Private Equity in a Crisis: Evidence from the COVID-19 Pandemic *

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Abstract

Starting in March 2020, the COVID-19 pandemic caused a large unexpected negative shock to many firms and industries. We find that private equity(PE)-backed Swedish firms experienced a relative increase in investment, received more credit and equity inflow, and were more likely to receive government support in the year 2020 than comparable firms. Moreover, the impact of private equity is even more substantial among firms facing severe financial constraints. These findings are consistent with previous work studying the 2008 financial crisis, which indicates private equity helps target firms address financial fragility during the crisis.

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1 Introduction

The spillover of COVID-19 has brought damage to the world and evolved into global public health and economic crisis. According to the World bank's [1] calculation, the world's GDP in 2020 decreased 3.59% compared to the data in 2019. The impacts of the pandemic are widespread and have caused a series of negative effect on the labor market, global trade, investment, and credit market, which lead companies to face severe financial constraints.

Studies of firms' activity during the 2008 financial crisis suggest that a high level of corporate debt maturing right after the third quarter of 2007 prevented firms from raising investment which aggravated the recession (Almeida, Campello, Laranjeira and Weisbenner, 2012). Although the economic crisis caused by the pandemic did not originate from the financial system, the availability of financing sources still is relevant for now severely firms were hit by the COVID-19 shock. The usage of leverage financing as an integral part of private equity ownership (Kaplan and Strömberg, 2009, Axelson, Jenkinson, Strömberg and Weisbach, 2013) raises our interest in exploring the behavior of private equity (PE)-backed companies and the role of private equity plays in handling the crisis during the 2020 pandemic.

Instead of rising risk of financial distress, previous studies have found that private equity plays a stabilizing role during bad times to help firms receive greater debt and equity inflow than their peer firms during the 2008 financial crisis without increasing firm leverage and financing cost (Bernstein, Lerner and Mezzanotti, 2019, Hotchkiss, Smith and Strömberg, 2021). Motivated by these results, we investigate the reaction of PE-backed and non-PE-backed firms during this new global crisis caused by the pandemic. We focus on Swedish firms' financial decisions and performance in the first year of the pandemic and explore how private equity influences target firms during economic downturns. The availability of detailed financial data on private firms and large PE industry makes it a suitable environment to study this question.

Our main analysis focuses on a test sample including 113 Swedish firms that have undergone a leveraged buyout before 2020 and for which we have financial data for 2020. Using a difference-in-difference (DiD) model, we explore the fi-

[1] World bank databank https://databank.worldbank.org/home.aspx

nancial decisions and performance of the PE-backed firms before and during the pandemic compared with a group of comparable peers. The firms in the control group are selected according to the industry that PE-backed firms belong to and had similar size, profitability, and leverage in 2019.[2] The control group have a similar pre-pandemic trend to target firms that satisfy the requirement of DiD model and allow us to investigate the difference brought by private equity interacting with the pandemic.

The main results show that PE-backed firms' investment increased during the pandemic while firms in the control group experienced an average decrease in investment. The effect of private equity on target firms is significant and causes around 15% higher investment for PE-backed firms. We then find that higher access to external finance can explain the relatively higher investment to PE-backed firms. Specifically, the debt issuance over assets of PE-backed firms is 10% higher, and equity injections over assets is 3% higher than control firms. These differences are only statistically significant during the pandemic.

To investigate more about private equity's impact on relaxing financial constraints, we divide firms into two groups based on business size, firm leverage, dependency on external finance (Rajan and Zingales, 1998), and average industry performance during the pandemic. We find that the positive effect of private equity on relaxing financial constraints is more significant among small firms and firms with higher leverage. Firms that depend more on external finance and experienced more severe shocks during the pandemic also experienced a stronger effect from private equity ownership.

We also explore the performance of PE-backed firms during the pandemic. We find that private equity helps firms grow their assets but do not improve profitability. We also find PE-backed firms are more generous in providing with customers with credit during the pandemic than firms in the control group.

Finally, we investigate PE-backed firms' willingness to take advantage of government support program. We find that firms with private equity backing are more likely to receive government support and use it to supplement equity injections compared to control firms.

[2]The methodology comes from Bernstein, Lerner and Mezzanotti (2019) and is originally from Boucly, Sraer and Thesmar (2011), we will discuss the details in section 4.

In summary, our results indicate that private equity investors help target firms to relax financial constraints caused by the economic downturn and maintain a high-level investment during the pandemic. This paper provides first a glance at the negative impact the pandemic brings to Swedish firms. The study on the effect of private equity relates to the research of financial institutions' behavior during the pandemic. It also contributes to the effect of private equity ownership on firm outcomes.

2 Impact of COVID-19 on the Swedish economy

The COVID-19 pandemic caused Sweden's GDP to fall by around 8.3% in the second quarter of 2020. With a 5% rebound in Q3 2020 and a slight decrease in Q4 2020, Swedish GDP in 2020 contracted by -2.8%. According to Statistics Sweden's production value index[3], production in the business sector as a whole decreased by around 9% in Q2 2020 compared to Q2 2019, with the drop in manufacturing (-15.9%) and service (-8.9%) being particularly large. In addition, the NIER's [4] surveys asking firms how their sales compare to a normal situation showed that sales in much of the business sector were much lower than normal in Q2, especially in manufacturing and services.

Although Sweden's lock-down measures were less coercive than in other countries, the labor market was unavoidably affected by the pandemic, which led the unemployment rate to climb to a high point of 9.1% in September 2020. The employment experienced a short rebound in the autumn but stopped growing in Q4 because of more strict restrictions with an 8.3% unemployment rate at the end of 2020.

Unlike other EU26 members, Sweden is one of a few countries that experienced a dramatic increase in FDI in 2020. According to recent statistics [5], foreign direct investment in Sweden tentatively amounted to $26 billion, which is more than a doubling from $10 billion the year before and well above the annual average level of 2001 to 2020, much due to the U.S. MNEs injecting loans in their affiliates in

[3]Statistics Sweden, Production value index. http://www.scb.se/nv0006-en
[4]Konjunkturinstitutet, statistical database http://statistik.konj.se/PXWeb/pxweb/en/KonjBar
[5]Statistics Sweden, The National Institute of Economic Research , Business Sweden (2021)

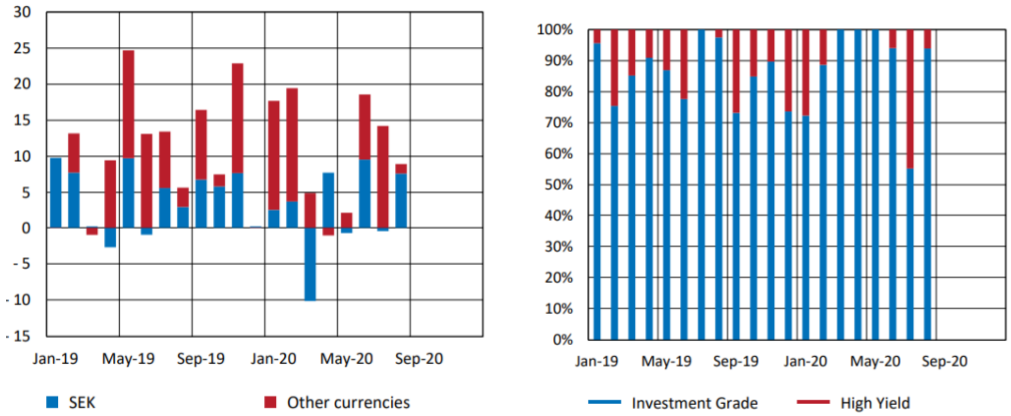
Sweden (UNCTAD, 2021). However, the enterprise investment of Swedish companies decreased in 2020 compared with 2019. Total investments decreased by SEK 35.7 billion, which corresponds to a decrease of 9% compared to 2019. Trade in goods and business services suffered the most significant drop in investment of -16% and -15% respectively (Table 1). According to Business Sweden's surveys (2021), as a result of the pandemic, 60% of Swedish companies pushed investments into the future.

Table 1: Investment change by industry: 2020 compared with 2019

Industry	Change(%)
Mining, and quarrying and manufacturing	-4
Energy, water and sewer	-8
Construction	-10
Trade in goods	-16
Transportation and storage	-10
Information and communication	-1
Banks and insurance companies	-10
Real estate	-10
Business services	-15
Total	-9

Source: Investment survey fourth quarter 2020.

In the meantime, corporate bonds were hit hard by the uncertain situation and the extreme stress on the financial markets. According to a Sveriges Riksbank staff memo by Wollert (2020), the yield spread increased sharply for corporate bonds concerning other types of Swedish bonds in March 2020. The stress also increased bid-ask spreads of corporate bonds from a stable 0.1% to more than 0.5%. The sudden jump indicates that the liquidity situation on the market deteriorated rapidly and substantially. With the risk premium and bid-ask spread increasing, it became more expensive for companies to issue new bonds. In addition, many investors switched to safer bonds and avoided investing in corporate bonds. Altogether, this led to no high yield bonds being issued bewtween March to May 2020, and issue volumes of corporate bonds declined substantially compared to 2019 (Figure 1).



(a) Net issue volumes (SEK billion)

(b) Monthly issues of corporate bonds by credit rating (share of total issue volume)

Figure 1: Monthly issues of corporate bonds by Swedish companies

Figure (a) shows the monthly net issue volumes of corporate bonds by Swedish companies. The net issue volumes are gross issue volumes minus repurchases and redemption of outstanding bonds. Source: The Riksbank and Statistics Sweden (SVDB) and Wollert (2020).

Figure (b) shows the monthly share of total issue volume of investment grade and high yield bonds, the classification of the credit rating is provided by Dealogic. Source: Dealogic and Wollert (2020)

In summary, the shock caused by the pandemic in 2020 made the Swedish economy recession with overall investment and credit market downturn. As private equity plays an important role in the Swedish economy (SVCA, 2020), this raises up our interest in the behavior of private equity during the crisis.

3 Private equity and its activity in Sweden

3.1 Literature

There exists a large academic literature on the economic role of private equity. Dating back to the 1980s, Jensen (1989) suggested that the leveraged buyout has an advantage over public corporations due to its stronger corporate governance, more concentrated ownership, and more efficient capital structure. With these features, managers would be able to focus on long-run value creation.

The positive impact of private equity on operational efficiency has been documented in the literature based on buyout samples from the U.S. and U.K. For example, based on 76 large management buyouts of public companies between 1980 and 1986, Kaplan (1989) shows that firms experienced an increase in operating income, cash flow, and market value in three years after a buyout transaction.

Focusing on U.S.-based manufacturing establishments that received P.E. investments between 1980 and 2005, Davis, Haltiwanger, Jarmin, Lerner and Javier (2014) find that private equity helps firms increase productivity in the two years following the transaction. The positive effect from private equity is not just present in particular economies and specific industries. Bernstein, Lerner, Sørensen and Strömberg (2017) find that industries, where P.E. funds have been active in the past five years, grow more rapidly than other industries in terms of total production, value-added, total wages, and employment across 20 industries in 26 major nations between 1991 and 2009.

Private equity can assist target firms in multiple ways. First, the early literature based on the U.S. market in the 1980s suggests that the performance improvement is derived from a cutting cost and investment, selling off assets (Kaplan, 1989, Chevalier, 1995, and Chevalier and Scharfstein, 1996) and reducing employment (Lichtenberg and Siegel, 1990). The focusing on cost-cutting may be due to the intense corporate restructuring and international competitive environment in the 1980s (Jensen, 1993). On the other hand, private equity has been shown to also increase investment in target firms, leading to industrial upgrading and resource reallocation through the accelerated exit of less productive establishments, replacing them with highly productive ones, and improving overall management practices throughout the organization (Davis, Haltiwanger, Jarmin, Lerner and Javier, 2014, Harris, Siegel and Wright, 2005, and Bernstein and Sheen, 2016). Moreover, private equity also drives firms to increase investment in R&D expenditures, focus on their core areas of strength, and generate higher-impact patents that improve long-term innovation (Lerner, Sorensen and Stromberg, 2011).

In markets where capital and credit markets are less developed compared to the U.S. and U.K., private equity also plays a role in assisting target firms in raising necessary financial resources to capture unexploited growth opportunities. Boucly, Sraer and Thesmar (2011) suggest that private equity can act as an engine of growth for small and medium-sized enterprises by relaxing credit constraints which in turn helps target firms increase profitability, capital expenditures, and debt issuance. These results are consistent with Acharya, Gottschalg, Hahn and Kehoe (2013), who find a high abnormal performance related to improvement

in sales and operating margin compared to peers based on PE deals in western Europe.

Given these results, it is important to understand the impact of private equity investment when the economy faces a sudden shock during a financial crisis. For one thing, it is known that the growth of leverage plays a crucial role in causing the credit bubbles that precede financial crisis (Minsky, 1980, Bian, Ge and Ji, 2019). Highly leveraged firms may be more likely to experience financial distress during a crisis, exacerbating cuts in investment and employment and contributing to the persistence of the downturn (Bernanke, Campbell, Friedman and Summers, 1988 and Bernanke, 1983). On the other hand, PE-backed firms may be able to utilize the resources and relationships with private equity owners and banks (Ivashina and Kovner, 2011). The study across different industries, nations, and times by Bernstein, Lerner, Sørensen and Strömberg (2017) shows that industries, where private equity invest actively are less exposed to industry shocks than non-PE industries. When firms experience default in financial distress, PE-backed firms restructure more quickly and are less likely to be liquidated, while PE owners are more likely to retain control post-restructuring by infusing capital when firms are in trouble (Hotchkiss, Smith and Strömberg, 2021). Comparing the performance of PE-backed and non-PE-backed comparable firms around the 2008 financial crisis in the U.K. market, Bernstein, Lerner and Mezzanotti (2019) find that private equities were relatively more active investors during the crisis and provided both equity and debt financing to their portfolio companies at a lower cost. These investments helped PE targets capture more market share and made them less likely to declare bankruptcy, suggesting private equity can play a stabilizing role during bad times.

3.2 Private equity activity in Sweden before and during pandemic

Sweden is a suitable market to study as the country holds a leading position within private equity. In the past 10 years, around 3,000 Swedish companies have received PE capital, adding up to more than SEK 240 bn which makes the Swedish PE market the third largest in Europe from 2017 to 2019 (Copenhagen Economics,

2020). Considering both direct and indirect effects of PE and venture capital (VC) together, a report from SVCA (2020) find that since 2007 the cumulative effects of PE and VC investments in Swedish firms has raised the GDP level by SEK 230bn, the equivalent of nearly 5% of GDP every year.

Sweden is not only the home to large private equity companies such as EQT and Nordic Capital, but also attracts international investors from U.S. and the other Nordic countries, who contribute to 80% of the total PE funding. Despite the 2020 pandemic, private equity funds in Sweden raised a total of 69 billion SEK, an increase of 36% compared to 2019 (SVCA, 2020). Given their important role in the Swedish economy, it is interesting to study the impact of pandemic to private equity backed firms.

4 Data

4.1 PE Sample construction

To collect firms with private equity background, we follow Strömberg (2008). To identify PE deals, we use data from Capital IQ, Pitchbook and Prequin and require that the firms belong to specifies categories: For Capital IQ, we search for transactions labeled as: "Completed transactions", "Acquisition of Equity Stake", "Majority", "Transaction secondary feature: Leveraged Buyout"; In Prequin, we search for deals where Investment type is labeled as "Buyout" or "public to private"; In Pitchbook, we search for dealtypes and dealclasses which belong to "buyout/lbo" and "private equity". We manually match the unique identifiers to firm names. As we use three databases to collect private equity transaction data, we need to make sure there is no duplicate record for each firm. One example is that a firm's name recorded in the databases may differ from the name and not the name at the time of entry. Consequently, we have to collect information manually on a particular firm's name changes by searching the web and the Swedish firm registry. As we want to study PE-backed firms in 2020, we need to define the status of the transaction, and especially the transaction exit year. We use the databases mentioned above to find corporate events that qualify as exits. There are different types of exits: (a) Secondary buyouts where only the PE owner

changes, (b) the sale of the PE-backed firm to a non-PE owner, (c) bankruptcy or financial restructuring, (d) sale to management or (e) IPO. We hand-collect all exits where we lack exit data from the PE-owners' websites and other publicly available data sources. We consider all exits until 2020. For firms that have not exited in 2020, we consider them still to be PE-owned.

By the method we introduced above, we are able to select Swedish firms with private equity backing in 2020. We then select firms that satisfy the following criteria: (1) headquartered in Sweden at the time of the deal; (2) had experienced leveraged buyout by the end of 2019 and (3) did not experience an exit by the PE group by the end of 2020. Furthermore, according to the two-digit SNI (Swedish Standard Industrial Classification[6]) code, we exclude firms in Mining and quarrying (05-08), Electricity, gas, steam, and air conditioning supply (35), Financial and insurance activities (64-65), part of Real estate (68, exclude three digit code equal to 683) and Public Administration (84) according to Brown, Martinsson and Thomann (2021). After the first step of filtering, we have 525 firms that have entered leveraged buyout transactions by the end of 2019.

We then match the data on PE-backed firms with the data on financial information for Swedish firms from the Serrano database. By August 2021, around 25% of Swedish firms do not have 2020 financial information in the Serrano database. We only select firms with financial statement data available in both 2020 and 2019. This leads to our sample dropping by more than 50%, since we lose 324 PE-backed firms that went through a leveraged buyout before 2020 but did not have financial data for 2020. This loss of transaction observations may weaken the power of our analysis.

After obtaining financial information of the firms, the next step is finding a proper control group for the DiD analysis.

4.2 Control group construction

As PE-backed firms are not randomly selected, it is essential to have a properly selected group of control firms for our analysis. The construction of the matched

[6]The Swedish Standard Industrial Classification is based on the EU's recommended standards, NACE Rev.2.

control group follows Bernstein, Lerner and Mezzanotti (2019), which in turn builds on Boucly, Sraer and Thesmar (2011). The identification of the control group is based on firms' SNI code, size (total asset), firm leverage (liability over total asset), and profitability (ROA) in 2019. First, firms in the control group should satisfy the following criteria: (1) belong to the same industry (two-digit SNI code) as the PE-backed firm; (2) have total assets within a 40% bracket around the target firm; (3) have firm leverage within a 50% bracket around target firm; (4) have ROA within a 20% bracket around target firm; (5) have financial statements reported in the same quarter as the target firms. Second, since some of the target firms may have more control firms than others, we keep the closest three firms according to the quadratic distance based on total assets, ROA, and firm leverage. In order to make sure all the PE-backed firms have comparable control firms, we exclude 88 PE-backed firms which do not match with any control firms. We end up with 113 target PE-backed firms and 241 control firms in the final sample. A detailed description of the test sample is provided in the next section.

Using the data from Serrano, we define several measures to describe company activity following Bernstein, Lerner and Mezzanotti (2019). We focus on three key ratios: investment, debt issuance and equity contribution. In particular, we calculate investments as the change in assets plus the reported depreciation. Similarly, we measure debt issuance as the change in total liabilities in the year. Furthermore, we identify the equity contribution in the company by measuring the change in equity minus net profit. All these variables are normalized by average total assets, defined as the average amount of assets recorded at the end of the current year and preceding year. In addition, we measure firm leverage as total liabilities over total assets and cost of debt as the ratio of total interest expenses to average total liability. In order to limit the influence of outliers, we winsorize all ratios at 1%. The Data Appendix provides more information about the dependent and control variables.

4.3 Data summary

We first show the industry distribution of PE-backed firms in Sweden and our test sample in Table 2. This table reflects the industry distribution in 2019. As

Table 2: Industry distribution

Industry code	Industry name	All firms(%)	All PE-backed firms(%)	Target firms(%)
10	Energy & Environment	0.65	1.00	0.88
15	Materials	1.14	2.99	1.77
20	Industrial goods	5.14	22.39	22.12
22	Construction industry	11.60	8.96	14.16
25	Shopping goods	16.37	15.42	15.04
30	Convenience goods	2.74	3.48	2.65
35	Health & Education	6.71	5.97	5.31
40	Finance & Real estate	13.93	4.98	3.54
45	IT & Electronics	6.11	9.45	10.62
50	Telecom & Media	1.79	2.49	0.88
60	Corporate services	29.47	20.90	20.35
98	Other	4.34	1.99	2.65
	Total	100	100	100

This table provides the industry distribution of firms in each group. Column "All firms" represents the distribution of all Swedish firms which have financial data by October 2021. Column "All PE-backed firms" represents the distribution of all PE-backed firms in all Swedish firms which have financial data. Column "Target firms" represents the distribution of PE-backed firms in our test sample.

the industry classification based on SNI two-digit code is very detailed, we show the classification codes defined by Serrano database, which divides the Swedish economy into 12 sectors. We only consider firms which already have reported 2020 financial data.

The column named "Target firms" shows the industry distribution of our final sample of PE-backed firms. Among all the industry sectors, the majority of the PE-backed firms in our final test sample are Industrial goods (22.12%) and Corporate services (20.35%). Three other industries also represent more than 10% of the total sample, including Shopping goods (15.04%), Construction (14.16%), and IT & Electronics (10.62%). Compared with the column "All PE-backed firms" which represents all PE-backed firms before excluding mismatched firms, we notice that the distribution is similar except the Construction (increase 5.2%) and Telecom & Media (decrease 1.61%). This suggests that excluding mismatched target firms does not significantly affect the overall distribution of target firms.

Secondly, compared to the universe of all Swedish firms (column "All firms"), target firms tend to be more concentrated in Industrial goods and less represented in Corporate services. There is also a decrease in the weight of Energy & Environment and Finance & Real Estate as we drop most firms in the corresponding

Table 3: Group comparison

Panel A Firms' Characteristic in 2019

	PE sample				Matched sample					
	N	Mean	SD	Median	N	Mean	SD	Median	Mean-diff	T-value
Net sale(100M SEK)	113	1.8	3.02	0.77	241	1.4	2.3	0.57	0.45	1.554
ROA	113	0.063	0.118	0.041	241	0.072	0.122	0.064	-0.009	-0.656
Investment	113	0.095	0.317	0.069	241	0.125	0.307	0.065	-0.03	-0.835
Debt issuance	113	0.04	0.275	0.009	240	0.072	0.276	0.016	-0.032	-1.028
Equity Con.	113	-0.036	0.125	0	240	-0.037	0.105	0	0.001	0.11
Leverage	113	0.678	0.222	0.714	241	0.657	0.209	0.682	0.021	0.868

Panel B Firms' Trends in 2019

	PE sample				Matched sample					
	N	Mean	SD	Median	N	Mean	SD	Median	Mean-diff	T value
1-year Growth 2018-2019										
Net sale	113	0.022	2.213	0.054	241	0.061	2.466	0.026	-0.039	-0.144
ROA	111	0.007	0.202	-0.005	233	-0.008	0.151	-0.001	0.016	0.814
Investment	109	-0.001	0.64	-0.036	233	-0.025	0.331	-0.031	0.024	0.463
Debt issuance	111	-0.053	0.357	-0.042	232	-0.033	0.289	-0.029	-0.02	-0.557
Equity Con.	111	0.058	0.365	0	232	0.022	0.225	0	0.036	1.114
Leverage	113	-0.003	0.075	-0.003	240	0.002	0.07	-0.003	-0.005	0.61
2-year Growth 2017-2019										
Net sale	111	0.397	2.051	0.17	233	-0.013	2.943	0.103	0.409	1.32
ROA	110	-0.029	0.177	-0.004	227	-0.005	0.184	0	-0.024	-1.125
Investment	108	0.007	0.434	0.006	227	-0.013	0.388	0.009	0.021	0.441
Debt issuance	109	0.02	0.399	-0.001	226	-0.019	0.375	-0.01	0.039	0.874
Equity Con.	110	0.059	0.33	0	226	0.035	0.222	0	0.024	0.786
Leverage	111	0.014	0.105	0	233	0.013	0.134	-0.005	0.001	0.046

Panel A reports the summary statistics of test sample firms in 2019 across PE-backed firms and matched firms. Column "Mean-diff" reports the mean difference across the two groups about relative variables. Column "T-value" reports the t-value of a t-test on the mean difference of two groups. Panel B reports the 1- and 2-year growth by the end of 2019. Column "Mean-diff" reports the mean difference across the two groups about relative variables. Column "T-value" reports the t-value of a t-test on the mean difference of two groups. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

SNI codes.

In Table 3, we compare the characteristics of firms in the target and the matched group in 2019. We first compare two groups' net sales, ROA, investment, debt issuance, equity contribution, and leverage as of 2019. As Table 3 Panel A shows, the differences of relative variables are insignificant at the 10% confidence level. These results suggest that the differences in firm activity across the treated and control groups in 2019 mostly vanish after matching firms with similar sizes, leverage ratios, and profitability within the same industry and report time. Secondly, we compare the relative financial performance across two

groups, by calculating the one-year and two-year relative growth of each financial variable by the end of 2019. In Table 3 Panel B, we find that the differences in relative growth rate between two groups are not significantly different from zero, which means firms from the target group exhibit a similar financial pattern to the matched group before the pandemic. Overall, the estimates from our previous tests suggest the performance of two groups follow parallel trends before the pandemic, which satisfies the main assumption of the difference-in-difference model (Angrist and Pischke, 2008).

Table 4: Distribution of government support

Panel A				
Number of firms receiving support in each industry				
Industry code	Industry name	Not receive	Receive	Percentage of Receive(%)
10	Energy & Environment	2626	78	2.88
15	Materials	4496	248	5.23
20	Industrial goods	18517	2874	13.44
22	Construction industry	46454	1774	3.68
25	Shopping goods	57835	10267	15.08
30	Convenience goods	10243	1148	10.08
35	Health & Education	26265	1656	5.93
40	Finance & Real estate	57280	638	1.10
45	IT & Electronics	24136	1272	5.01
50	Telecom & Media	6953	511	6.85
60	Corporate services	116491	5944	4.85
98	Other	17491	518	2.88
Panel B				
Number of firms receiving support in each group				
	Group	Not receive	Receive	Percentage of Receive(%)
	Target PE-backed firms	68	45	39.82
	Matched firms	194	47	19.50
	All PE-backed firms	115	86	42.79

Panel A reports the number of firms in Sweden that received government support during the year 2020 in each industry according to the classification from the Serrano database. "Not receive" represents firms that did not receive support, and "Receive" represents firms that received support. "Percentage of Receive" represents the percentage of received firms overall firms in each industry. Panel B reports the number of firms that received government support during the year 2020 in each group. "Target PE-backed firms" represents PE-backed firms in our test sample. "Matched firms" represents firms in matched group. "All PE-backed firms" represents all selected PE-backed firms that have reported financial data by the time of our research.

4.4 Government support

Since March 2020, the Swedish government tried to mitigate the economic impact of the COVID-19 outbreak for companies in various ways. Introduced in 2014, the "Short-time Working Allowance" support program enables employers to reduce their employees' working hours without dismissing them.[7] A large part of the cost of retaining the employees will instead be covered by financial support provided by the government. Due to the COVID-19 pandemic, this scheme was activated for the first time in April 2020 (Government Offices of Sweden, 2020). By the end of 2020, the government had received 90,853 applications and approved 74,916 of them. Most of the applications happened in the first three months after the pandemic.

To study the reaction of PE-backed firms to government support, we collect 53,898 observations of government support from the Swedish Agency for Economic and Regional Growth. After merging these with firm financial information, we end up with 26,928 firms that received government support in 2020. The distribution of government support across industries is provided in Table 4 Panel A, using Serrano industry codes. As the table shows, Shopping goods, Industrial goods, and Convenience goods are the top three industries, with more than 10% of the firms receiving government support. Our test sample includes 45 PE-backed firms receiving government support, which accounts for 39.82% of all PE-backed firms in our sample. As Table 4 Panel B shows, there are more PE-backed firms receiving support compared to matched firms. We analysis this further in Section 6.4.

5 Identification Strategy

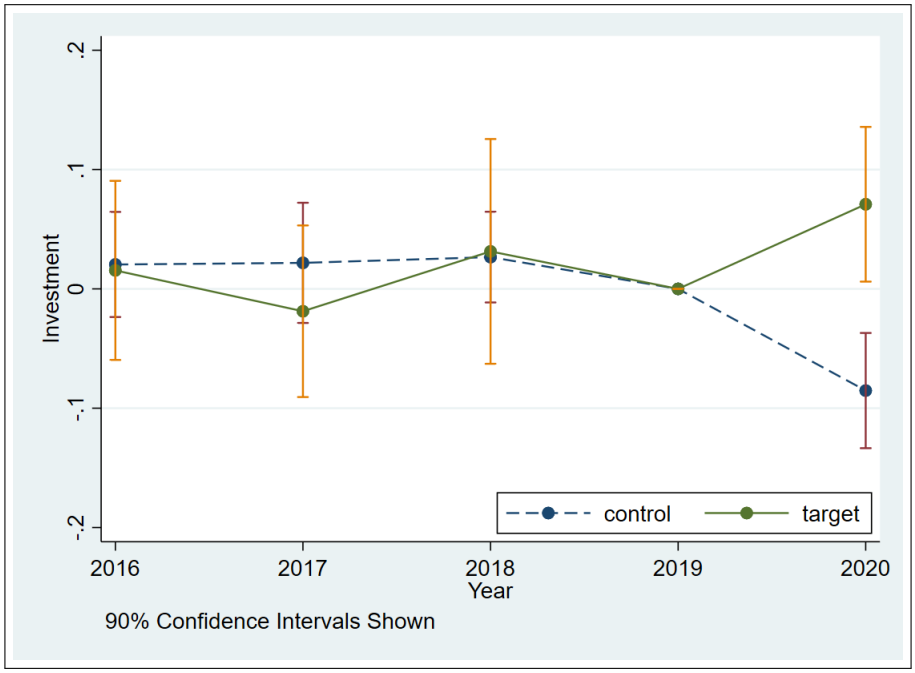
The method we use to analyze private equity's impact is based on the Difference-in-Difference (DID) method, following Bernstein, Lerner and Mezzanotti (2019). We estimate the following equation:

$$y_{it} = \alpha_i + \alpha_t \times \alpha_s + \beta_1(PE_i \times COVID_t) + \Theta X_{it} + \epsilon_{it} \quad (1)$$

[7] EMCC, Short-time working allowance. https://www.eurofound.europa.eu/observatories/emcc/erm/support-instrument/short-time-work-allowance

where y_{it} represents the dependent variable of company i at time t, $\alpha_i, \alpha_t \times \alpha_s$ are a set of company (i), time (t) and industry (s) fixed effects. PE_i is a dummy variable for PE-backed firms, which is equal to 1 since the year when firms enter into a PE transaction. $COVID_t$ is a dummy variable for the period after March 2020. We also set a group of control variables X_{it} capturing the firm's financial situation, with corresponding coefficients Θ. The error term ϵ_{it}, is clustered at the firm level.

Figure 2: Year fixed effects on Investment



This figure illustrates the change of investment of PE-backed firms and matched firms due to the year fixed effect. We calculate year fixed effect according to equation: $y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it}$. α_i captures firm fixed effect, α_t captures year fixed effect and α_s captures industry fixed effect. The year 2019 is used as the benchmark and its coefficient is normalized to zero. The estimates are plotted with 1.65 standard errors above and below the point estimates. Standard errors are clustered at the firm level.

By including firm fixed effects, we are able to control for unobservable firm-level characteristics (Ed, 2021). As the firms' situations may change over time, it is essential to include a time fixed effect as well. To give a reasonable interpretation of the results, our model requires a parallel trend of PE-backed and control group firms, which tries to ensure that treatment and control group firms should have perform similarly without the impact of the pandemic. However, it is impossible for us to observe the situation with the absence of shock in 2020. To solve this problem, we choose to explore the pre-shock trend to reinforce the interpretation of our analysis.

First, as we have shown before, firms that belong to the treatment group and control group have similar investment, debt issuance, leverage, and profitability in 2019. We then study whether both groups had similar financial situations two years before 2019 by studying the year effects estimates around the pandemic in 2020. The model is based on equation (1):

$$y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it} \tag{2}$$

where α_i captures firm fixed effects, α_t captures year fixed effects and α_s captures industry fixed effects. We use the year 2019 as the benchmark and therefore the corresponding coefficient is normalized to zero. The estimates are plotted with a 90% confidence interval above and below the point estimates. Standard errors are clustered at the firm level. As illustrated in Figure 2, the differences between treated and control firms in investment are insignificant before the shock of 2020. Along with this result, we then formally examine the time-varying behavior of the treatment effects for the main outcomes in our analysis by estimating:

$$y_{it} = \alpha_i + \alpha_t \times \alpha_s + \sum \beta_k (PE_i) + \Theta X_{it} + \epsilon_{it} \tag{3}$$

where β_k represents the difference that PE brings to the target firm for every year between 2017 to 2020. We then expect that β_k should only be significant after the pandemic happened in 2020. We will provide more details on this in the next section.

In addition, we select a number of control variables to capture the heterogeneity across firms along important characteristics one year before each test year. In particular, we choose the firm business size (lagged one year net sales), growth of sales (relative sales growth), firm leverage (lagged one year firm leverage), and profitability (lagged one year of ROA). In addition, we consider industry fixed effects which we interact with the time fixed effects to account for industry-level changes around the pandemic. The industry is defined by the 2-digit SNI code. Results will be provided in the next section.

6 Regression analysis

6.1 Main results

As previous mentioned, in Sweden, the investment rate among enterprises decreased 9% [8] in 2020 compared with 2019, and the issue volume of debt also experienced a remarkable drop after March 2020. These facts lead us to examine whether firms backed by private equity were affected more or less by the shock from the pandemic.

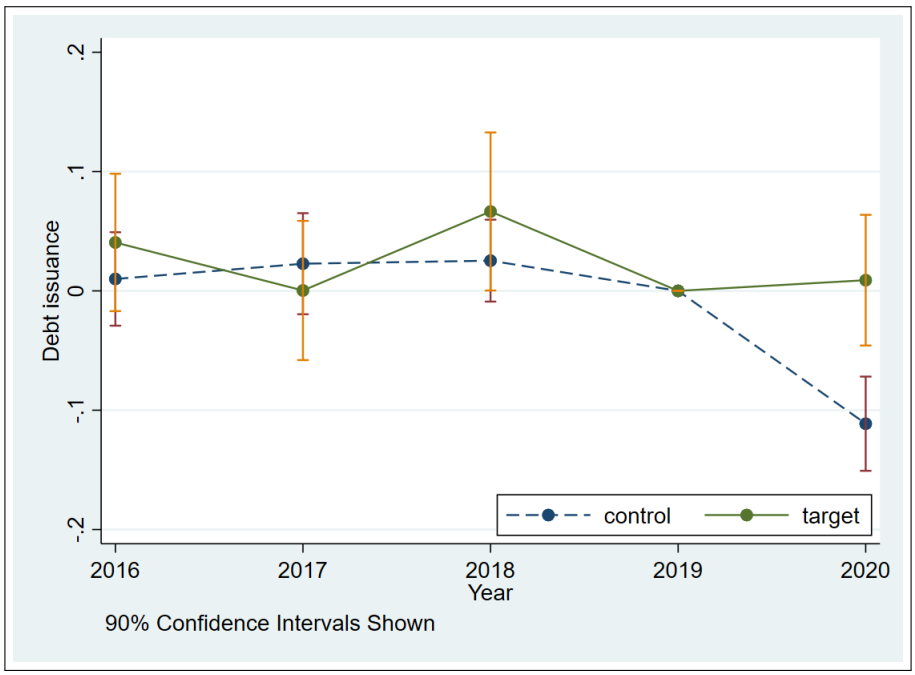
We firstly study the change in capital investment among PE-backed firms and their control firms. Figure 2 plots the year-fixed effects from 2016 to 2020 separately for the PE-backed firms and control group. We notice that before 2020, the difference in investment among PE-backed firms and control group firms is not statistically significant as there is an overlap of the confidence intervals. However, once the pandemic started, the control group firms experienced a dramatic decrease in investment in 2020 while the investment of PE-backed firms increased during the pandemic. This result is consistent with the evidence provided in Table 5. In column 1, we find that the coefficient for PE is significant for investment and equal to 0.174, suggesting that total asset increase (add depreciation) in 2020 over average total asset is 17.4% higher for PE-backed firms. In column 2, we find that although the coefficient slightly decreases to 0.148 when control variables are included, the positive impact of PE is unchanged with statistical significance and large magnitude.

Evidence from Table 6 also reinforces our previous conclusion. In Table 6, we capture the year-by-year PE effects using equation (3). This test will give us a clear view of the difference between the two groups over the years before and during the pandemic. In column 1 of Table 6, we find that firms with PE backing experienced a significant investment increase in 2020. In addition, we confirm that the impact of private equity remains insignificant before the pandemic. The results remain strong after including control variables.

Collectively, the evidence suggests that compared to a group of firms that have a similar pre-crisis financial performance, PE-backed firms were more resilient in

[8] Statistics Sweden, Investment Survey fourth quarter 2020

Figure 3: Year fixed effects on Debt issuance



This figure illustrates the change of debt issuance of PE-backed firms and matched firms due to the year fixed effect. We calculate year fixed effect according to equation: $y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it}$. α_i captures firm fixed effect, α_t captures year fixed effect and α_s captures industry fixed effect. The year 2019 is used as the benchmark and its coefficient is normalized to zero. The estimates are plotted with 1.65 standard errors above and below the point estimates. Standard errors are clustered at the firm level.

the face of the pandemic. This conclusion is similar to Bernstein, Lerner and Mezzanotti (2019) who find that the investment of PE-backed firms decreased less during the 2008 financial crisis.

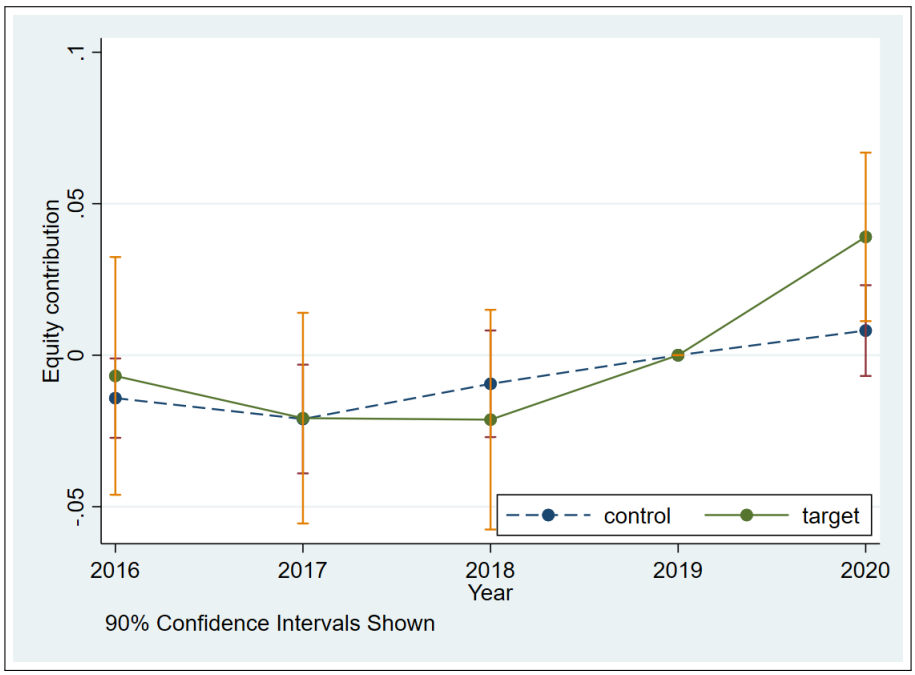
We then examine the mechanisms behind this finding. Bernstein, Lerner and Mezzanotti (2019) suggest that private equity can maintain a high investment level by relaxing firms' financial constraints in two ways. First, as private equity firms have a strong relationship with banks (Ivashina and Kovner, 2011), target firms can utilize this advantage to access the credit market more easily. Second, private equity has the ability to inject equity into the companies to the extent they have undrawn fund commitments (Hotchkiss, Smith and Strömberg, 2021). To test these hypotheses, we investigate firms' debt issuance and equity contributions using the same regression methodology as for investment.

Table 5: Investment and funding policies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Investment	Investment	Debt issuance	Debt issuance	Equity con.	Equity con.	Leverage	Leverage	Cost of debt	Cost of debt
PE×COVID	0.174***	0.148***	0.112***	0.097***	0.037**	0.031*	-0.009	0.001	0.003	0.003
	(0.039)	(0.040)	(0.034)	(0.034)	(0.018)	(0.018)	(0.017)	(0.017)	(0.003)	(0.003)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
N	1374	1236	1371	1235	1370	1234	1391	1235	1373	1234
Adjusted R-squared	0.062	0.068	0.071	0.169	0.225	0.372	0.708	0.732	0.299	0.296

Table 5 reports the estimates of the difference-in-differences fixed effect model on the related variables. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Columns 7 and 8 report the effect on firm leverage; Columns 9 and 10 report the effect on the cost of debt. Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

Figure 4: Year fixed effects on equity contribution



This figure illustrates the change of equity contribution of PE-backed firms and matched firms due to the year fixed effect. We calculate year fixed effect according to equation: $y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it}$. α_i captures firm fixed effect, α_t captures year fixed effect and α_s captures industry fixed effect. The year 2019 is used as the benchmark and its coefficient is normalized to zero. The estimates are plotted with 1.65 standard errors above and below the point estimates. Standard errors are clustered at the firm level.

Regarding debt issuance, we find that PE-backed firms issued more debt during the pandemic than control group firms. In Figure 3, we see that PE-backed firms and control group firms had similar debt issuance before the pandemic but showed a significant difference in 2020. Firms in the control group experienced a significant decrease in debt issuance after the shock. In contrast, PE-backed firms maintained a similar level of debt issuance compared to 2019. Normalized by average total assets, column 3 of Table 5 suggests that PE-backed firms issued more debt over total average assets by 0.112 compared to control firms, which is statistically significant and of a large economic magnitude. This effect is still significant after adding control variables. Considering that the bank system facing a significant challenge in 2020, this result suggests private equity enables firms to issue debt more efficiently during the pandemic. Columns 3 and 4 in Table 6 reinforce our finding that PE-backed firms raised more debt in 2020 than the control group, while the difference was not significant before the pandemic. This result is also consistent with the finding in Bernstein, Lerner and Mezzanotti (2019) suggesting that private equity firms facilitate firms' access to the credit markets during crisis.

Table 6: Investment and funding policies over time

	(1) Investment	(2) Investment	(3) Debt issuance	(4) Debt issuance	(5) Equity con.	(6) Equity con.
PE×2017	-0.043	-0.050	-0.007	-0.027	-0.005	-0.008
	(0.054)	(0.049)	(0.045)	(0.039)	(0.024)	(0.021)
PE×2018	0.000	-0.020	0.054	0.020	-0.014	-0.009
	(0.066)	(0.066)	(0.046)	(0.045)	(0.027)	(0.024)
PE×2020	0.164***	0.129**	0.128***	0.097**	0.031*	0.026
	(0.049)	(0.050)	(0.041)	(0.040)	(0.018)	(0.019)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1236	1371	1235	1370	1234
Adjusted R-squared	0.060	0.067	0.071	0.169	0.224	0.371

Table 6 reports the estimates from a time-varying fixed effects model. All tests include firm, year, and industry fixed effect. The test is based on the equation: $y_{it} = \alpha_i + \alpha_t \times \alpha_s + \beta_t(PE_i) + \Theta X_{it} + \epsilon_{it}$. α_i captures firm fixed effect, $\alpha_t \times \alpha_s$ captures the fixed effect of the interaction of year and industry. As we use the year 2019 as the benchmark, the estimators of related variables are normalized to zero and therefore be ignored in this table. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

Compared to the increase of debt issuance in PE-backed firms, the effect of private equity on equity contributions during the pandemic is relatively small, but still statistically significant. In Figure 4, we notice that the equity contribution of PE-backed and non-PE-backed firms before the pandemic did not diverge significantly, following a similar increasing path. Both groups experienced an equity contribution increase during the pandemic, but PE-backed firms increased more, indicating that private equity firms help target firms inject more equity than comparable firms. Results provided in columns 5 and 6 in Table 5 and Table 6 are consistent with this prediction. However, we also notice that after introducing control variables (column 6 in Table 5 and Table 6), private equity's effect is only significant at the 10% confidence level. This is because the lagged one year firm leverage has a significant effect predicting the injection of equity. We will discuss this result in the next section. Meanwhile, as columns 7 to 10 in Table 5 and Table 6 suggest, firm leverage and cost of debt of PE-backed firms and control firms are not significantly different before or during the pandemic.

6.2 The heterogeneity of PE-backed companies

From the previous analysis, we conclude that private equity helps target firms relax financial constraints during a pandemic by allowing them to issue more debt and equity. We also notice that after including control variables (such as lagged one year net sales, relative sales growth, lagged one year firm leverage, and lagged one year ROA), the positive effect of private equity becomes lower in magnitude. In this section, we exploit heterogeneity across the sample firms. We focus on the differences across firms in size, financial resources, leverage, and industry performance during the pandemic.

First, according to Bottero, Lenzu and Mezzanotti (2015), smaller firms are more likely to be financially constrained and cut investment when facing a tightening in credit supply. To address this potential effect, we use firms' net sales to split the sample according to size. Specifically, we define large firms as those with net sales at the top 20% of the distribution in 2019 and regard the rest as small firms. As the results provided in Panel A of Table 7 (columns 1 to 6), we find that large firms invested more, issued more debt and received more equity than small firms during the shock. On the other hand, the interaction of PE with the pandemic and size dummy variables are significantly negative. This result indicates that the positive effect of private equity is stronger among small firms.

Second, as the credit market tightened during the pandemic, we expect that firms that rely more on external finance will suffer a larger investment drop. Moreover, if private equity investors do help targets to alleviate financial stress by providing extra support, this effect will be more significant on firms that require more external financing. We use the standard Rajan-Zingales (RZ) index [9] (Rajan and Zingales, 1998) to measure the degree of dependence on external finance, where a high RZ index indicates that firms are more dependent. We then classify firms having the 20% highest RZ index as the high external finance dependence firms. As predicted, results in columns 1 to 4 of Panel B of Table 7 suggest that firms in industries that are more dependent on external finance have lower investment and debt issuance during the pandemic. This effect is statistically significant with

[9] In particular, for each two-digit SNI industry, we measure the RZ index as the median of CAPEX minus cash flows from operations, scaled by CAPEX.

Table 7: Heterogeneity across firms' financial constraints

Panel A	(1)	(2)	(3)	(4)	(5)	(6)
	Investment	Investment	Debt issuance	Debt issuance	Equity con.	Equity con.
PE×COVID	0.234***	0.213***	0.166***	0.159***	0.042**	0.029
	(0.043)	(0.044)	(0.039)	(0.039)	(0.019)	(0.018)
BigSale×COVID	0.128**	0.112**	0.085*	0.066*	0.015	0.027
	(0.059)	(0.053)	(0.044)	(0.039)	(0.027)	(0.024)
PE×BigSale×COVID	-0.262***	-0.272***	-0.209***	-0.227***	-0.007	0.013
	(0.094)	(0.095)	(0.068)	(0.067)	(0.052)	(0.052)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1236	1371	1235	1370	1234
Adjusted R-squared	0.067	0.077	0.075	0.177	0.223	0.373
Panel B	(1)	(2)	(3)	(4)	(5)	(6)
PE×COVID	0.104**	0.093**	0.089***	0.071**	0.034	0.038
	(0.045)	(0.043)	(0.033)	(0.031)	(0.025)	(0.024)
HighRZ×COVID	-0.128**	-0.097*	-0.085*	-0.077*	0.019	0.026
	(0.059)	(0.052)	(0.046)	(0.045)	(0.022)	(0.021)
PE×HighRZ×COVID	0.189**	0.157*	0.078	0.074	0.019	0.006
	(0.085)	(0.087)	(0.078)	(0.086)	(0.036)	(0.035)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1237	1371	1235	1370	1234
Adjusted R-squared	0.068	0.069	0.073	0.075	0.225	0.266
Panel C	(1)	(2)	(3)	(4)	(5)	(6)
PE×COVID	0.171***	0.152***	0.107***	0.085**	0.058***	0.060***
	(0.043)	(0.043)	(0.032)	(0.033)	(0.022)	(0.022)
Highleve×COVID	-0.163**	-0.158**	-0.232***	-0.213***	0.063**	0.044*
	(0.081)	(0.069)	(0.066)	(0.061)	(0.026)	(0.023)
PE×Highleve×COVID	0.052	0.006	0.072	0.076	-0.082**	-0.096**
	(0.107)	(0.100)	(0.107)	(0.107)	(0.041)	(0.039)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1237	1371	1235	1370	1234
Adjusted R-squared	0.069	0.075	0.095	0.096	0.228	0.268

Table 7 reports results of standard difference-in-difference fixed effects model and repeat the specification of Table 5 in exploring the effect of pandemic and PE on firms with heterogeneous financial constraints in 2019. All specifications include firm, year, and industry fixed effect. Panel A investigates interacted effect with business size. *BigSale* is a dummy variable equal to one of the firm's net sales in the year 2019 is in the top 20% and zero otherwise. Panel B investigates interacted effect with firms' finance resources. *HighRZ* is the dummy variable that describes firms' dependency on external finance, measured by the RZ index (Rajan and Zingales, 1998). *HighRZ* will equal one if firms' RZ index is in the top 20%, and zero otherwise. Panel C investigates interacted effect with firms' leverage. *Highleve* is the dummy variable that describes firms' leverage that will equal one if the firm's leverage is in the top 20%, and zero otherwise. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

Table 8: Heterogeneity across firms' performance in year 2020

	(1) Investment	(2) Investment	(3) Debt issuance	(4) Debt issuance	(5) Equity con.	(6) Equity con.
PE×COVID	0.155***	0.138***	0.106***	0.097***	0.026	0.021
	(0.040)	(0.039)	(0.033)	(0.033)	(0.018)	(0.017)
Worse×COVID	-0.297*	-0.197	-0.209	-0.148	-0.072	-0.033
	(0.174)	(0.142)	(0.150)	(0.129)	(0.055)	(0.044)
PE×Worse×COVID	0.494**	0.415**	0.334**	0.328**	0.265**	0.195*
	(0.192)	(0.169)	(0.161)	(0.139)	(0.122)	(0.116)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1389	1256	1386	1255	1385	1254
Adjusted R-squared	0.037	0.065	0.056	0.165	0.212	0.357

Table 8 reports results of the standard difference-in-difference fixed effects model and repeats the specification of Table 7 in exploring the effect of pandemic and PE on firms with heterogeneous business performance in 2020. All specifications include firm, year, and industry fixed effect. $Worse$ is the dummy variable that describes firms' performance that will equal one if the average net sales growth (weighted by net sales) of a firm's industry is in the bottom 20%, and zero otherwise. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

or without including control variables. Meanwhile, in row 3 of Panel B of Table 7, we find private equity has a large positive effect on investment for firms with high RZ index.

Third, we consider firm leverage as an additional measure of financial constraints. Typically, firms with high leverage are expected to have less financial flexibility and are exposed to higher default risk, which leads to a high cost of debt. As a result, they will be more fragile when the credit market experiences sudden shock. To identify high leverage firms, we use leverage in 2019 as a benchmark and define firms with the top 20% highest leverage as high leverage firms. In columns 1 to 4 of Panel C of Table 7, we find that companies with high pre-crisis leverage cut investment more and issued less debt but injected more equity. But high leverage companies backed by PE investors injected significantly less equity during the pandemic compared to other firms.

Finally, we study the impact of private equity on firms belonging to the industries which suffered the most during the pandemic. We define a dummy variable "Worse" to divide the industries into two groups. "Worse" will equal one if the

average sales growth (weighted by firms' net sales) of the industry belongs to the bottom 20% among the industries in the test sample. Because of collinearity, we do not include industry fixed effects in this test. In general, as Table 8 suggests, the industries that performed worse during the pandemic experienced a larger investment decline, less debt issuance and lower equity injections. On the other hand, private equity has a larger positive effect on investment, debt and equity issuance for firms in the worst-hit industries compared to firms in other industries that suffered less in the pandemic.

6.3 Operational Performance and Asset Allocation

In this section, we explore whether the support from private equity helps improve firms' operating performance during the crisis. We are also interested in the allocation of investment to see which part in the balance sheet affected most by support during the pandemic.

In columns 1 and 2 of Table 9, we find that the total assets of PE-backed firms grow more than the control group, which is consistent with the previous results on investment.

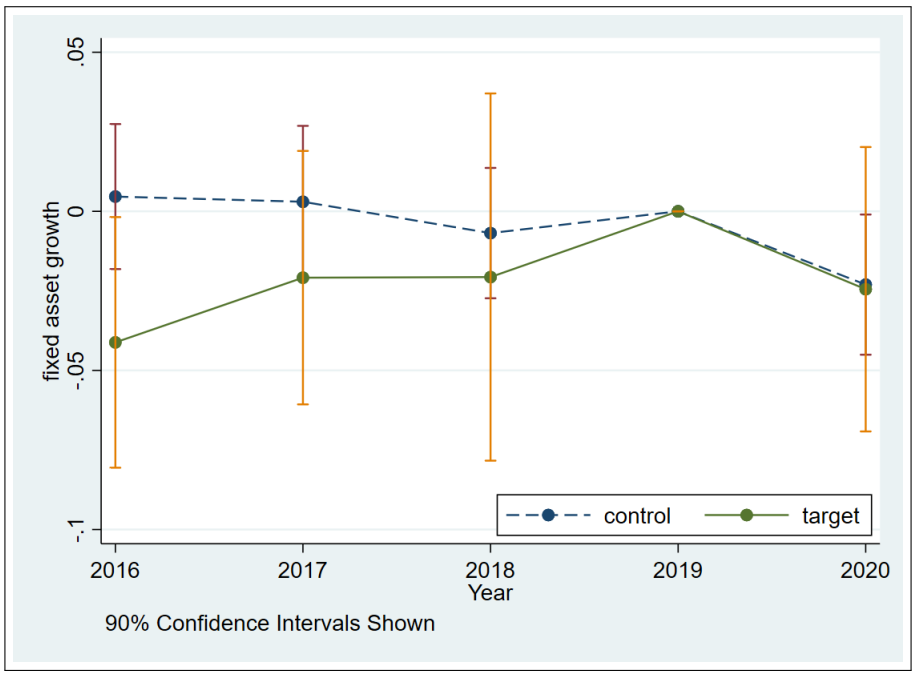
Table 9: Performance analysis

	(1) Asset growth	(2) Asset growth	(3) Sales growth	(4) Sales growth	(5) ROA	(6) ROA	(7) EBITDA / Asset	(8) EBITDA / Asset
PE×$COVID$	0.193***	0.155***	-0.070	-0.048	0.016	0.010	0.019	0.009
	(0.043)	(0.044)	(0.062)	(0.051)	(0.019)	(0.020)	(0.023)	(0.023)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES	NO	YES
N	1374	1236	1262	1236	1373	1260	1227	1102
Adjusted R-squared	0.067	0.046	0.076	0.366	0.342	0.379	0.363	0.394

Table 9 reports the estimates of the difference-in-differences fixed effect model on the related variables. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on the relative growth of total assets; Columns 3 and 4 report the effect on the relative growth of net sales; Columns 5 and 6 report the effect on ROA; Columns 7 and 8 report the effect on EBITDA over average asset. Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

On the other hand, we do not find significant evidence that private equity helps improve firms' operating performance in the pandemic. In columns 3 and 4,

Figure 5: Year fixed effects on fixed asset growth

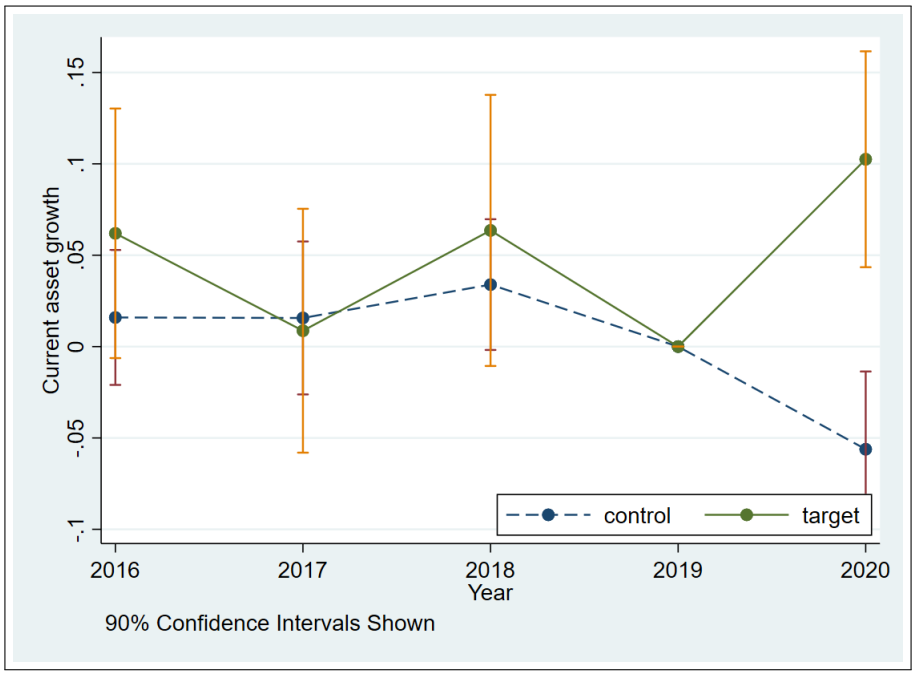


This figure illustrates the growth of fixed asset of PE-backed firms and matched firms due to the year fixed effect. We calculate year fixed effect according to equation: $y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it}$. α_i captures firm fixed effect, α_t captures year fixed effect and α_s captures industry fixed effect. The year 2019 is used as the benchmark and its coefficient is normalized to zero. The estimates are plotted with 1.65 standard errors above and below the point estimates. Standard errors are clustered at the firm level.

we study relative sales growth. The insignificant coefficient suggests that private equity firms do not help target firms grow faster. We also explore the impact on firms' profitability using ROA and EBITDA over average asset. From columns 5 to 8, we find that the average performance of PE-backed firms during the pandemic was not different compared to the matched firms.

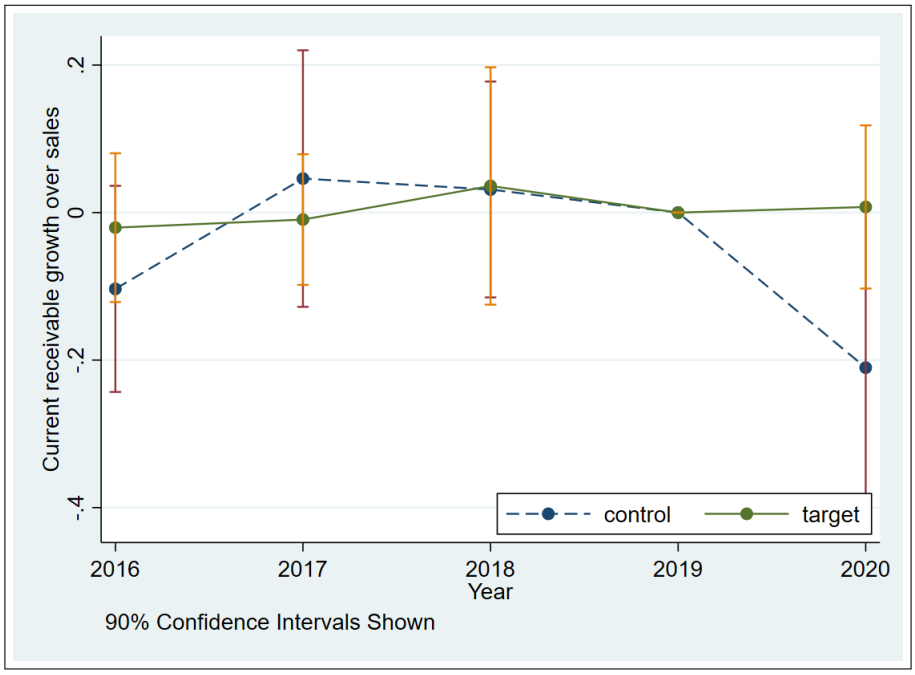
We then look at the different components of investment to investigate which type of assets increases more due to PE backing. We first divide total assets into two parts: fixed assets and current assets. Detailed information on these two variables is provided in Appendix. To begin with, we plot the year fixed effect on the increase of fixed assets and current assets for both groups. As Figure 5 shows, fixed assets did not change significantly before or during the pandemic. However, in Figure 6, PE-backed firms' current assets increased significantly during the pandemic compared to matched control firms, and showed a similar pattern to the total investment increase. Results from columns 3 and 4 of Table 10 also support this finding which show the positive impact of private equity on firms' current assets during the pandemic. In current assets, as Figure 7 shows, we notice

Figure 6: Year fixed effects on current asset growth



This figure illustrates the growth of current asset of PE-backed firms and matched firms due to the year fixed effect. We calculate year fixed effect according to equation: $y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it}$. α_i captures firm fixed effect, α_t captures year fixed effect and α_s captures industry fixed effect. The year 2019 is used as the benchmark and its coefficient is normalized to zero. The estimates are plotted with 1.65 standard errors above and below the point estimates. Standard errors are clustered at the firm level.

Figure 7: Year fixed effect on current receivables growth over sales



This figure illustrates the growth of current receivables over average net sales of PE-backed firms and matched firms due to the year fixed effect. We calculate year fixed effect according to equation: $y_{it} = \alpha_i + \alpha_t + \alpha_s + \epsilon_{it}$. α_i captures firm fixed effect, α_t captures year fixed effect and α_s captures industry fixed effect. The year 2019 is used as the benchmark and its coefficient is normalized to zero. The estimates are plotted with 1.65 standard errors above and below the point estimates. Standard errors are clustered at the firm level.

Table 10: Investment allocation analysis

	(1) Fixed asset growth	(2) Fixed asset growth	(3) Current asset growth	(4) Current asset growth	(5) Current receivable growth/sale	(6) Current receivable growth/sale
PE×$COVID$	0.014	0.004	0.156***	0.144***	0.243**	0.169*
	(0.021)	(0.022)	(0.034)	(0.035)	(0.109)	(0.100)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1236	1374	1236	1295	1236
Adjusted R-squared	0.109	0.078	0.029	0.085	0.050	0.024

Table 10 reports the estimates of the difference-in-differences fixed effect model on the related variables. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on the increase of fixed assets; Columns 3 and 4 report the effect on the increase of current assets; Columns 5 and 6 report the increase of current receivable; Columns 7 and 8 report the effect on the increase of current receivable over sales. Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

that the current receivables over average net sales did not change significantly in the PE-backed firms during the pandemic, however, it decreased significantly in control firms. This evidence is also supported by the results from columns 5 and 6 showing a relative increase of current receivables over average net sales in PE-backed firms. These results suggest that PE-backed firms were more generous in giving credit to their customers during the pandemic to help solve the short-term liquidity problems of their customers.

6.4 Government support

One of the challenges to firms during the pandemic was to cover wages of employees as their business activities deteriorated. The Swedish government's "Short-time Working Allowance" support program played an important role to relieve firms' financial stress by covering part of the cost of the labor force.

In this section, we will discuss the PE-backed firm's relative use of this government support. To address this question, we first investigate what kind of firms were more likely to receive government support in 2020. We investigate the likelihood of receiving government support among all Swedish firms with more than

ten employees in 2020. To study this, we run the following logit regression:

$$Support_i = \beta_1 L.Emp_i + \beta_2 L.WageSale_i + \Theta X_i + \epsilon_i \tag{4}$$

where $Support_i$ is dummy variable equal to 1 if firms have received government support in 2020 and 0 otherwise. Since the government support was aimed at covering firms' labor costs, the likelihood of applying and receiving government support should be related to firms' labor costs $WageSale_i$ (wage over net sales) and log number of employees Emp_i. X_i is a set of controls. All the explanatory variables we use in the model are lagged one year.

Table 11: Government support Analysis: All firms

	(1)	(2)
	Support	Support
L.Emp	2.055***	1.412***
	(0.029)	(.050)
L.WageSale	1.582***	2.434***
	(0.081)	(0.18)
PE		1.358*
		(0.253)
rel_sales_gr		0.644***
		(0.022)
L.ROA		0.437***
		(0.038)
L.l_sales		1.275***
		(0.031)
Industry fixed effects	YES	YES
N	34441	30147
Pseudo R2	0.230	0.223

Table 11 reports the estimates (odds ratio) of the logit model of the possibility of receiving government support in the year 2020 with related variables overall Swedish firms. We focus on the effect brought by the log number of employees $L.Emp$ and cost of wage over net sales $L.WageSale$ in 2019. PE is the dummy variable that equals one if the firm has private equity background and zero otherwise. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. rel_sales_gr is relative sales growth in year 2020; $L.ROA$ is firms' ROA in the year 2019; $L.l\_sales$ is the log of the net sale in the year 2019. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

In column 1 of Table 11, we report odds ratio of logit estimation. We notice that the odds ratio of labor costs (wage over sales) is 1.582 which means for every unit increase in wage over sales, the likelihood that receiving government support increases by approximately 1.6 times. We also notice that firms with more employees in 2019 were more likely to receive government support during the pandemic with an odds ratio 2.055. We then introduce a set of controls for

the firms' financial situation. As column 2 of Table 11 suggests, the likelihood of receiving government support is related to firms' profitability, size (log of net sales), and growth rate (relative sales growth). We find that firms with higher profitability (ROA) in 2019 and higher growth (relative sales growth) in 2020 were less likely to receive government support with odds ratio 0.437 and 0.644, respectively. On the other hand, firms with a larger previous year business size (log of net sales) are more likely to apply and receive government support with a odds ratio 1.275.

Table 12: Government support Analysis: test sample

	(1)	(2)
	Support	Support
PE	2.837***	2.893***
	(0.913)	(1.028)
L.WageSale	2.492	1.539
	(2.013)	(1.831)
L.Emp	1.566***	2.740***
	(0.258)	(0.922)
L.ROA		0.146
		(0.253)
L.l_sales		0.638*
		(0.157)
rel_sales_gr		0.019***
		(0.016)
Industry fixed effects	YES	YES
N	269	268
Pseudo R2	0.181	0.284

Table 12 reports the estimates (odds ratio) of the logit model of the possibility of receiving government support in the year 2020 with related variables over firms in the test sample. We focus on the effect brought by the number of employees $L.Emp$ and cost of wage over net sales $L.WageSale$ in 2019. PE is the dummy variable that equals one if the firm has private equity background and zero otherwise. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. rel_sales_gr is relative sales growth in year 2020; $L.ROA$ is firms' ROA in the year 2019; $L.l\_sales$ is the log of the net sale in the year 2019. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

As government support is a way of releasing firms' financial pressure, we want to explore whether firms with private equity backing were more likely to apply for and receive government support. In column 2 of Table 11, we notice that private equity backing positively affects the likelihood of receiving government support compared to the universe of Swedish firms after including control variables. The odds ratio of 1.358 suggests that firms with PE backing are 1.35 times more likely to receive government support compared to non-PE-backed firms. This result is consistent with the finding in Table 4 Panel B that more PE-backed firms have

received government support.

In order to have more reliable evidence, we then look closer to PE-backed firms and compare them with matched firms with a similar previous year financial performance by running a logit regression using equation (5):

$$Support_i = \beta_1 PE_i + \beta_2 L.Emp_i + \beta_3 L.WageSale_i + \Theta X_i + \epsilon_i \tag{5}$$

PE_i is a dummy variable and equals one if the firm has PE backing in 2020 and equals zero otherwise. Other explanatory variables are the same as equation (4). In column 1 of Table 12, we find that firm with PE backing has an odds ratio 2.837, which is statistically significant. This suggests PE-backed firms are 2.837 times more likely to receiving government support. Similar to the universe market sample, more employees and higher wage over sales make firms more likely to apply and receive government support. Meanwhile, firms with higher profitability (ROA) and higher one-year sales growth are less likely to receive government support.

Table 13: Heterogeneity across government support

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment	Investment	Debt issuance	Debt issuance	Equity con	Equity con
PE×COVID	0.159***	0.142***	0.103**	0.098**	0.054**	0.048*
	(0.047)	(0.050)	(0.042)	(0.042)	(0.025)	(0.025)
Support×COVID	-0.127**	-0.095*	-0.117**	-0.085**	0.035	0.048**
	(0.059)	(0.050)	(0.050)	(0.042)	(0.025)	(0.019)
PE×Support×COVID	0.119	0.075	0.107	0.067	-0.05	-0.061*
	(0.082)	(0.078)	(0.072)	(0.068)	(0.037)	(0.036)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1236	1371	1235	1370	1234
Adjusted R-squared	0.065	0.07	0.074	0.17	0.225	0.374

Table 13 reports results of the standard difference-in-difference fixed effects model and repeats the specification of Table 7 in exploring the effect of pandemic and PE on firms with government support. All specifications include firm, year, and industry fixed effect. *Support* is the dummy variable that will equal one if the firm receives government support in 2020 and zero otherwise. Odd-numbered columns report the basic regression results, while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

This finding is consistent with the goal of this program of helping firms reduce wage costs during the pandemic. Similar to the previous analysis using all Swedish

firms, we find that PE-backed firms are more likely to receive government support. This motivates us to explore how government support affected firm performance during the pandemic. In Table 13, we first see the effect of private equity backing in row 3. It seems that PE-backed firms performed similarly regardless of support with respect to investment and debt issuance. However, columns 5 and 6 show that private equity tends to inject less equity in firms that have received government support. This may indicate that government support replaced part of private equity funding during the pandemic.

6.5 Robustness tests

According to Boucly, Sraer and Thesmar (2011), PE-backed firms tend to be more profitable, grow much faster, and issue more debt than a group of control firms in the first three years after leveraged buyout. Therefore, the overall increase of investment and debt issuance in the PE-backed group may be caused by firms receiving leveraged buyout from 2017 to 2019. To address this concern, we exclude PE-backed firms that experienced a leveraged buyout after 2017 and redo the test in the previous section. After dropping 34 PE-backed firms, as shown in Table A.1 in appendix, we find that the main result remains unchanged except for the equity contribution part. This result shows that private equity tends to inject more equity into companies that have just experienced leveraged buyout. This result is consistent with Hotchkiss, Smith and Strömberg (2021) suggesting PE-backed firms in which the original buyout happened longer ago are less likely to receive capital injections than other PE-backed firms.

Second, in our matching method, we use firm leverage as one of the matching criteria. However, as Bernstein, Lerner and Mezzanotti (2019) suggest, we may select some firms which are unrepresentative due to their high leverage which may influence our understanding of private equity's effect on normal firms. Therefore, we modify the matching method according Boucly, Sraer and Thesmar (2011) and only match controls on SNI code, ROA, and total asset. This increases the number of observations due to a larger number of matched firms. Finally, as the results show in Table A.2, we can see our main result does not change in any major way and are still statistically significant in this alternative sample.

Third, as we including three years (2017, 2018, 2019) of data before the pandemic in the regression, the results may be influenced by the asymmetric time window before and after the shock. Therefore, we then use only 2019 and 2020 data to do the analysis. As the results provided in Table A.3, we notice that the effect of private equity does not change significantly.

Finally, we investigate the effect of firms' different time exposure to the pandemic. Since the financial data we use is reported based on firms' fiscal years, we want to know whether the report time in the pandemic year affects difference in firms' performance. As the first round of shock from the pandemic ends around October, we define a dummy variable "first" that equals one if a firm's fiscal year ends before October. We then add this dummy variable into our analysis. Evidence provided in Table A.4 suggests that report time does not significantly affect our main results.

7 Conclusion

We provide a first analysis of the response of Swedish PE-backed companies to the COVID-19 crisis. We explore the impact of private equity on firms' investment, financing and performance and find that PE-backed firms experienced a better financial situation during the pandemic. Specifically, firms with private equity backing invested more, issued more debt, and received more equity compared to a matched group of control firms, while profitability and leverage were similar. The positive effect of private equity is more pronounced among firms that were more likely to be financially constrained during the pandemic. We also find that firms with PE backing provided more credit to their customers during the crisis. These results are consistent with the previous study by Bernstein, Lerner and Mezzanotti (2019) on the 2008 financial crisis and point to the benefits of private equity when the financial market faces serious problems.

Moreover, the introduction of government support shows another mechanism through which private equity backing affects a firm's behavior. We find that PE-backed firms are more likely to apply and receive government support than the matched group, consistent with PE-backed firms having more knowledge about

these programs, compatible with Bloom, Sadun and Reenen (2015). We find that private equity contributes less to equity injection if the target firms have received support from the government.

In conclusion, we find private equity positively decreases firms' financial fragility during the pandemic. As we can only study the first year following the pandemic, future research should examine the longer-term effect of private equity backing on firms as more data becomes available.

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Appendix

Variable description

Investment(t)	(Total Asset(t) - Total Asset(t-1)+Depreciation(t)) / Avg_Total Asset(t)
Debt issuance(t)	(Total Liability(t) - Total Liability(t-1)) / Avg_Total Asset(t)
Equity Contribution(t)	(Total Equity(t)-Total Equity(t-1)-Net profit(t)) /Avg_Total Asset(t)
ROA(t)	Net Profit(t) / Avg_Total Asset(t)
Firm leverage(t)	Total Liability(t) / Total Asset(t)
Cost of debt(t)	Financial Cost(t)/Total Liability(t)
l_sales(t)	Ln(Net Sales(t))
rel_sales_gr(t)	l_sales(t)-l_sales(t-1)
EBITDA(t)/Asset	EBITDA(t)/Avg_Total Asset(t)
Fixed asset growth(t)	(Fixed Asset(t)-Fixed Asset(t-1))/Avg_Total Asset(t)
Current asset growth(t)	(Current Asset(t)-Current Asset(t-1))/Avg_Total Asset(t)
Current Receivable growth(t)	(Current Receivable(t)-Current Receivable(t-1))/Avg_Total Asset(t)
Current Receivable growth over sale(t)	(Current Receivable(t)-Current Receivable(t-1))/Avg_Sales(t)
Avg_Total Asset(t)	(Total Asset(t) + Total Asset(t-1))/2
Avg_Sales(t)	(Net Sales(t) + Net Sales(t-1))/2
WageSale(t)	Wage(t)/Net Sales(t)
Emp(t)	Ln(Number of Employee(t))

*"t" represents year

Robustness test results

Table A.1: Robustness, exclude PE-firms entering leveraged buyout in 2018 and 2019

	(1) Investment	(2) Investment	(3) Debt issuance	(4) Debt issuance	(5) Equity con.	(6) Equity con.
PE×COVID	0.184***	0.146***	0.136***	0.110***	0.002	0.001
	(0.046)	(0.046)	(0.040)	(0.041)	(0.019)	(0.019)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	957	842	956	842	956	842
Adjusted R-squared	0.073	0.117	0.092	0.198	0.204	0.384

Table A.1 reports the estimates of the difference-in-differences fixed effect model on the related variables after excluding PE-backed firms that received leveraged buyout in the years 2018 and 2019. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. Odd-numbered columns report the basic regression results while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

Table A.2: Robustness, alternative matching procedure

	(1) Investment	(2) Investment	(3) Debt issuance	(4) Debt issuance	(5) Equity con.	(6) Equity con.
PE×COVID	0.183***	0.138***	0.108***	0.088***	0.026	0.022
	(0.036)	(0.036)	(0.030)	(0.030)	(0.017)	(0.017)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1735	1519	1732	1518	1731	1517
Adjusted R-squared	0.061	0.116	0.027	0.173	0.173	0.35

Table A.2 reports the estimates of the difference-in-differences fixed effect model on the related variables. We obtain matched firms without setting a limitation on firm leverage. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. Odd-numbered columns report the basic regression results while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

Table A.3: Robustness, 2019-2020 only

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment	Investment	Debt issuance	Debt issuance	Equity con.	Equity con.
PE×COVID	0.164***	0.138***	0.128***	0.105***	0.030*	0.023
	(0.049)	(0.046)	(0.042)	(0.036)	(0.018)	(0.018)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	704	626	700	626	698	624
Adjusted R-squared	-0.011	0.183	0.040	0.322	0.249	0.298

Table A.3 reports the estimates of the difference-in-differences fixed effect model on the related variables using only data from 2019 and 2020. This covers the data of last year before the pandemic and the first year during the pandemic. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. Odd-numbered columns report the basic regression results while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.

Table A.4: Robustness, report time

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment	Investment	Debt issuance	Debt issuance	Equity con.	Equity con.
PE×COVID	0.173***	0.147***	0.109***	0.094***	0.034*	0.030*
	(0.039)	(0.040)	(0.034)	(0.033)	(0.018)	(0.018)
First	-0.068	-0.036	-0.110*	-0.114**	-0.107**	-0.048
	(0.084)	(0.089)	(0.061)	(0.055)	(0.052)	(0.050)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Firm controls	NO	YES	NO	YES	NO	YES
N	1374	1236	1371	1235	1370	1234
Adjusted R-squared	0.062	0.067	0.073	0.172	0.232	0.373

Table A.4 reports the estimates of the difference-in-differences fixed effect model on the related variables. We study the impact of the report time of financial data. All tests include firm, year, and industry fixed effect. We focus on the effect brought by the interaction between the $COVID$ dummy and PE dummy. $First$ is the dummy variable that is equal to one if the data was reported before October 2020, and zero otherwise. Odd-numbered columns report the basic regression results while the even-numbered columns report regression with a set of control variables. These control variables include lagged one year of ROA, lagged one year of firm leverage, lagged one year of log of net sales, and relative one-year net sales growth. Columns 1 and 2 report the effect on investment; Columns 3 and 4 report the effect on debt issuance; Columns 5 and 6 report the effect on net equity contribution; Details about the related variables are reported in Appendix. Standard errors are clustered at the firm level. *** denotes significance at the 1% level, ** at the 5% level, * at the 10% level.