private equity buyer is defined.

We take all relevant information, such as the transaction date, the name(s) and location(s) of the investor(s), the transaction value (if disclosed), and the type of buyout transaction. In order to identify how and when the private equity investor exits a deal in each case, we use a variety of resources. We use Capital IQ's merger & acquisition database to search for sales to trade buyers and sales to other private equity investors (secondary buyouts). We also use Factiva and manual searches of financial news for acquisitions, initial public offerings, and bankruptcies/liquidations involving the target firms. In some instances, we conduct extensive web searches on a deal-by-deal basis in order to understand the ultimate outcome of the transaction.

2.2. Company financial accounts

To source companies' financial accounts, we use the FAME database, published by Bureau Van Dijk Electronic Publishing (BvDEP). This database sources historical accounts of companies in the UK from Companies House, the national UK register. The reliability of the source of companies' financial data (Companies House) and the coverage of both public and private firms is a key strength of the data. Unsurprisingly, recent empirical studies in corporate finance have acknowledged that the UK is an excellent setting in which to study private firms (see for example Brav (2009), Saunders and Steffen (2011), Michaely and Roberts (2012) and Bernstein et al. (2019)). The extent of the requirement to disclose financial information in the UK, however, varies with the size of the company. Smaller companies are allowed to file abridged accounts or micro-entity accounts.[2] Since the amount of information small firms disclose to Companies House (and hence in the FAME data set) can be very limited, some of these firms may not feature in our empirical analysis. We download companies' financial accounts (balance sheets and profit & loss statements) and other firm information (such as industry codes, location, date of incorporation) for all companies in the FAME database for 2001 through 2021.

The next step is to match target firms from our list of PE buyouts in Capital IQ and Pitchbook to the FAME database. In order to maximize our matches, we do so manually. An advantage of FAME in this case is that it tracks firms' prior names. If company names differ between our list of transactions from Pitchbook and FAME, we verify that we are tracking the correct company by cross-checking that information such as reported sales, total assets, and company address or website are consistent between the two sources. We also use Companies House in this respect. Importantly, given that the ownership structure of PE target firms changes considerably post-buyout, we ensure that we track the correct consolidated entity in FAME from pre- to post-buyout for each target firms (Cassel, 2022).

2.3. Insolvency filings

We gather data on all UK company insolvency filings at Companies House and formal notices in the London/Edinburgh Gazettes from 1998 to 2022. This includes company filings for administration, receivership, company voluntary arrangements (CVA), and liquidations. We are then able to match this information to our samples of PE-backed and control firms using companies' registration numbers. In doing so, we can identify precisely when PE-backed and control firms file for insolvency in our sample and the type of insolvency filing. This allows us to study whether the probability of PE-backed firms filing for insolvency increases or decreases during the pandemic period relative to matched non-PE-backed firms.

2.4. Final sample

Finally, given that we are interested in examining portfolio firm performance during the COVID-19 pandemic, we reduce our sample to firms which were under PE ownership during the pandemic period. We follow Bernstein et al. (2019) (who study the performance of portfolio companies during the financial crisis) and limit our sample of PE target firms to those which had been acquired by a PE investor by the end of 2019, and had not experienced an exit by the PE investor by the end of 2020. This reduces our sample to 1516 PE-backed firms which were under PE ownership at the onset of the pandemic.

3. Firm performance and growth

3.1. Constructing a matched control sample

For a difference-in-differences estimation, we construct a group of control firms which are similar in nature to our sample of PE-backed firms at the onset of the pandemic based on their observable characteristics. In order to do so, we follow matching methodologies used in recent PE literature (Boucly et al., 2011; Bernstein et al., 2019; Cohn et al., 2021). Specifically, we match firms in such a way that each control firm meets the following criteria: (1) has the same two-digit SIC code as the treated PE-backed firm; (2) has total assets in the pre-pandemic year (2019) within a 30% bandwidth as the treated firm; (3) has leverage (defined as total debt divided by total assets) within a 30% bandwidth in the pre-pandemic year; (4) has return on assets within a 30% bandwidth in the pre-pandemic year. We match each PE-backed firm to up to five control firms. If a target firm matches to more than five control firms based on this matching, we select the closest five based on the quadratic distance computed based on the variables. This matching technique allows us to match 828 PE-backed firms to a total of 2825 control firms.[3]

Of course, given the nature of the study, how we construct the matched control group has implications for the size of the sample and the results we generate. To ensure the robustness and validity of our results, we generate several other treated-control samples of firms by adjusting our matching technique. To do so, we tighten and loosen the matching bandwidths of 30%, and we also include other matching parameters, as well as reducing the number of matching parameters included. We also control for a wide set of observable firm-level characteristics in the pre-pandemic period. These adjustments are described in detail in Section 3.5.

[2] The thresholds for company size and the level of financial accounting disclosures in the UK as of March 2022 are available at: https://www.gov.uk/government/news/accounts-filing-options-for-small-companies.

[3] Of course, there are other unobservable factors which will determine a PE investor's decision to invest in a firm, such as its future growth potential. While this is often an important factor for PE investors to consider, it is very difficult to capture in terms of observable characteristics. Importantly, however, the control group is similarly unobservable in this respect. In robustness checks of our matching, we use prior sales growth as an alternative matching factor, which helps to capture future growth prospects.

Table 1
Matched treated and control pre-pandemic descriptive statistics.

Variable	PE				Control				Difference	
	N	Mean	Median	SD	N	Mean	Median	SD	Mean	Median
Age	827	22	18	17.12	2827	22	17	19.56.10	0	1
Employment	811	450	148	1221	2502	401	129	885	49*	19
Total assets (£000)	827	101,183	20,578	556,172	2827	90,673	19,130	351,572	10,510	1448
Total debt (£000)	827	45,138	4500	288,013	2827	39,811	4287	193,033	5327	213
Total cash (£000)	813	5937	1791	17,378	2630	6792	1601	31,007	−855	190
Sales (£000)	821	67,165	23,391	175,319	2755	62,196	22,006	235,074	4969	1385
EBITDA (£000)	825	7696	2484	30,812	2812	6138	2155	15,975	1558	329
Return on assets	827	0.05	0.05	0.15	2827	0.05	0.06	0.15	0.00	−0.01
EBITDA margin	820	0.12	0.10	0.17	2753	0.13	0.10	0.19	−0.01	0.00
Debt/assets	827	0.32	0.24	0.32	2827	0.33	0.24	0.34	−0.01	0.00
Cash/assets	827	0.12	0.07	0.13	2827	0.13	0.07	0.16	−0.01	0.00
Debt/EBITDA	825	2.47	0.95	6.32	2810	2.67	0.94	6.81	−0.20	0.01
Working capital/assets	827	0.20	0.21	0.34	2826	0.18	0.19	0.36	0.02	0.02
Labor productivity	707	62.5	50.0	46.5	2025	67.1	50.9	58.3	−4.6	−0.9
Total factor productivity	573	5.27	5.27	0.58	1544	5.24	5.22	0.71	0.03	0.05*
Investment	799	0.25	0.20	0.37	2494	0.22	0.18	0.35	0.03	0.02
Equity issuance	818	−0.02	0.00	0.10	2768	−0.03	0.00	0.11	0.01	0.00
Debt issuance	816	0.06	0.04	0.19	2763	0.05	0.02	0.21	0.01	0.02

The table reports summary statistics for the pre-pandemic year (2019) across PE-backed companies and control firms. *PE-backed* refers to all PE-backed companies; *Control* refers to a sample of non-PE-backed firms, matched on their two-digit SIC code, total assets, ROA (net income/total assets), and leverage (total debt/total assets) within a 30% bracket in the pre-pandemic year. All ratios are winsorized at the 2% level. Variable definitions are provided in the appendix. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

3.2. Descriptive statistics

Table 1 shows extensive firm characteristics for matched PE-backed and control firms at the onset of the pandemic. We look at numerous variables covering firms' size, profitability, debt, cash holdings, productivity, and working capital. The matching algorithm appears to work well, with differences between PE-backed and control firms' mean and median values being minimal. Moving a step further, Table 2 shows pre-pandemic growth rates in firm characteristics of treated and control firms. Again, the mean and median growth rates across treated and control firms are very similar, suggesting that our matching process has worked well. Overall, Tables 1 and 2 provide comforting evidence suggesting that the parallel trends assumption is satisfied.

Fig. 2 provides a visual interpretation of the evolution of firm performance variables around the pandemic. Specifically, the graphs present the α_t of the following equation:

$$y_{it} = \alpha_t + \alpha_i + \varepsilon_{it} \tag{1}$$

where y_{it} is the outcome variable for firm i at time t. α_t captures year fixed effects and α_i denotes firm fixed effects. We use the year before the pandemic, 2019, as the base period, and we normalize its corresponding coefficient to zero. We estimate the equation separately for both the PE-backed and matched control samples, with standard errors clustered at the firm level. We consider firms' sales, assets, employment, and earnings (as measured as EBITDA). All variable definitions are noted in the appendix.

In each instance, the PE-backed and control firms appear to follow similar paths in the pre-pandemic years, and then at the onset of the pandemic, there is a divergence. In the cases of sales, employment, and earnings, there is a marked decline for both firms when the pandemic hits in 2020, but less so for PE-backed firms relative to the control firms. As for total assets, the control firms experience a plateau while the PE-backed firms continue an upward trend. These graphs plotting year effects estimates around the pandemic offer an initial insight into the potential cushioning effect of PE ownership on firm performance during the COVID-19 pandemic. At first glance, PE-backed firms appear to have been more resilient to the negative impact of the pandemic.

3.3. Model

We then move to a formal econometric estimation of the impact of the COVID-19 pandemic on PE-backed companies in the UK using a difference-in-differences technique. Following other recent papers studying the impact of PE ownership on firm outcomes (Bernstein et al., 2019; Cohn et al., 2021), our baseline difference-in-differences model is as follows:

$$y_{it} = \alpha_t + \alpha_i + \beta_1 PE_i * Post_t + \theta X_i * Post_t + \varepsilon_{it} \tag{2}$$

where i is a firm index, and t is a year index. PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. The choice of 2020 as the first year of the pandemic is consistent with the first nationwide UK lockdown being announced on the 23 March 2020. The model also includes year fixed effects, α_t, and firm fixed effects, α_i. Standard errors are clustered at the firm-level. We also include several firm-level controls variables, X_i, to control for firm characteristics in the pre-pandemic period. Specifically, we control for firm age, size (total assets), cash holdings, sales growth, leverage, and profitability.

Table 2
Matched treated and control pre-pandemic growth rates.

Variable	PE				Control				Difference	
	N	Mean	Median	SD	N	Mean	Median	SD	Mean	Median
Employment	797	0.09	0.07	0.22	2429	0.07	0.06	0.18	0.02	0.01
Total assets	818	0.18	0.11	0.41	2769	0.16	0.09	0.44	0.02	0.02
Total debt	723	0.19	0.06	0.91	2472	0.15	0.05	0.88	0.04	0.01
Total cash	803	0.37	0.04	1.10	2569	0.39	0.05	1.14	−0.02	−0.01
Sales	780	0.13	0.07	0.30	2593	0.12	0.05	0.34	0.01	0.02*
EBITDA	783	0.01	0.03	1.04	2651	0.03	0.04	1.04	−0.02	−0.01
Return on assets	785	−0.08	−0.05	1.44	2665	−0.06	−0.04	1.46	−0.02	−0.01
EBITDA margin	778	−0.10	−0.05	0.87	2589	−0.07	−0.03	0.84	−0.03	−0.02
Debt/assets	723	0.04	0.00	0.35	2472	0.04	−0.01	0.41	0.00	0.01
Cash/assets	803	0.17	0.00	0.88	2569	0.19	0.01	0.91	−0.02	−0.01
Debt/EBITDA	704	0.14	−0.11	1.64	2382	0.10	−0.13	1.49	0.04	0.02
Working capital/assets	817	0.02	0.01	0.82	2763	−0.01	0.00	0.77	0.03	0.01
Labor productivity	650	0.02	0.00	0.28	1865	0.04	0.01	0.26	−0.02	−0.01
Total factor productivity	527	0.01	0.01	0.18	1400	0.02	0.02	0.17	−0.01	−0.01
Investment	782	0.27	−0.13	2.08	2351	0.24	−0.15	2.36	0.03	0.02
Equity issuance	655	−0.23	−0.11	2.21	2331	−0.38	−0.04	2.38	0.15	−0.07
Debt issuance	805	−0.81	−0.76	1.72	2636	−0.79	−0.82	1.69	−0.02	0.06

The table reports one year growth rates for the pre-pandemic year (2019) across PE-backed companies and control firms. *PE-backed* refers to all PE-backed companies; *Control* refers to a sample of non-PE-backed firms, matched on their two-digit SIC code, total assets, ROA (net income/total assets), and leverage (total debt/total assets) within a 30% bracket in the pre-pandemic year. All ratios and growth rates are winsorized at the 2% level. Variable definitions are provided in the appendix. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

Following Bernstein et al. (2019), these controls are taken in the pre-pandemic year and are interacted with the $Post_t$ variable. The main coefficient of interest is β_1, which will capture the estimated change in PE-backed firms' performance from before the pandemic to after the pandemic outbreak, relative to control firms. A positive coefficient would reveal that PE-backed firms are more resilient to the negative impact of the pandemic.

To further validate the parallel trends assumption, we extend the analysis to gain an insight into how firm performance evolves over time around the pandemic. Fig. 2 show that the divergence in treated and control firms' performance appears to have coincided with the onset of the pandemic. We formally explore how firm performance evolves over time around the pandemic in more detail by estimating the following equation, which shows year-by-year effects of private equity ownership around the pandemic:

$$y_{it} = \alpha_t + \alpha_i + \Sigma\beta_k(PE_i) + \varepsilon_{it} \tag{3}$$

where we estimate a different β_k for each year between 2017 and 2021, using the pre-pandemic year, 2019, as the reference year. Given our matching methodology, we expect the effect of private equity ownership on firm performance to appear only at the onset of the pandemic.

3.4. Results

Panel A of Table 3 shows the baseline results of estimating Eq. (2) where we study whether PE-backed firms outperformed matched control firms during the COVID-19 pandemic period. In each specification we include firm, and year fixed effects. We report coefficient estimates and standard errors clustered at the firm-level. Even-numbered columns include a vector of firm control variables, taken in the pre-pandemic year and interacted with the *Post* variable. These include firm age, size, cash holdings, sales growth, leverage, and profitability.

The results are striking. Across all measures of firm performance, the results suggest that PE-backed firms outperformed other similar firms, in line with our hypothesis. The results are strongly statistically significant, and meaningful in terms of the size of their economic magnitude. In columns 1 and 2, the coefficients imply that PE-backed firms' increased their sales by approximately 5% during the pandemic period relative to control firms. This is consistent with Fig. 2, where we examine the year effects estimates around the time of the pandemic. There appears to be a divergence in PE-backed and control firms' sales at the onset of the pandemic.

In columns 3 to 8, we study other measures of firm performance. The results are similar. For example, in column 3, we find that PE-backed firms assets increased by around 10% during the pandemic relative to control firms. Again, this is consistent with Fig. 2, where matched non-PE-backed firms' asset growth appears to stall at the beginning of the pandemic, while PE-backed firms continue their upward trend. With regards to unemployment, UK redundancies reached record levels during the pandemic in 2020. Over 400,000 redundancies were recorded between September and November of 2020, which was a record high in the UK (Powell et al., 2022). When we study employment in our matched sample of firms, we find that PE-backed firms' employment was less affected during the pandemic relative to that of similar, non-PE-backed firms. That is, their employment levels increased by approximately 7% relative to control firms' employment in the pandemic period. This aligns with the divergence during the pandemic shown in Fig. 2. PE-backed firms' earnings likewise increase compared to the control group. Specifically, the coefficient estimates in columns 7 and 8 suggests an increase of around 6% in earnings relative to the control group during the pandemic period.

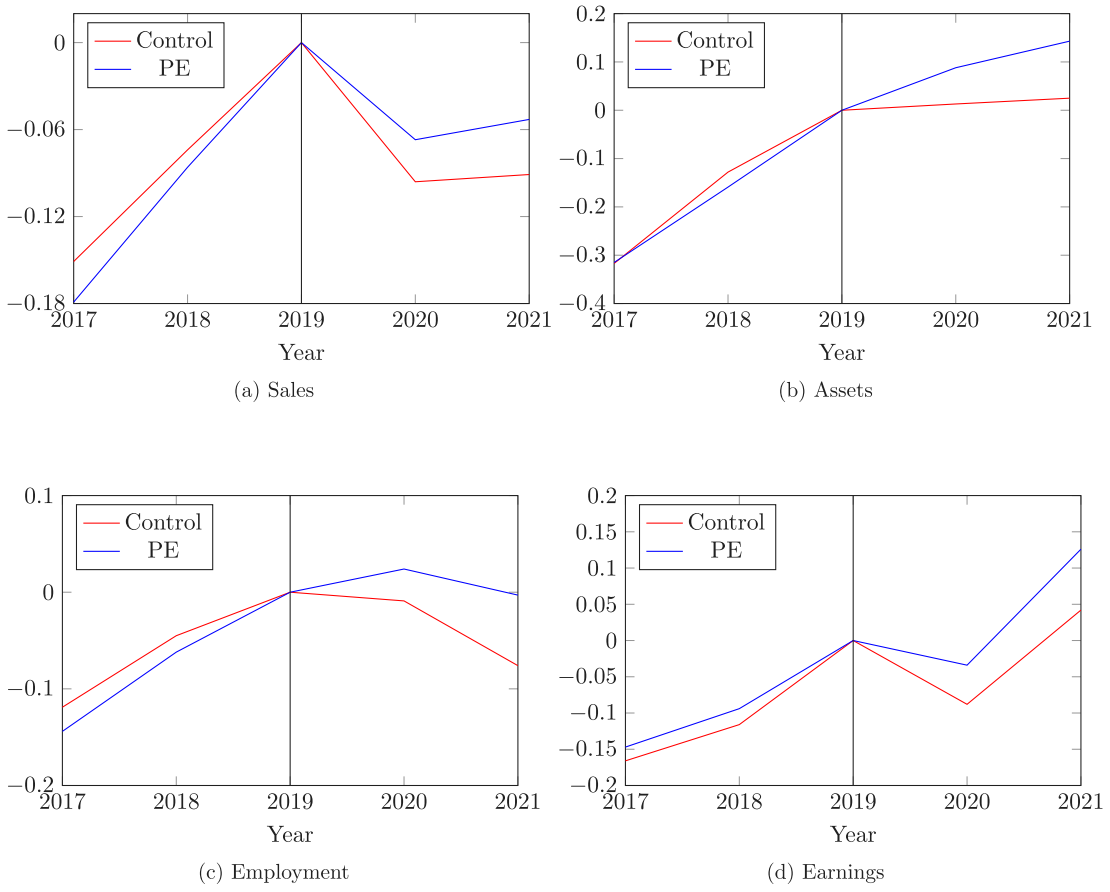


Fig. 2. The effect of PE ownership on firm performance during the COVID-19 pandemic. This figure reports the α_t of the following equation: $y_{it} = \alpha_t + \alpha_i + \epsilon_{it}$, where α_t captures year fixed effects and α_i captures firm fixed effects. The year before the pandemic, 2019, is the base period, and its corresponding coefficient is normalized to zero. The equation is estimated separately for both the PE-backed and control firms, with standard errors clustered at the company level.

While the estimates in panel A of Table 3 capture the average change in firm performance from before to after the onset of the pandemic, they do not shed light on the timing of these changes. Panel B of Table 3 shows the results of estimating Eq. (3), which indicates the time-varying behavior of the treatment effects of our dependent variables. The results corroborate those in panel A. For example, in columns 1 and 2, there are no divergent trends in PE-backed and control firms' level of sales prior to the pandemic. The divergence appears in 2020 when the pandemic hits. Similar trends appear in columns 3 to 8 when we look at firm assets, employment, and earnings. Any pre-pandemic differences are weakly statistically significant, if significant at all. Overall, the results here support the lack of statistically significant patterns before the pandemic and that firm performance diverged considerably at the onset of the pandemic.

Finally, while our results so far suggest outperformance of PE-owned firms during the pandemic, it is worth gauging the level of outperformance relative that during a benign period in the business cycle. If the outperformance of PE-backed firms is stronger during a crisis period relative to "normal" times, it likely reflects the active management and support which PE can offer during a crisis period to alleviate the effects of the said crisis. If the outperformance is weaker, it may reflect PE investors' advantage in selecting strong investments ex ante. To do so, we rematch PE-backed and control firms using the same criteria, but over the period 2012 to 2018.[4] This sample allows us to study the performance of PE portfolio companies in the post-buyout period relative to the pre-buyout period, and relative to matched control firms, during a "normal" period in time, before the pandemic occurred. To save space, these results are provided in table 4 of the appendix.

During the pre-COVID years, the positive effect of PE on target firms is highly statistically significant, and large in terms of the economic magnitude. For example, in columns 1 and 2, the point estimates indicate an average increase in sales of over 40 percentage points in the post-buyout period compared to control firms, during the pre-COVID years. This is considerably greater in magnitude than the outperformance of sales during the pandemic period, which is found to be around 6 percentage points. The results for firm assets, employment, and earnings are similar. That is, we find that the outperformance of PE-backed firms is

[4] Full details on the matching, and the regression specification are provided in the appendix.

Table 3
Firm performance during the pandemic.

	Sales		Total assets		Employment		Earnings	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Baseline difference-in-differences								
PE*Post	0.056***	0.049**	0.107***	0.105***	0.077***	0.073***	0.061**	0.058**
	(0.021)	(0.022)	(0.027)	(0.026)	(0.022)	(0.022)	(0.022)	(0.025)
Panel B: Year-by-year effects								
PE*2017	−0.037*	−0.035	0.002	0.005	−0.031	−0.029	−0.004	−0.006
	(0.022)	(0.024)	(0.033)	(0.033)	(0.024)	(0.025)	(0.018)	(0.019)
PE*2018	−0.030	−0.26	−0.051	−0.050	−0.021	−0.022	−0.024	−0.025
	(0.025)	(0.025)	(0.032)	(0.033)	(0.019)	(0.019)	(0.020)	(0.021)
PE*2020	0.034***	0.032**	0.075***	0.075***	0.033**	0.031**	0.044**	0.042**
	(0.012)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)	(0.019)	(0.020)
PE*2021	0.059***	0.055***	0.108***	0.106***	0.068***	0.064**	0.062**	0.060**
	(0.014)	(0.015)	(0.028)	(0.027)	(0.028)	(0.028)	(0.033)	(0.034)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	16,511	16,511	17,430	17,430	15,739	15,739	14,505	14,505

We estimate all specifications using a difference-in-differences estimator. In panel A, we present the results from our baseline difference-in-differences model, Eq. (2). PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. In panel B, we show the estimates from regression equation (3), where we estimate a different β_k for each year between 2017 and 2021, using the pre-pandemic year, 2019, as the reference year. Standard errors, reported in the parentheses, are clustered at the firm-level. Even-numbered columns include firms controls which are taken in the pre-pandemic year, 2019, and are interacted with the Post dummy. These include firm age, size, leverage (debt divided by assets), return on assets, cash holdings scaled by assets, and sales growth. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

considerably greater in economic magnitude in the pre-pandemic period, relative to during the pandemic period. Taken together, the results of Table 4 in the appendix, and of Table 3, suggest that while PE-backed firms outperform matched industry peers during non-crisis years as well as during the crisis years of the pandemic, the relative outperformance in terms of operating performance is of a greater economic magnitude during non-crisis years. This suggests that at least some of the outperformance of PE-backed firms during the pandemic period may be due to investors' ex ante selection of target firms.

3.5. Robustness

We perform several robustness checks to ensure the validity of our baseline results. These results are described and presented in the online appendix.

4. Firm vulnerability and industry exposure to the pandemic

The impact of the pandemic was not homogeneous across all firms and industries. Firms naturally differ in their financial structure, balance sheet composition, and growth trajectory at any given moment in time. When the pandemic hit, some firms held large cash buffers, had little leverage, and had limited exposure to rollover risk. Given their consequent ability to finance an unexpected cash flow shortfall, these firms have increased financial flexibility (Fahlenbrach et al., 2021). On the other hand, firms with a higher degree of leverage and less cash holdings enjoy less flexibility, and unanticipated shocks to their cash flow can have more severe repercussions for their financial health. Indeed, Fahlenbrach et al. (2021) show that firms which had lower financial flexibility at the onset of the pandemic (i.e. firms with less cash and higher leverage) experienced weaker operating performance and lower stock returns compared to firms which had stronger balance sheets. Similarly, Campello et al. (2020) show that credit constrained firms (firms with lower cash holdings or firms with no credit lines to tap into) cut job postings by more than that of less constrained firms. Barry et al. (2022) provide evidence that greater workplace, investment, and financial flexibility helped to mitigate the impact of the pandemic on firms real activities.[5]

As for different industries, certain sectors were naturally more exposed to the pandemic and the resulting restrictions and lockdowns than others. There was a supply shock due to government-mandated lockdowns which caused production to fall for firms and industries which are dependent on workers being close to one other. At the same time there was a demand shock as demand fell for firms whose customers have to interact with the firm and its employees in-person (Papanikolaou and Schmidt, 2022; Fahlenbrach et al., 2021). Consequently, certain industries were far more exposed to the COVID-19 pandemic relative to others. Fahlenbrach et al. (2021) show that industries which were more exposed to lockdowns and the need for social distancing

[5] Ding et al. (2021) show that the pandemic-induced drop in stock returns was milder among firms with stronger pre-2020 finances (more cash and undrawn credit, less debt, and greater profits).

performed poorer during the pandemic, based on their stock returns and their operating performance. Likewise, Papanikolaou and Schmidt (2022) document evidence that industries where a higher fraction of the workforce could not work remotely experienced larger falls in employment and expected revenue growth, weaker stock market performance, and a higher probability of default.

With regards to the role of PE firms and their role in mitigating constraints during the pandemic period, PE firms may have focused their efforts on weaker firms and on those in more exposed industries, and the outperformance of PE-backed firms may be particularly strong amongst these companies. Indeed, Bernstein et al. (2019) find evidence consistent with this during the global financial crisis. They find that the positive impact of PE ownership on firm investment during the crisis is stronger in companies which were ex-ante more likely to be constrained. The authors note two primary channels through which PE investors can help to mitigate constraints during an economic downturn. Firstly, through providing further equity injections. Secondly, through easier access to debt markets given PE firms often enjoy strong ties with banks and other lenders (Ivashina and Kovner, 2011).

Alternatively, the nature of the crisis may have reduced the ability of PE firms to help the most vulnerable firms outperform in that they were unable to reverse the impact of the pandemic on firms. That is, they could not make halt the spread of the virus, or overturn lockdown decisions, and consequently re-introduce demand which had evaporated due to the spread of the pandemic. This contrasts with the global financial crisis, which was a credit crisis in nature, where PE firms were able to directly mitigate the primary effect of the crisis and help firms access credit, while other firms struggled to do so. In turn, these PE-backed firms could then outperform their peers (Bernstein et al., 2019). Moreover, the pandemic differed in that there was an unprecedented level of policy intervention, including furlough schemes, and various business loan schemes made available to businesses of all sizes. Given the widespread availability of government aid, this may have reduced the ability of PE investors to provide support additional to what other non-sponsored firms were able to access. This is in stark contrast to the global financial crisis, where lending to businesses and the availability of credit sharply contracted, and PE could step in to help portfolio firms. A more malevolent interpretation of this would be that PE firms may have "cut their losses" on their weakest or most exposed firms who they were unable to help outperform, and instead focused their attention on firms which they deemed to be more manageable and "treatable".

Our findings so far suggest that, on average, PE-backed firms outperformed closely matched control firms during the pandemic period. In this section, we now study whether PE firms were able to help the most exposed firms outperform matched peers during an exogenous shock with abundant policy intervention such as the COVID pandemic, or whether the outperformance is driven by firms which were in better health at the onset of the pandemic and in less-exposed industries. We do so using a wide range of measures of firm vulnerability and industry exposure to the pandemic.

4.1. Measures of firm vulnerability and industry exposure

We use nine measures of firm vulnerability. We first categorize firms as being more or less vulnerable on the basis of their growth trajectory when the exogenous pandemic shock occurred. First, we consider a firm to be more vulnerable if its one- or two-year growth in sales in 2019 is in the bottom quartile.[6] Firms which were already on a weaker growth trend in the pre-pandemic period are likely to have been even more impacted by the unanticipated, exogenous shock to demand and cash flow caused by the pandemic. Next, we do similar for growth in both firm EBITDA, and firm employment. We then classify firms as being more or less vulnerable on the basis of their level of financial flexibility, following Fahlenbrach et al. (2021). Specifically, we classify a firm as being more vulnerable if its ratio of cash over assets is in the bottom quartile of the distribution at the onset of the pandemic. Next, we consider firm leverage, and define a firm as being more vulnerable if its ratio of short term debt over total assets is in the top quartile. The intuition is that firms with greater cash reserves and less short-term debt have greater financial flexibility to finance an unanticipated shock to their cash flow. Lastly, we also use a measure of labor intensity, defined as the number of employees over total sales, as more labor intensive firms are more likely to have had a higher exposure to the pandemic (Fahlenbrach et al., 2021). In this case, we classify firms that are in the top quartile of labor intensity as being more vulnerable.

Next, we focus on the industry-level exposure to the pandemic. We use four measures of industry exposure. First, we follow the Office for National Statistics (ONS) definition for "high contact" industries which are more reliant on physical interaction and so were more adversely affected by the restrictions that were put in place. These are wholesale and retail; transportation and storage; accommodation and food services; arts, entertainment and recreation; and other services. Second, we follow Bloom et al. (2020) who use the UK Decision Maker Panel survey data to gauge the impact of the pandemic on UK firms. We categorize exposed industries as those in top five most affected in terms of the expected impact on their sales and employment from 2020Q2 to 2021Q1. These are: accommodation and food; administration and support; recreational services, construction, and other services. A concern may be that these first two definitions of exposure are too broad. We therefore use two further measures of industry exposure at a more granular level. First, we follow Koren and Pető (2020) who classify industries at the three-digit NAICS level based on how they are affected by social distancing. Following Fahlenbrach et al. (2021), exposed firms belong to industries in the top quartile of the affected share distribution in Koren and Pető (2020). Second, we use the manual classification of industries at the six-digit NAICS level in Fahlenbrach et al. (2021).[7] The authors manually review six-digit NAICS industries to eliminate industries where selling takes place online rather than in-person, as a three-digit NAICS industry could have businesses that are brick and mortar businesses or online businesses. These two types of businesses have very different exposures to the pandemic and the accompanying lockdowns and

[6] In unreported regressions we also use three-year growth rates. We also classify firms as being vulnerable if their one-, two-, or three-year growth in sales, EBITDA, or employment growth is negative in 2019. These results are very similar and are available upon request.

[7] We are extremely grateful to the authors for kindly sharing this classification with us.

Table 4
Firm vulnerability.

	Panel A: Sales								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	0.014	0.062	0.027*	−0.025	0.052	0.041	0.006	0.011	0.063
	(0.026)	(0.068)	(0.016)	(0.054)	(0.053)	(0.048)	(0.062)	(0.070)	(0.048)
Observations	3901	3713	3459	3324	3729	3650	3824	4121	3785
Vulnerable = 0									
PE*Post	0.103**	0.069**	0.079**	0.083***	0.072***	0.075**	0.065***	0.067***	0.048***
	(0.039)	(0.024)	(0.022)	(0.024)	(0.025)	(0.026)	(0.025)	(0.024)	(0.027)
Observations	11,968	11,330	10,744	10,215	11,115	10,872	12,687	12,390	11,346
	Panel B: Total assets								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	0.042	−0.014	0.049*	−0.018	0.035	0.033	0.011	0.052	0.080
	(0.055)	(0.059)	(0.031)	(0.054)	(0.045)	(0.046)	(0.059)	(0.062)	(0.064)
Observations	4002	3765	3597	3410	3835	3752	4053	4439	3938
Vulnerable = 0									
PE*Post	0.104***	0.118***	0.089***	0.149***	0.131***	0.129***	0.121***	0.130***	0.115***
	(0.031)	(0.030)	(0.032)	(0.031)	(0.032)	(0.031)	(0.029)	(0.031)	(0.032)
Observations	12,172	11,421	10,933	10,332	11,654	11,358	13,377	12,991	11,728
	Panel C: Employment								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	0.056	0.036	0.014	0.012	0.068*	0.006	0.019	0.032	0.086
	(0.046)	(0.061)	(0.039)	(0.045)	(0.044)	(0.053)	(0.058)	(0.052)	(0.059)
Observations	3422	3210	3209	3025	3790	3716	3507	3941	3896
Vulnerable = 0									
PE*Post	0.066***	0.073***	0.105***	0.109***	0.065***	0.092***	0.094***	0.090***	0.074***
	(0.024)	(0.022)	(0.024)	(0.023)	(0.022)	(0.021)	(0.022)	(0.024)	(0.022)
Observations	11,374	10,703	10,058	9541	11,536	11,268	12,232	11,798	11,580
	Panel D: Earnings								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	0.023	−0.022	0.016	−0.092	−0.038	−0.019	−0.035	0.016	0.027
	(0.019)	(0.049)	(0.069)	(0.079)	(0.083)	(0.092)	(0.083)	(0.091)	(0.084)
Observations	3233	3055	2922	2716	3091	3057	3321	3627	3098
Vulnerable = 0									
PE*Post	0.050**	0.057**	0.048*	0.068**	0.043**	0.041**	0.053**	0.062**	0.057*
	(0.022)	(0.019)	(0.020)	(0.026)	(0.014)	(0.017)	(0.020)	(0.017)	(0.036)
Observations	10,641	10,130	10,377	9891	9955	9732	11,184	10,878	10,134
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

We estimate all specifications using a difference-in-differences estimator. PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. In column 1, *Vulnerable* is a dummy variable equal to one if the one-year sales growth in 2019 is in the bottom quartile of the distribution, and in column 2 it is equal to one if the two-year sales growth in 2019 is in the bottom quartile. Columns 3 and 4 do likewise for EBITDA growth rates, while columns 5 and 6 do similar for the growth in the number of employees. In column 7, *Vulnerable* is equal to one if the firm is in the lowest quartile of cash holdings, as measured by the ratio of cash to total assets, in 2019. In column 8 it equals one where the firm is in the top quartile of the ratio of short term debt to total assets, while in column 9 it equals one where the firm is in the top quartile of labor intensity, as measured by the ratio of employees to sales. Standard errors, reported in the parentheses, are clustered at the firm-level. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

restrictions. As an example from Fahlenbrach et al. (2021), while the three-digit NAICS industry 454 may be classified as exposed, they reclassify the subindustry 454 110 "Electronic Shopping and Mail-Order Houses" as less exposed (e.g., Amazon.com is a member of that subindustry). Exposed firms are therefore part of the industries manually classified by Fahlenbrach et al. (2021) as having a greater exposure to the pandemic. Finally, given that the pandemic generated a sharp decrease in demand in many industries,

industries with a higher degree of leverage may have been more seriously affected. We therefore construct an industry-level index of financial leverage using a database of over 250,000 UK firms. We measure firm leverage as the ratio of total debt-to-total assets, and define a firm as being in an 'exposed' industry if it operates in an SIC two-digit industry which had a median leverage ratio in the top quartile in 2019, at the onset of the pandemic.

4.2. Results

We run Eq. (2) on subsamples of firms which are more and less vulnerable at the onset of the crisis, and firms which operate in more and less exposed industries. The results are shown in Table 4 and in Table 5. Firstly, in Table 4 we study firm-level vulnerability at the onset of the crisis. In panel A, we see that, across all nine measures of vulnerability, the positive impact of PE ownership on firm sales during the pandemic is stronger for firms which were in less vulnerable positions at the onset of the pandemic. The coefficients on the more vulnerable firms are largely insignificant, whereas the estimates on the sample of less vulnerable firms are strongly statistically significant suggesting that these firms significantly outperformed during the pandemic period. For example, in panel A, the outperformance of their sales during the pandemic period is found to be between 5 and 10 percentage points. This is consistent across a range of definitions of firm vulnerability, including pre-pandemic firm growth, financial flexibility, and labor intensity. In panels B to D, we observe similar results for firm assets, employment, and earnings. That is, the effect of PE ownership on firm performance during the pandemic is only statistically significant for companies that were ex-ante less likely to be constrained; i.e, firms with stronger pre-pandemic growth, firms which held larger cash buffers, firms with less short-term debt, and less labor-intensive firms. For example, in panel C where we look at firm employment, the coefficients on less vulnerable firms are positive and statistically significant at the 1% confidence level, implying their employment increases by over 6 percentage points, whereas the coefficients on more vulnerable firms are smaller in economic magnitude and statistically insignificant.

Moving to Table 5, we then study industry-level exposure to the pandemic. The results echo somewhat those in Table 4. That is, we find that the impact of PE ownership on firm performance during the pandemic is stronger on firms operating in less-exposed industries compared to those in more-exposed industries. For example, in panel A, the impact of being PE-owned on firm sales during the pandemic is largely statistically insignificant for firms in the most exposed industries. In contrast, the coefficients for firms in less exposed industries imply that they outperformed by approximately 5–7 percentage points. We observe similar results for firm assets, employment, and earnings in panels B to D. Firms in less exposed industries assets increased by over 10 percentage points, while the impact on firms in more exposed industries is statistically insignificant. Panels C and D show likewise for employment and earnings. PE ownership has a positive and strongly statistically significant impact on firms operating in less exposed industries employment and earnings, while the impact on firms in more exposed industries is found to be statistically insignificant. We also provide a parallel to the analysis, where we study industries which experienced an increase in demand during the pandemic, and were positively affected by the shock. In Table 5 of the appendix, we study the relative performance of PE-backed companies in positively-affected industries, using the manual classification of Fahlenbrach et al. (2021). We find some evidence that, in industries which were positively affected by the pandemic, PE-backed firms outperformed their peers.

Overall, the results of this section suggests that the impact of PE ownership on firm performance during the pandemic was not homogeneous across all firms. In particular, the positive effect of PE ownership on firm performance during the pandemic was stronger among firms which were less vulnerable when the shock occurred, and in firms which operate in industries which were less-exposed to the pandemic. The performance of more vulnerable PE-backed and control firms, or those in more exposed sectors, was very similar. This suggests that PE investors were less able to help the most vulnerable and exposed firms outperform during the pandemic, contrasting with the findings of Bernstein et al. (2019) during the global financial crisis. This may be a reflection of the nature of the shock itself. The financial crisis was characterized by firms being starved of credit, and PE firms, with their deep pockets and strong connections with banks, were able to fill this gap. During the pandemic, however, PE firms were less able to undo the immediate impact of the shock. That is, they were unable to reverse the government-mandated restrictions and lockdowns which hampered demand and consequently deteriorated firms' cash flow. An alternative take may be that PE firms may have cut their losses on firms in weaker positions, and focused their efforts on other firms which were less exposed to the immediate impact of the pandemic. We study this in the next section.

5. Did PE firms cut their losses on weaker firms?

5.1. Channels of growth and value-added

Having established results which indicate, on average, an outperformance of PE-backed firms during the pandemic, we next turn our attention to the potential channels and mechanisms through which the impact may work. That is, we ask what enabled PE-backed firms to outperform during the pandemic. Literature to date acknowledges three primary channels through which PE investors can help their portfolio companies: Operational engineering, governance engineering, and financial engineering (see for example Gompers et al. (2016), Hammer et al. (2017), Cohn et al. (2022) and Gryglewicz and Mayer (2023)). Operational engineering relates to actions such as reducing costs, making bolt-on acquisitions, expanding overseas and providing strategic guidance. Governance engineering includes making changes to the board or senior management, and helping to hire managers and directors. Lastly, financial engineering captures activity such as injecting further equity into companies, accessing other sources of liquidity, such as debt finance, and facilitating a high value exit. These various channels are, of course, not mutually exclusive from one another. Survey evidence from Gompers et al. (2016) concludes that investors create value from a combination of

Table 5
Industry exposure.

	Panel A: Sales				
	(1)	(2)	(3)	(4)	(5)
Exposed = 1					
PE*Post	0.037	−0.016	0.025*	−0.027	0.028
	(0.047)	(0.059)	(0.015)	(0.106)	(0.041)
Observations	3254	5066	1652	1879	4497
Exposed = 0					
PE*Post	0.061**	0.078***	0.045**	0.073***	0.065**
	(0.027)	(0.022)	(0.024)	(0.022)	(0.028)
Observations	13,257	11,445	14,859	14,632	12,014
	Panel B: Total assets				
	(1)	(2)	(3)	(4)	(5)
Exposed = 1					
PE*Post	0.059	0.010	0.079*	0.052	0.015
	(0.052)	(0.047)	(0.056)	(0.054)	(0.063)
Observations	3377	5353	1708	1943	4819
Exposed = 0					
PE*Post	0.119***	0.146***	0.089***	0.115***	0.142***
	(0.032)	(0.033)	(0.029)	(0.030)	(0.029)
Observations	14,053	12,077	15,722	15,487	12,611
	Panel C: Employment				
	(1)	(2)	(3)	(4)	(5)
Exposed = 1					
PE*Post	0.062*	0.057*	0.064	0.059	0.038
	(0.042)	(0.038)	(0.082)	(0.053)	(0.050)
Observations	3263	4899	1282	1875	4208
Exposed = 0					
PE*Post	0.131***	0.125***	0.149**	0.124**	0.091***
	(0.035)	(0.034)	(0.065)	(0.048)	(0.023)
Observations	12,476	10,840	14,457	13,864	11,531
	Panel C: Earnings				
	(1)	(2)	(3)	(4)	(5)
Exposed = 1					
PE*Post	−0.153	−0.070	0.029	−0.076	−0.004
	(0.094)	(0.073)	(0.041)	(0.127)	(0.069)
Observations	2889	4422	1549	1607	3939
Exposed = 0					
PE*Post	0.065**	0.052**	0.068**	0.047*	0.054**
	(0.023)	(0.019)	(0.029)	(0.028)	(0.017)
Observations	11,616	10,083	12,956	12,898	10,566
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

We estimate all specifications using a difference-in-differences estimator. PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. In column one, *Exposed* is a dummy variable equal to one if the firm operates in a high-contact industry in the UK, as defined by the Office for national Statistics (ONS) (see here). In columns 2, *Exposed* equals one if the firm operates in one of the top five most affected industries in terms of the change in sales and employment from 2020Q2 to 2021Q1 based on the UK Decision Maker Panel (DMP) data (see here). In column 3, *Exposed* firms belong to industries in the top quartile of the affected share distribution, where the affected share is as defined by Koren and Pető (2020). In column 4, *Exposed* equals one if the firm operates in an industry defined as exposed in the manual classification by Fahlenbrach et al. (2021). In column 5, *Exposed* equals one if the firm operates in an two-digit SIC industry which had median leverage (total debt divided by total assets) in the top quartile in 2019, at the onset of the pandemic. Standard errors, reported in the parentheses, are clustered at the firm-level. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

operational, governance, and financial engineering. Empirical evidence of PE buyouts in various countries supports this notion (see for example Boucly et al. (2011), Bernstein and Sheen (2016), Bernstein et al. (2019) and Wilson et al. (2022b)).

In this section, we look to empirically study the ways in which PE-backed companies were able to outperform industry peers during the pandemic. We focus on both operational and financial engineering measures.[8] We consider three types of operational engineering: reduction of costs, improved working capital, inventory and cash flow management, and stronger capital investment. Through the operational engineering channel, we would expect PE-backed firms to have more resilient levels of investment, better cash flow management, and potential reductions in their cost base relative to control firms (Boucly et al., 2011; Gompers et al., 2016, 2022). As for channels of financial engineering, we examine both debt and equity financing. PE firms can often inject further equity into portfolio companies to helps resolve any distress concerns (Bernstein et al., 2019; Hotchkiss et al., 2021). Similarly, portfolio firms can raise debt finance as source of liquidity during downturns (Bernstein et al., 2019; Gompers et al., 2022). It is well-documented that PE investors have strong ties with banks, which they may be able to leverage during downturns (Ivashina and Kovner, 2011). We track both equity and debt financing of companies from before to after the pandemic period.

To examine the mechanisms through which PE portfolio companies may be outperforming their peers, we use a similar DiD model as in Eq. (2). To capture operational engineering, we use three measures. First, following Boucly et al. (2011), we measure cost reduction as the ratio of intermediate inputs to sales, where intermediate inputs are measured as the cost of sales plus administration expenses, less remuneration. A negative coefficient would suggest that PE-backed firms cut costs more aggressively than their peers during the pandemic. Secondly, we study firms working capital, inventory, and cash flow management. To do so, we examine firms' cash conversion cycle (CCC). The CCC combines the cycles of inventories, accounts receivable, and accounts payable and refers to the time elapsed from the moment the firm pays for its inputs to the moment it receives payment for the goods it sells. It is a widely used metric to assess the effectiveness of a firm's management and the liquidity needed for external financing (Wang, 2019). In particular, a lower CCC implies a firm is better able to manage its working capital and is in a better liquidity position. A higher CCC suggests that firms have to wait longer before they can receive cash from their sales and therefore have a higher need for external financing for their working capital (Raddatz, 2006; Tong and Wei, 2011). Lastly, we study firm investment during the pandemic, where investment is defined as the change in fixed assets plus any depreciation for the year, and is scaled by assets (Bernstein et al., 2019). Where financial engineering is concerned, we study both equity and debt financing.

Following Bernstein et al. (2019) and Haque et al. (2022) we define equity financing as the change in book value of equity, less profit, and scale by assets. Debt issuance is the change in total debt, and is scaled by assets. We also include a variable called "charge on assets". This comes from the FAME database and is a dummy variable equal to one where there is a charge placed against a firms' assets in a given year, and zero otherwise. We can observe in FAME when there is a charge placed on the assets of a company, which is indicative of some form of lending. The data contains the names of the bank(s) (chargeholders) that have secured loans (charges) against each firm at a given point in time. According to Companies House, a charge is defined as the security, such as land, property or financial instruments a company provides as collateral for a loan. We observe the lender, and whether the charge has been settled, but not the loan amount or the interest rate paid on the loan. Under the financial engineering mechanism, we would expect that the debt and equity issuance of PE-backed firms is more resilient during the pandemic compared to their nonsponsored peers.

5.1.1. Results

Table 6 presents the results for both operational and financial engineering channels. Panel A shows the baseline difference-in-differences estimate of Eq. (2), while panel B shows the year effects estimates of Eq. (3). Columns 1 to 3 cover the three operational mechanisms while columns 4 and 5 show the financial engineering measures. In columns 1 to 3 of panel A, we find weak evidence of PE firms adding value via operational measures during the pandemic. In column 1, we find that cost reduction in PE-backed firms was not significantly different from control firms during the pandemic. In column 2, we observe that PE-backed firms experienced a drop in their cash flow conversion cycle relative to control firms, suggesting they had more efficient management of their inventory, cash and working capital cycle during the pandemic. In particular, PE-backed firms' cash conversion cycle fell by around 6 percentage points compared to control firms, albeit the estimate is only statistically significant at the 10% level. Lastly, we ask if the outperformance during the pandemic can be explained by stronger levels of capital investment. The point estimate in column 3 implies that PE-backed firms' investment fell by around two percentage points less than that of control firms during the pandemic, but, again, the estimate is only weakly statistically significant.

We then move to the financial engineering channel where we study firms' equity and debt issuance. We find that both equity and debt issuance were significantly higher for PE-backed firms during the pandemic relative to control firms. The estimates in columns 4 and 5 of panel A indicate that the impact on debt issuance was around twice the size of that of equity issuance in terms of its economic magnitude. Specifically, the results imply that PE-backed firms' debt issuance was around two percentage points stronger than that of the control group. Bernstein et al. (2019) find that, while on average, debt issuance declined during the

[8] We do not consider governance engineering measures for several reasons. The primary reason is due to data availability. We are only able to observe the appointment of directors to the board, but do not observe the often informal hiring of interim managers (from the PE firms pool of experienced and specialist managers), which is sometimes on a consultancy-type basis. In interviews with several UK PE GPs, investors spoke of managers they used across several of their portfolio companies who came in for a short period of time to help affected companies. These were not formal appointments of directors, so such actions are difficult to observe as data points. This is reflected in Gompers et al. (2016) where they speak of the introduction of "shared" services where PE investors can help several of their companies simultaneously. Moreover, Gompers et al. (2022) document evidence that operational and financial engineering were considerably more prevalent as sources of value during the pandemic compared to governance engineering.

Table 6
Channels of growth and value added.

	Operational engineering			Financial engineering		
	Int. inputs/sales (1)	CCC (2)	Investment (3)	Equity issuance (4)	Debt issuance (5)	Charge on assets (6)
Panel A: Baseline difference-in-differences						
PE*Post	−0.014	−0.063*	0.021*	0.009**	0.018***	0.030**
	(0.009)	(0.038)	(0.013)	(0.004)	(0.006)	(0.014)
Panel B: Year-by-year effects						
PE*2017	−0.001	−0.024	−0.005	−0.004	−0.003	−0.032
	(0.008)	(0.027)	(0.009)	(0.005)	(0.004)	(0.008)
PE*2018	0.003	0.003	−0.002	−0.001	−0.008	0.012
	(0.009)	(0.022)	(0.010)	(0.004)	(0.010)	(0.009)
PE*2020	−0.017*	−0.006	0.019*	0.010**	0.016**	0.022**
	(0.009)	(0.019)	(0.010)	(0.003)	(0.006)	(0.010)
PE*2021	−0.005	−0.060**	0.014	0.004**	0.006*	0.039**
	(0.006)	(0.025)	(0.010)	(0.001)	(0.003)	(0.013)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,987	7077	15,524	16,549	17,427	18,268

We estimate all specifications using a difference-in-differences estimator. In panel A, we present the results from our baseline difference-in-differences model, Eq. (2). PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. In panel B, we show the estimates from regression Eq. (3), where we estimate a different β_k for each year between 2017 and 2021, using the pre-pandemic year, 2019, as the reference year. Standard errors, reported in the parentheses, are clustered at the firm-level. Even-numbered columns include firms controls which are taken in the pre-pandemic year, 2019, and are interacted with the Post dummy. These include firm age, size, leverage (debt divided by assets), return on assets, cash holdings scaled by assets, and sales growth. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

2008 financial crisis, this decline was 4% smaller for PE-backed firms relative to control firms. Our estimates imply similar results during the COVID-19 pandemic, albeit of a smaller economic magnitude. The results concerning equity issuance are consistent with those of Haque et al. (2022) in the US. The coefficient suggests that PE-backed firms' equity issuance was around one percentage point higher during the pandemic. What is more, the estimate in column 6 suggests that PE-backed firms were significantly more likely to have charges placed against their assets during the pandemic period compared to control firms, which similarly indicates stronger access to external credit. Overall, our results concerning the financial engineering mechanism reflect the survey evidence in Gompers et al. (2022), where PE investors highlight the importance of accessing debt financing more so than further equity injections as a means of helping companies during the pandemic. They find that accessing debt was more prevalent as a means of helping companies compared to further equity infusions during the pandemic. Our empirical evidence supports this notion. In summary, we find evidence suggesting that financial engineering played an important role for PE-backed firms during the pandemic period.[9]

5.1.2. Firm vulnerability and industry exposure

Having found evidence suggesting that the outperformance of PE-backed firms during the pandemic was driven by firms which were less vulnerable to the downturn and which operated in less exposed industries, and having observed that the primary observable channel of value-added from PE investors during the pandemic was via financial engineering (both debt and equity issuance), we now study whether or not the financial engineering mechanism was more or less prominent across different types of PE portfolio firms.

The results are presented in Tables 7 and 8. First, in Table 7, we study whether the financial engineering channel differed across firms which were more and less vulnerable at the onset of the pandemic. In panel A we study equity issuance, and in panel B we consider debt issuance. Across both debt and equity issuance, the results are striking. The estimates imply that the positive impact of PE ownership on equity and debt issuance during the pandemic is stronger for firms which were in less vulnerable positions at the onset of the pandemic. Where more vulnerable firms are concerned, they do not outperform closely matched peers in terms of their access to external financing during the pandemic. The coefficients on more vulnerable firms are insignificant, whereas the estimates on the sample of less vulnerable firms are strongly statistically significant suggesting that these firms' debt and equity issuance was considerably higher compared to closely matched control firms during the pandemic period. The point estimates suggest that less vulnerable firms equity issuance was approximately 1.1 to 1.4 percentage points higher during the pandemic, while their debt issuance was around 1.3 to 1.9 percentage points higher. This is consistent across our nine definitions of firm vulnerability, which include weaker pre-pandemic firm growth, less financial flexibility, and a higher labor intensity.

[9] In Table 6 of the appendix, we also exploit the cross-section of PE sponsors, and show that access to debt financing appears to have been stronger for portfolio companies backed by more reputable PE sponsors. This is consistent with the relationship and reputation stories in Demiroglu and James (2010) and Ivashina and Kovner (2011), and with the renegotiation channel proposed by Haque and Kleymenova (2023).

Table 7
Firm vulnerability: financial engineering.

	Panel A: Equity issuance								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	−0.006	−0.002	−0.003	−0.002	0.004	0.001	−0.010	−0.001	0.014*
	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.007)	(0.008)
Observations	3874	3676	3458	3319	3709	3647	3847	4122	3704
Vulnerable = 0									
PE*Post	0.012***	0.013***	0.011**	0.011**	0.012**	0.013***	0.014***	0.011**	0.012**
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Observations	11,766	11,190	10,618	10,140	11,090	10,868	11,748	12,426	11,191
	Panel B: Debt issuance								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	0.008	−0.001	0.025	0.007	0.009	0.011	0.022	0.026*	0.016
	(0.016)	(0.017)	(0.017)	(0.016)	(0.016)	(0.015)	(0.016)	(0.015)	(0.014)
Observations	4031	3765	3597	3410	3835	3751	4053	4313	3937
Vulnerable = 0									
PE*Post	0.018**	0.019***	0.013**	0.017**	0.015**	0.013*	0.014**	0.017***	0.015**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Observations	12,143	11,421	10,933	10,332	11,653	11,358	12,376	13,112	11,728
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

We estimate all specifications using a difference-in-differences estimator. PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. In column 1, *Vulnerable* is a dummy variable equal to one if the one-year sales growth in 2019 is in the bottom quartile of the distribution, and in column 2 it is equal to one if the two-year sales growth in 2019 is in the bottom quartile. Columns 3 and 4 do likewise for EBITDA growth rates, while columns 5 and 6 do similar for the growth in the number of employees. In column 7, *Vulnerable* is equal to one if the firm is in the lowest quartile of cash holdings, as measured by the ratio of cash to total assets, in 2019. In column 8 it equals one where the firm is in the top quartile of the ratio of short term debt to total assets, while in column 9 it equals one where the firm is in the top quartile of labor intensity, as measured by the ratio of employees to sales. Standard errors, reported in the parentheses, are clustered at the firm-level. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

We find similar results in Table 8. That is, the effect of PE ownership on debt and equity issuance seems to be stronger among firms in industries less exposed to the pandemic. In panel A, the impact of being PE-owned on equity issuance during the pandemic is statistically insignificant for firms in the most exposed industries, relative to matched controls, implying their access to external financing during the pandemic was similar. In contrast, the coefficients for firms in less exposed industries imply that they outperformed by approximately one percentage point. We observe similar results for debt issuance in panel B. Debt issuance of firms in less exposed industries was around two percentage points higher.

5.2. COVID loan analysis

The systemic nature of the pandemic shock precipitated Government intervention to support businesses and a range of support schemes to mitigate against the impacts of COVID-19. A policy tool used in the COVID-19 pandemic was the Loan Guarantee Scheme. Loan Guarantee schemes are policy instruments that address the imperfections in the market for finance, particularly for smaller firms. In the case of COVID business loans, the UK government extended the existing Loan Guarantee Scheme encouraging the banking sector to advance loans to businesses with the government (British Business Bank) acting as a guarantor in the event of default. In total the government guaranteed more than £80bn of loans and over one million UK limited companies received some form of bank loan, guaranteed by the government, during the pandemic period.

In Table 9 we present summary statistics on COVID-19 loan activity across our samples of PE-backed and controls firms, as well as comparing to the general population of all UK limited companies. Panel A shows loan activity across all companies and we can see that PE-owned firms were very active in obtaining COVID loans, and considerably more so than the control group. Almost a quarter of the PE sample obtained some form of loan, whilst only 15% of control firms did so. This reflects our previous findings in Table 6, that PE-backed firms were more engaged in accessing financing during the pandemic. The repayment rate on loans for both samples is very similar, while PE-owned firms have a higher default rate, albeit the number of defaults in the sample is very low (only ten in total).

In panel B, we observe the loan terms. PE-backed firms appear to have secured larger cheque sizes, with an average loan size of £1.8 m versus an average of £1.1 m for the control group. This difference in means is strongly statistically significant. The loan term and interest rate charged are very similar across both groups of firms. In summary, PE-owned firms appear to have been slightly more active in accessing COVID loans, and secured larger cheque sizes, on average.

Table 8
Industry exposure: financial engineering.

	Panel A: Equity issuance				
	(1)	(2)	(3)	(4)	(5)
Exposed = 1					
PE*Post	0.010	0.007	−0.011	−0.005	0.003
	(0.009)	(0.008)	(0.015)	(0.012)	(0.007)
Observations	3211	5075	1630	1861	4580
Exposed = 0					
PE*Post	0.009**	0.008*	0.010**	0.010**	0.010**
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	13,338	11,474	14,919	14,688	11,969
	Panel B: Debt issuance				
	(1)	(2)	(3)	(4)	(5)
Exposed = 1					
PE*Post	0.028**	0.010	−0.004	0.025*	0.018
	(0.014)	(0.013)	(0.020)	(0.016)	(0.014)
Observations	3377	5353	1708	1942	4652
Exposed = 0					
PE*Post	0.016**	0.021***	0.020***	0.016**	0.015**
	(0.007)	(0.008)	(0.007)	(0.007)	(0.006)
Observations	14,050	12,074	15,719	15,485	12,306
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

We estimate all specifications using a difference-in-differences estimator. PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. In column one, *Exposed* is a dummy variable equal to one if the firm operates in a high-contact industry in the UK, as defined by the Office for national Statistics (ONS) (see here). In columns 2, *Exposed* equals one if the firm operates in one of the top five most affected industries in terms of the change in sales and employment from 2020Q2 to 2021Q1 based on the UK Decision Maker Panel (DMP) data (see here). In column 3, *Exposed* firms belong to industries in the top quartile of the affected share distribution, where the affected share is as defined by Koren and Pető (2020). In column 4, *Exposed* equals one if the firm operates in an industry defined as exposed in the manual classification by Fahlenbrach et al. (2021). In column 5, *Exposed* equals one if the firm operates in an two-digit SIC industry which had median leverage (total debt divided by total assets) in the top quartile in 2019, at the onset of the pandemic. Standard errors, reported in the parentheses, are clustered at the firm-level. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

Table 9
COVID-19 loan statistics.

Panel A: Loan activity						
	PE-backed		Control		All limited companies	
	(N)	(%)	(N)	(%)	(N)	(%)
Obtained a loan	198	23.9	436	15.4	1,106,861	na
Repayment rate	74	37.4	161	36.9	156,660	14.2
Default rate	6	3.0	4	0.9	189,624	17.1

Panel B: Loan terms				
	PE-backed mean (1)	Control mean (2)	Difference in means (3)	All limited companies mean (4)
Loan amount (£000)	1795	1083	0.01	57
Loan term (months)	57	59	0.24	82
Interest rate (%)	4.57	4.51	0.25	2.78

The table reports the loan terms on the COVID-19 loans granted to PE-backed firms, matched control firms, and the entire population of UK limited companies which were granted a loan through the Loan Guarantee Scheme. Panel A shows statistics on loan activity, and panel B shows statistics on loan terms Column 3 in panel B reports the *p*-value from a t-test of means between the PE-backed and control group samples. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

Table 10
The probability of financial distress during the pandemic.

Panel A: Firm vulnerability									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Vulnerable = 1									
PE*Post	0.009**	0.010**	0.009**	0.016***	0.015**	0.013**	0.010**	0.018***	0.020***
	(0.003)	(0.003)	(0.004)	(0.006)	(0.007)	(0.006)	(0.004)	(0.006)	(0.007)
Observations	4250	3940	3780	3565	4035	3932	4290	4567	4123
Vulnerable = 0									
PE*Post	0.007	0.008*	0.004*	0.003	0.004*	0.005*	0.006*	0.004	0.002
	(0.005)	(0.005)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Observations	12,615	11,825	11,300	10,660	12,092	11,740	12,290	13,698	12,275
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Industry exposure				
	(1)	(2)	(3)	(4)
Exposed = 1				
PE*Post	0.031***	0.024***	0.041***	0.032***
	(0.010)	(0.007)	(0.015)	(0.011)
Observations	3515	5615	1760	2488
Exposed = 0				
PE*Post	0.002	0.002	0.003	0.002
	(0.003)	(0.002)	(0.002)	(0.003)
Observations	14,753	12,653	16,508	15,780
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes

We estimate all specifications using a difference-in-differences estimator. PE_i is a dummy variable that equals one for PE-backed companies, and zero for the control group. $Post_t$ is a dummy variable that equals one for observations during the pandemic period of 2020 to 2021, and 0 in the pre-pandemic years of 2017 to 2019. The dependent variable is a dummy variable equal to one if a firm files for insolvency in that year, and zero otherwise. Panel A consider nine measures of firm vulnerability. In column 1, *Vulnerable* is a dummy variable equal to one if the one-year sales growth in 2019 is in the bottom quartile of the distribution, and in column 2 it is equal to one if the two-year sales growth in 2019 is in the bottom quartile. Columns 3 to 4, and 5 to 6 do likewise for EBITDA and employment growth rates. In column 7, *Vulnerable* is equal to one if the firm is in the lowest quartile of cash-to-assets in 2019. In column 8 it equals one where the firm is in the top quartile of the ratio of short term debt to total assets, while in column 9 it equals one where the firm is in the top quartile of labor intensity, as measured by the ratio of employees to sales. Panel B considers four measures of industry exposure to the pandemic. In column one, *Exposed* is a dummy variable equal to one if the firm operates in a high-contact industry in the UK, as defined by the Office for national Statistics (ONS) (see here). In columns 2, *Exposed* equals one if the firm operates in one of the top five most affected industries in terms of the change in sales and employment from 2020Q2 to 2021Q1 based on the UK Decision Maker Panel (DMP) data (see here). In column 3, *Exposed* firms belong to industries in the top quartile of the affected share distribution, where the affected share is as defined by Koren and Pető (2020). In column 4, *Exposed* equals one if the firm operates in an industry defined as exposed in the manual classification by Fahlenbrach et al. (2021). All specifications include firms controls which are taken in the pre-pandemic year, 2019, and are interacted with the Post dummy. These include firm age, size, leverage (debt divided by assets), return on assets, cash holdings scaled by assets, and sales growth. Standard errors, reported in the parentheses, are clustered at the firm-level. *** denotes statistical significance at the 1% level, ** denotes the 5% level, and * denotes the 10% level.

5.3. Financial distress

In the final section of our empirical analysis, we study incidence of financial distress during the pandemic. To do so, we use data on all historical UK company insolvency filings at Companies House and formal notices in the London/Edinburgh Gazettes. This includes company filings for administration, receivership, company voluntary arrangements (CVA), and liquidations. Administration involves handing over the control of the firms to an Insolvency Practitioner who will attempt to restructure a business, with the aim of either turning it into a profitable company or effecting a sale of the business to preserve some value and employment. A CVA sets out a plan for the repayment of the company's outstanding debts and occurs where creditors take action to recover debt. It typically involves minimal court involvement and allows directors to retain control of the business. A company has the option to continue trading whilst under a CVA or cease trading — the decision depends on the company's situation and its creditors. Thus the firms' management have been pro-active to retain control, under the supervision of an independent insolvency practitioner, and enter into an agreement with creditors to pay some or all outstanding debts over a specified period. In this case the firm may recover from the insolvency and continue to trade. Lastly, liquidation is the end stage of a company whereby the assets are sold and proceeds distributed to creditors. This rich data set allows us to identify when a company in our data set files for insolvency, and what type of filing they use. We can then study whether the probability of PE-backed firms filing for insolvency increases or decreases during the pandemic period relative to closely matched non-PE-backed firms.

Table 11
Insolvencies during the COVID-19 pandemic.

	PE	Control
Panel A: Total insolvencies		
Total firms	828	2825
Insolvencies during the pandemic	16	15
Insolvency %	1.9%	0.5%
Panel B: Firm vulnerability definitions		
Bottom quartile one-year sales growth	5	3
Bottom quartile two-year sales growth	5	3
Bottom quartile one-year EBITDA growth	3	4
Bottom quartile two-year EBITDA growth	6	2
Bottom quartile one-year employment growth	7	5
Bottom quartile two-year employment growth	6	5
Bottom quartile cash holdings	6	3
Top quartile short-term debt/assets	8	2
Top quartile labor intensity	10	3
Panel C: Industry exposure definitions		
ONS high-contact industries	11	4
Bloom et al. (2020) DMP most affected	12	5
Koren and Pető (2020) affected share top quartile	8	1
Fahlenbrach et al. (2021) manual classification	9	2
Panel D: Insolvency type		
Administration	7 (44%)	10 (67%)
Company Voluntary Arrangement	9 (56%)	1 (7%)
Liquidation	0 (0%)	4 (27%)

The below table shows the number and types of insolvencies in our sample of PE-backed and matched non-PE-backed firms.

To formally test whether PE-backed firms were more susceptible to filing for insolvency during the pandemic period relative to matched control firms, we estimate the following equation, where the dependent variable, $Insolvency_{it}$, is a dummy variable equaling one if a company files for insolvency in a given year, and zero otherwise:

$$Prob(Insolvency_{it} > 0) = \alpha_t + \alpha_i + \beta_1(PE_i * Post_t) + \varepsilon_{it} \quad (4)$$

Table 10 shows estimates from treated-control linear probability estimations on the likelihood of filing for distress during the pandemic period. As before, we estimate the equation on subsamples of firms which were more and less vulnerable at the onset of the crisis (panel A), and which operate in industries which were more or less exposed to the pandemic (panel B).

The probability of PE-backed firms entering into distress during the pandemic appears to be driven by firms which were more vulnerable at the onset of the pandemic, whereby they had weaker growth, less financial flexibility, or more short-term debt, and by firms which operate in industries which were more exposed to the consequences of the pandemic. Incidence of financial distress appears to be driven by these subsets of PE-backed firms. In panel A, the coefficient on the $PE_i * Post_t$ variable is positive and strongly statistically significant in each specification for the sample of more vulnerable firms, suggesting that PE-backed firms which were vulnerable at the onset of the shock were significantly more likely to enter into insolvency during the pandemic compared to nonsponsored firms. The effect is economically significant. The probability of more vulnerable PE-backed firms entering into insolvency increases by around 1 to 2 percentage points in the pandemic period relative to control firms. When we categorize firms based on their industry exposure in panel B, we see similar results. The positive impact of PE ownership on financial distress is concentrated in firms operating in industries which were more exposed to the pandemic. In panels B and C of Table 11 we show the distribution of distressed firms across our measures of vulnerability and exposure. Unsurprisingly, relatively more PE-backed firms which file for insolvency are more vulnerable at the onset of the pandemic, and are in more exposed industries.

However, we find differences in the restructuring of distressed firms between both samples of firms. Panel D of Table 11 details the type of insolvency filings across both PE-backed and control firms. No PE-backed firms in the sample which file for insolvency are liquidated, while over half secure a CVA, suggesting that PE investors are proactive in negotiating with creditors to keep distressed portfolio companies trading relative to other owners, as discussed earlier. This is consistent with recent evidence on the insolvency risk and restructuring of PE-backed firms in distress (Wilson and Wright, 2013; Hotchkiss et al., 2021). Hartman-Glaser et al. (2023) show that firms with better access to equity financing, i.e., PE-backed firms, obtain more cash flow-based financing and are less likely to be liquidated. In distress, these firms are continued as going-concern, akin to Chapter 11 bankruptcy. Hotchkiss et al. (2021) find that, while PE-backed firms default at higher rates than other companies borrowing in leveraged loan markets, they restructure faster, avoid bankruptcy court more often, and liquidate less often compared to other firms in distress. The authors conclude that while PE-backed firms may be more likely to default, PE investors appear to manage financial distress at a lower cost. Our findings are consistent with this, and show evidence of this in action during a real economic crisis.

In summary, our analyses suggest that, while, on average, PE-backed firms outperformed closely matched industry peers during the COVID-19 pandemic, the most vulnerable and exposed firms did not. These firms appear to have been less active in obtaining

additional financing during the pandemic, and consequently, suffered a significantly higher incidence of distress. However, distressed PE-backed firms were more likely to restructure out of court and with their owners keeping control, relative to other firms.

6. Conclusion

In this paper, we investigate the performance of PE portfolio companies during the recent COVID-19 pandemic. While we find that, on average, PE-backed firms outperformed closely matched industry peers during the pandemic period, the magnitude of outperformance is lower than that during the benign pre-pandemic period. Moreover, the positive impact of PE ownership on firm performance during the pandemic appears to have been stronger among firms which were less vulnerable and exposed to the pandemic. Firms which had lower growth, fewer cash holdings, and more short-term debt in the pre-pandemic period, and firms which operated in industries more exposed to the consequences of the pandemic, did not outperform. This supports the notion that the outperformance was less related to support provided to vulnerable firms during a crisis period, and more reflective of PE investors' selection of target firms.

The findings provide a significant new perspective on the potential reactions of private equity investors to a substantial and unexpected event such as the COVID-19 pandemic. Unlike the global financial crisis which was characterized by credit markets freezing and businesses struggling to access finance, and where PE investors could reverse the main impact of the shock on the most constrained firms by facilitating this access (Bernstein et al., 2019), the COVID-19 pandemic resulted in an abrupt drop in demand for certain goods and services, and wholesale changes to how businesses were allowed to operate. PE investors, despite their strategic know-how, their deep pockets, and their wide networks of consultants, banks, and operating partners, were restricted in their ability to reverse the most severe consequences of the pandemic, such as government-mandated lockdowns, social distancing measures, and demand in certain industries drying up. Consequently, the outperformance of PE targets was lower than that during non-crisis periods, and PE investors were less able to aid the most severely-affected firms outperform during the pandemic period. This suggests that the outperformance of PE-backed firms may have been driven by PE investors' ex ante selection of target firms, more so than support mechanisms provided to firms in need.

CRediT authorship contribution statement

Paul Lavery: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Nick Wilson:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jcorpfin.2024.102641.

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