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Private equity, investment activity, funding and financial constraints: evidence from the Brexit uncertainty

Abstract

Can PE act as an economic stabilizing factor by keeping up investment activity and funding of their portfolio companies relative to non-PE-backed companies during the Brexit referendum? This paper finds that in the period after the Brexit referendum (2017 – 2019), PE-backed companies increased investment activity more relative to their peers. Part of this can be explained by PE taking on more debt to support investments of their portfolio companies. Conversely, it appears PE acts differently when looking at companies who are bound to financial constraints. The paper shows evidence that PE prefers to inject equity in their portfolio companies rather than taking on more leverage for financially constrained companies. Lastly, no evidence has been found of PE contributing more to small companies as it does to large companies. Altogether, this research builds upon the scarce literature on PE, investments and funding during periods of political and economic uncertainty.

Keywords: Private Equity, Brexit, Investments, Funding, Financial constraints.

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Introduction

The Private Equity (PE) industry started playing a big role in the market of corporate control around the year 1980, where management lost its incentives of ownership to realize high returns on invested capital. Therefore, PE investors started acquiring companies using committed funds from partners and large amounts of debt with the goal to sell the company after a few years with a substantial return on invested capital (Kaplan, 1989b; Kaplan & Stein, 1993). However, PE practices have raised concerns, since transaction are financed with high amounts of leverage, even during crises such as the financial crisis of 2008. PE markets are prone to distortions created by credit cycles. On the other side, a period of a better financial environment is associated with greater fundraising, higher deal value and more leverage.

The recent Brexit referendum on the 23rd of June 2016, in where inhabitants from the United Kingdom (UK) voted with a majority of 52% for withdrawal from the European Union (EU), increased economic uncertainty in the UK. For UK companies, the event has a large impact on factors such as fundraising, M&A activity, employment, domestic interest rates, foreign exchange rates, consumer confidence, customs union and many others. The withdrawal from the EU will also have consequences for the UK PE market and portfolio companies in particular, but the impact of a crisis such as the Brexit on investment patterns of PE-backed companies remains poorly understood. PE-backed companies can be resilient to economic downturns since they might cope better with a crisis situation relative to non-PE-backed companies, because PE firms allow portfolio companies to have superior access to (external) funds to ensure that they continue to invest in capital expenditures and research & development (R&D) to grow (Wright, 2016; Bernstein et al., 2019). These funds are committed, which means that investors are obliged to provide them once promised, even in a period of economic uncertainty and even if banks do not want to lend money. This paper seeks to understand if PE can act as a stabilizing factor for the economy in times of economic uncertainty. Indeed, there exists evidence that PE firms can keep up investments and funding of portfolio companies during bad times (Bernstein et al., 2019). Nevertheless, the literature on investments and funding of PE portfolio companies during the Brexit referendum is scarce and it remains an interesting field of research. Therefore, in this paper, the following research question will be examined:

"Can PE act as an economic stabilizing factor by keeping up investment activity and funding of their portfolio companies relative to non-PE-backed companies during the Brexit referendum?"

There are various reasons why this question is relevant. First, the Brexit is a modern-day topic. On the 24th of December 2020, the UK and the EU finally agreed a deal effecting UK's formal separation from the EU after months of negotiations. While this date acts merely as a formal matter, the consequences of the deal for UK companies might already be visible for the UK economy after the referendum in 2016. The Brexit

referendum and its economic and political uncertainty that remained present during the transition period has raised concerns for companies operating in the UK, particularly with regards to financing and investment decisions, as the uncertainty can lead to companies postponing their investments and consumers their consumption. Because these two fields are both vital for our real economy, it is important to know their implications and react to them in the right way. Second, the UK is a relevant country to study, as it is estimated that the country accounts for the largest part of fundraising (± 50%), investments (± 40%) and divestments (± 40%) in Europe during the period of 2007 to 2019 (Invest Europe / EDC, 2020). As such, the UK has the largest PE market in Europe (CMBOR, 2016). It is of great interest to investigate if PE firms were capable of keeping up investments of their portfolio companies to contribute to the economy in the largest PE country of Europe, particularly during an exogenous shock such as the Brexit referendum of 2016. Third, there is evidence that PE can stabilize investments, funding and consumption in periods of economic downturn, since they have committed funds from their partners and have good relationships with debt providers. This paper can therefore improve the understanding of the relation between political and economic uncertainty and financial intermediaries. However, the literature on this topic has not been examined to a large extent and subsequently, it remains an interesting field of research to study the choices PE makes with respect to firm investment and funding.

This paper builds upon the very scarce existing literature regarding PE, firm investment and funding. Prior studies in these fields have been conducted by Boucly, Sraer & Thesmar (2011), Engel & Stiebale (2014), Jens (2017) and Bernstein et al. (2019). The overall shared conclusion is that PE is capable of creating value for their companies in several ways, of which one is through keeping up investment activity of their portfolio companies. However, only Bernstein et al. (2019) have researched this in conjunction with funding and financial constraints during the global financial crisis, with the implications of the Brexit referendum remaining poorly understood. There is still a lack of evidence regarding the recent Brexit and therefore, this paper attempts to find empirical evidence that takes away the gap in the literature on firm investments, funding policy and financing constraints of PE-backed companies during the transition period of the Brexit.

The data used in this research is obtained from two databases: Zephyr and Orbis. Zephyr contains information on both public and private firms, which is important when investigating private equity deals of target companies. After collecting UK private equity deals, financial annual report data of these companies is retrieved from Orbis, which contains detailed data on 375 million public and private companies worldwide. The portfolio companies taken over by PE firms are matched one-to-one on similar firm characteristics (size, profitability, leverage and industry) to a control group of UK firms that did not experience PE investment. The final sample led to 630 unique firms, of which 315 have received PE investment and 315 did not, with observations ranging from 2012 to 2019.

Using a difference-in-difference approach, this paper finds that while business investment and lending levels remained relatively high in the UK during the Brexit uncertainty, PE still contributed more to the investment activity of their portfolio companies relative to peers. Part of this story is explained by the fact that PE took on additional debt to fund firm's investments, indicating a strong relationship with the banking industry. Additional equity injections by PE do not seem to explain the higher investment activity for PE-backed companies. However, this paper finds additional evidence that PE acts differently when a portfolio company is financially constrained. PE favors to use equity injections as method of funding when the company already has high debt levels, instead of taking on additional debt and potentially bringing the company into financial distress. Furthermore, there is no significant relationship between firm size and PE ownership, meaning that PE contributed equally to small companies as it does to large companies. Lastly, the robustness checks suggest that the results are not driven by time-varying differences before the Brexit referendum or differences in accounting performance. The overall conclusion of this paper is that PE can act as an economic stabilizing factor by keeping up investment activity, equity injections and debt issuances of portfolio companies in times of economic and political uncertainty such as the period after the Brexit referendum.

The paper is structured as follows. Section 2 reviews the literature on PE, PE in the UK, corporate investment activity, financial constraints and investment activity of PE-backed companies. Section 3 describes the data and construction of the used variables. Section 4 discusses the methodological procedure and section 5 analyses the results. Finally, section 6 concludes and reviews the findings, limitations and next steps for future research.

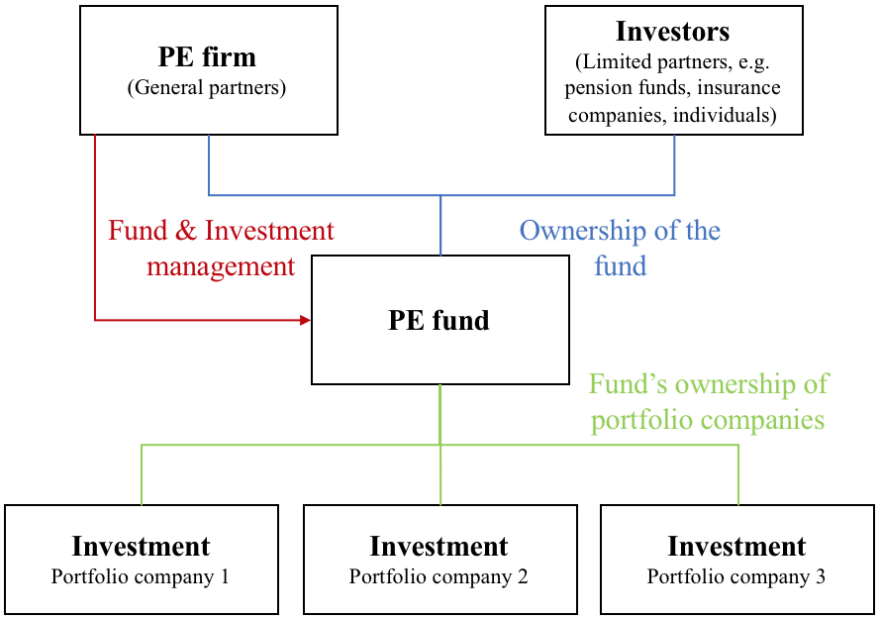
2. Literature review

2.1 Introduction to PE

2.1.1 The PE firm and its fund

First, before introducing literature on investments of target companies, it is necessary to understand the PE firm and the organizational structure of its committed fund. The PE firm is managed by the general partners (GP) and receives capital from the PE fund. The PE fund is a close-ended fund and consists of money provided by institutional investors such as pension funds, insurance companies or wealthy individuals who serve as limited partners (LP) to the fund (Kaplan & Strömberg, 2009). The fund's lifetime is typically restricted to seven to ten years and can be divided in two phases: the investment phase and the harvesting phase. The investment phase, lasting about five years, is the phase where the PE firm commits the capital transferred from LPs to the PE fund to the identified target companies. In general, the GPs from the PE firm manage the fund and take on all the decisions regarding the investment opportunities and thus, the LPs do not have an active role in the decision-making process regarding the selected investments. During the harvesting phase, the PE firm aims to sell the acquired companies with a profit and consequently, the used capital is returned to the LPs (Kaplan & Strömberg, 2009; Arcot et al., 2015). The trick here for the PE firm is to identify preferably under-priced companies, add value to the business through active management during the holding period and eventually sell them with a substantial return on invested capital (Gilligan & Wright, 2020). In figure 1, the typical PE fund structure is shown.

Figure 1: PE fund structure



In common literature, the term 'PE' encompasses Leveraged Buy-Outs (LBOs) and Venture Capital (VC). The important difference between these two types of PE firms is that VC mainly acquires minority stakes in start-ups or early-stage companies with high growth potential, whereas buyout funds execute LBOs of companies who are established in a more mature stage of their life (Harris et al., 2014; Braun et al., 2017). This paper will solely focus on LBOs, as it is the the most common way for a PE firm to acquire a company.

LBOs are highly leveraged, majority investments in companies with preferably stable and predictable cashflows. Using leverage allows the PE firm to transfer part of the risk to the creditor and realize a larger return on its own invested equity. During the holding period, PE firms attempt to increase the value of the portfolio company through operational enhancements such as increasing revenue and cutting costs. The cashflows the portfolio company generates over the years then are used to pay down the debt level, increasing the proportionate amount of equity in the finance structure, eventually leading to higher returns and compensation when exiting (Gilligan & Wright, 2020).

Compensation for the GPs is set as follows. The GPs are investors in the fund themselves and their compensation is bound to the performance (e.g. the return on capital) of the fund, typically 1 to 10 percent of the committed capital. Next to this, they mainly earn management fees and carried interest. Management fees are an annual percentage of the committed capital during the investment phase. If a certain investment is made, the GPs receive a percentage of the corresponding employed capital. After the LPs received a minimum return (around 8 to 10 percent) on their invested capital, carried interest – typically 20 percent of the value improvement realized by the PE firm – is distributed among the GPs and other employees of the PE firm. Subsequently, the LPs have a claim on the remaining 80 percent and this distribution is also known as the '80-20 rule'. Additionally, GPs can receive other fees such as monitoring fees, non-executive director fees and arrangement fees (Kaplan & Strömberg, 2009; Gilligan & Wright, 2020).

2.1.2 Evolution of PE activity

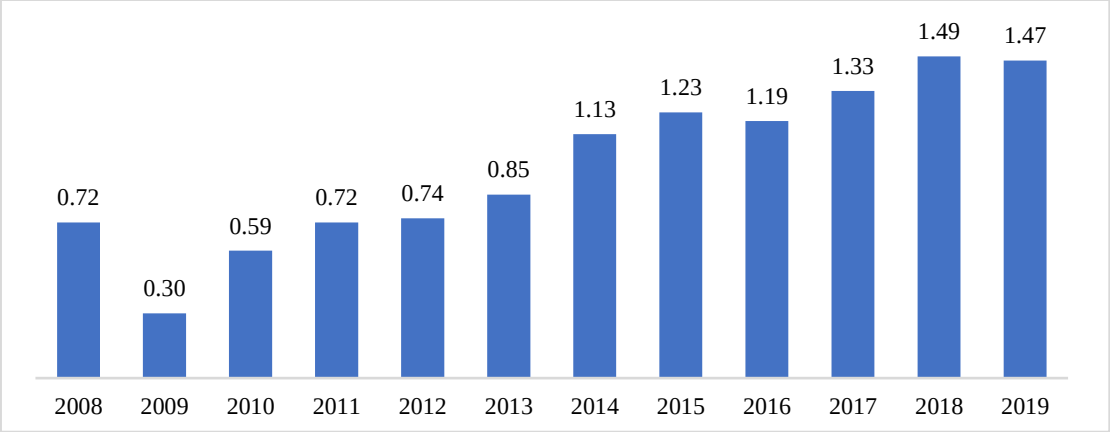
Next, to understand if PE is able to keep up investments of their portfolio companies, it is relevant to understand the origin and the development of its activity over the past decades. PE activity became significant around the year 1980 where the first big wave of buyouts started to occur, predominantly in the US (Lichtenberg & Siegel, 1990; Guo et al., 2011). Following corporate governance deficiencies in the United States, PE firms learned that LBOs could overcome these shortfalls by managing companies more adequately and use underutilized resources more efficiently. Hence, they started to acquire companies using leverage to undertake buyouts, pay off the debt they used to finance the buyout, increase shareholder value and increase return on capital when exiting (Kaplan, 1997). According to Kaplan (1991), the LBO activity

gained a boost in the 1980s, reaching a total value of $77 billion in 1988 while in 1979 this value was only worth $1.4 billion.

Whilst the 1980s is seen as the primary buyout boom period, buyout activity around the year 1990 decreased heavily. This is mainly due to the economic downturn of the early 1990s, more specifically the collapse of the junk bond market, causing financial distress for many PE-backed companies and making it harder to raise capital for deal-financing (Guo et al., 2011; Hurduzeu & Popescu, 2015). Also, roughly one-third of the LBOs completed after 1985 defaulted on their leverage. An increased appetite for LBOs attracted new entrants and capital to the market, causing purchase prices of target companies to rise and causing the benefits of discipline, incentives and governance shift from post-buyout LBO investors to the selling shareholders (Kaplan, 1997). Still, the larger LBOs kept being succesful during this period despite the many defaults (Kaplan & Stein, 1993).

After the mid-1990s, economic growth and low inflation provided favourable conditions for an increase in the amount of PE transactions (Gilligan & Wright, 2020). Accommodating on these conditions, the second buyout wave arose in 2005. During this wave, PE activity not only remained concentrated in the US, but it began spreading to Western Europe and more specifically to the UK (Kaplan & Strömberg, 2009). The wave reached its peak in 2007 with PE funds managing roughly $1 trillion of capital and buyout funds responsible for two-thirds of the capital (Metrick & Yasuda, 2010; Wilson et al., 2012). However, due to the financial crisis of 2008, PE deal volume dropped significantly to $0.3 trillion worldwide in 2009, as shown in figure 2 (McKinsey, 2020). Reason for this is that banks were needed to hold cash on their balance in order to meet their obligations, instead of lending it to customers. As a consequence, the amount of funds raised and deal-acitivity decreased heavily. The changed market conditions after the financial crisis, such as the recovery of the world economy as a whole and lowered interest rates, affected PE firms who generally use as much leverage as they can to increase returns in a positive way. Because debt was available at lower cost due to lowered interest rates, PE firms started borrowing more, which led to an increase in deal volume, reaching its peak in 2018 as viewed in figure 2. From this, it can be concluded that the changed market conditions are closely linked to the PE activity, and therefore, that PE activity is linked to the world's economic cycle.

Figure 2: Worldwide PE deal volume (in $ trillion)



Data source: PitchBook

2.2 PE in the UK

2.2.1 The UK PE buyout market

A trusted source for data on the UK PE buyout market is Invest Europe / EDC (2020), which keeps track of all fundraising, investment and divestment flows of PE firms in countries within continental Europe. In Figures B.1 – B.4 of the appendix, data on the UK PE buyout market is shown. "Buyout" is defined as "funds acquiring companies by purchasing majority or controlling stakes, financing the transaction through a mix of equity and debt". First, regarding fundraising, the UK is the largest contributor to total fundraising in continental Europe, accounting for a constant share of 50% from 2015 to 2019 (Invest Europe / EDC, 2020). However, after the financial crisis (2008), UK PE buyout firms experienced a sharp decline in the amount and number of funds raised (Figure B.1), while in the year of the Brexit referendum (2016), this was the opposite. This is mainly due to an increase in funding from Europe and outside Europe, as is shown in Figure B.2. The share of domestic funds of UK PE buyout firms relative to funds raised from Europe fluctuated around 25% over the years. Second, the UK is the country with the largest share[1] (39%) of investments made by its domestic PE firms in Europe, in line with Wright et al. (2017). Nevertheless, UK PE-backed buyouts dropped in number after the financial crisis and the Brexit referendum (Figure B.3). Investments of UK PE firms in UK companies decreased significantly due to the financial crisis (Figure B.4). Also, a small drop is seen in year 2016, following increasing investments in the more recent years which might be a consequence of the amount of funds raised in that period, contributing to their 'dry powder', funds that are ready to be invested. Over the entire period, UK PE firms' share of total investments in UK target companies is around 90%. Furthermore, although not shown in the graphs, companies in the

[1] This includes both UK and Ireland, but the aggregation is considered insignificant due to an investment distribution of 99:1% according to BVCA (2019)

"Business products and services", "ICT", "Consumer goods and services" and "Financial and insurance activities" industries were among the most popular to invest in (Invest Europe / EDC, 2020). Third, with regards to divestments of UK portfolio companies, the amount decreased after the financial crisis (Figure B.4). According to Wright et al. (2017), this is because corporations and family owned businesses are more reluctant to sell when asset prices are reduced. From 2015 to 2019, a constant drop in divestments can be viewed, suggesting longer holding periods for UK PE firms, which could be caused by the uncertainty of Brexit. Moreover, UK PE firms account for approximately 90% of all divestments of UK portfolio companies. All in all, these figures suggest that the UK is still the leader in the continental European PE market and the most attractive country to invest in.

2.2.2 The European regulatory framework

Before the financial crisis, the European PE regulation framework consisted of Member State requirements and limited supervision instead of being a uniform EU regime (Ferran, 2015). The European Commission (EC) therefore implemented the "Alternative Investment Fund Managers Directive" (AIFMD) on 22 July 2013, which main purpose is to "regulate all alternative investment fund managers (AIFMs) operating or marketing funds in the EU and thus to avoid risks for financial stability imposed by PE investments" (ECB, 2007; Gibson & Witney 2017). The directive introduced transparency measures and disclosure requirements for PE funds to improve investor protection. For the PE industry, the AIFMD is the most important piece of EU regulation (FTI, 2017). It implemented passporting, which allow AIFMs to manage and market its funds to investors freely across the EU, without requiring a separate authorisation in any other member state (Gibson & Witney, 2017). This falls within the free movement of capital, one of the four main freedoms of the EU's single market (Wright, 2016). As a consequence, GPs had the possibility to avoid the registration under various National Private Placement Regimes (NPPR) protected by their domestic law, which facilitates cross-border fundraising in the EU. On the contrary, non-EU AIFMs in 'third countries' are obliged to use NPPRs for every country in the investment process seperately or use a new passport equivalence regime with certain provisions (Ferran, 2015). Furthermore, the non-EU AIFMs must comply with every requirement of the AIFMD, which includes having an office in the EU and being regulated by it (BVCA, 2018). In the context of harmonizing the AIFMD, the Capital Markets Union (CMU) has been formed in 2014 with the aim to ensure free movement of non-bank capital and reduce investment barriers between EU members (European Commission, 2017b). Its range also extends to initiatives which have consequences for the PE industry, of which the most important are facilitating of cross-border investments and removal of investment barriers, fostering VC investments in Small- and Mediumsized Enterprises (SMEs) and start-ups and harmonization of corporate and capital tax policies (Dietlmeier, 2019).

2.2.3 Implications of economic uncertainty for UK firms

By now, we know that the UK lost its former passport rights to the EU's single market as of January 1st 2021 to sell funds around Europe investors granted under AIFMD, making UK a third-party country for the EU and making London as the financial centre of Europe less attractive (Latham, 2021). Consequently, UK fund managers must receive authorization from each individual European country to operate. As of 2021, the Brexit is a fact, but the current trade agreement does not offer many details on how financial services such as private equity will be affected, so that the uncertainty with regards to fundraising and investments still exists.

Although the Brexit referendum on the 23rd of June 2016 merely acted as a formal matter, various issues stemmed from the political uncertainty for the UK economy are already visible. Following the Brexit referendum, there was a period of negative stock market reactions and a depreciation of the British Pound (Gros, 2016). Since a country's Foreign Direct Investments (FDI) and its EU membership are positively related, research finds a loss of Financial FDI for the UK (Fournier et al., 2015; Dhingra et al., 2017). As we already know, the UK lost its passporting rights, which impacted the ability of the UK PE industry to raise funds and reduce the availability of investments to businesses in both UK and Europe (Wright et al., 2016; BVCA, 2018). Furthermore, a capital flight from the UK started to occur and is still occurring, with relocations of financial firms to Europe as a consequence, potentially leading to weaker economies of scale for the UK (Böttcher & Schmithausen, 2014; Morel et al., 2016). The Brexit could lead to more fragmented markets, making it more difficult for asset managers with large portfolios to have access to different financial markets, which is essential to them (Balling et al., 2017). Other research shows that policy uncertainty caused by Brexit leads to further instabilities in the UK such as weakened investments, less hiring of people and lower stock returns (Belke et al., 2016). According to Smales (2017), political uncertainty is positively related to uncertainty in financial markets, increasing volatility and cost of capital for investors who make portfolio choices and who are looking to raise finance or make investments around the time of important political events. Important evidence about capital investments and the Brexit comes from Górnicka (2018), who investigated the effect of the uncertainty around the Brexit referendum on business investment of UK companies. She first shows that prior to the event, business investment declined in the UK. Then, using a difference-in-difference approach, she finds that higher trade costs have a significant negative effect on firm investment after the referendum. While not during the Brexit referendum, Bloom et al. (2007) find that firms who are subject to greater economic uncertainty are much more cautious in their investment decisions and in line with this research, Smietanka et al. (2018) report that UK firms that experience macro-economic uncertainty adjust their payout policies to secure cash against potential future uncertain investment outcomes. Melolinna et al. (2018) study the impact of economic uncertainty (measured as stock price volatility) and cost of capital on firm-level investment during the financial crisis and find that

firms react sharply to the uncertainty by lowering investments after the crisis. Furthermore, Julio & Yook (2012) investigated the influence of national elections on corporate investment and find evidence that political uncertainty can lead to reduced investment expenditures until the uncertainty is resolved. This is confirmed by Jens (2017) who also finds a decline in firm investment and finds a delay in equity and debt issuances tied to firm investment.

With regards to the implications of the Brexit referendum for PE in the UK specifically, little literature exists. According to Wright (2016) who conducted 25 in-depth interviews with financial market participants on the impact of Brexit, the free movement of capital, one of the freedoms of EU's single market, is essential for PE firms since they have direct access to EU-backed funding from the European Investment Fund and other European funds. With a Brexit, these sources of funding could potentially be cut off, which has a particularly negative effect on smaller or purely domestic PE firms, since they are not able to cope with the high marketing funding costs compared to larger PE firms. A single market without trade tariffs makes it easier for UK portfolio companies with cross-border operations to invest and grow (Wright, 2016). Moreover, Lannoo (2017) states that Brexit leaves asset managers limited time to adapt their value chains. Wright et al. (2016) argue that Brexit could have negative implications for fundraising and employment and performance of portfolio companies. Although committed capital to a PE fund cannot be withdrawn, raising new funds (including the raise of debt) for UK PE firms might become harder because a significant portion of their funds are from EU investors (Gilligan & Wright, 2020; Invest Europe / EDC, 2020). Potential restrictions on the free movement of people could cause difficulties in attracting low- and high skilled employees, leading to higher wages and employment costs, suggesting decreased efficiency. The risk of shocks to export led business models in the UK could increase, causing PE firms to focus more on domestic focussed businesses rather than export businesses. Furthermore, if asset prices decrease due to the economic uncertainty following the referendum, increase in the incidence of corporate distress could provide attractive targets for PE investors, but at the same time, corporations may be reluctant to sell unless they are under pressure (Ahlers et al., 2016). Thus, these are concerns that potentially have value-destroying effects on UK companies in general.

2.3 Investment activity

2.3.1 Corporate investment policy

The main topic of interest in this paper is the investment activity of PE-backed companies. Therefore, this section will discuss literature on corporate investment. I must start with explaining the "Jensen hypothesis" (Jensen, 1989), which is based on the well-known 'principle-agent' problem. It explains how to reduce agency costs that arise because of the conflict between shareholders ('principle') and managers ('agent')

who both act in their own interest, leading to disagreement on how to use free cashflow of the firm. Corporate governance literature assumes that agency costs arise because of the separation of ownership and control, leading to information asymmetries and management using free cashflow of target firms for unprofitable projects (i.e. over-investment) to keep more resources under own control (Jensen & Meckling, 1976; Jensen, 1986). To maximize value for the company, excess cashflows should be transferred to shareholders rather than kept by the firm (Jensen, 1989). PE can add value to their portfolio companies by alleviating agency concerns through improved ownership structures. The choice of ownership is particularly relevant for investment decisions of portfolio companies. This is because of the following: company investment decisions are affected by several factors, such as market conditions with respect to goods, production, technology and adjustment costs (Jorgenson, 1963). Capital market frictions cause additional effects on these investment decisions. According to Hubbard (1998), the frictions are in turn influenced by the firm's age, size, industry, productivity, capital structure and ownership structure. Although most factors stay relatively stable over time, the latter two can be subject to abrupt variations (i.e. buyout by PE), which can lead to a changing corporate investment policy.

Investment projects are undertaken only if the present value of the discounted cashflows exceeds the corresponding capital expenditure. Regarding the financing of these investment projects, Modigliani & Miller (1958) were the first to acknowledge that a firm's investment decisions are independent from its financial situation in perfect markets, making internal and external sources of capital perfect substitutes (Hall & Jorgenson, 1967). However, we know that markets are not efficient and that a companies' investment policy is dependent on its capital structure. In the context of choosing the optimal capital structure and making the right investment decisions, asymmetric information and agency conflicts could potentially raise concerns.

Myers (1977) document that investment decisions are influenced by capital structure, since risky debt may lead to *underinvestment* driven by the wealth transfer from shareholder to creditors that can occur. According to Myers & Majluf (1984) and Jensen (1986), agency costs arise due to the existence of asymmetric information between a company and capital markets, as external finance may be deemed overly expensive by management and the capital market being less well-informed about the project's quality. Therefore, firms hold on to a 'pecking order' in financing their investments: they first rely on internal capital which is the source with the lowest opportunity cost; when internal capital is exhausted, they search for external capital (usually debt). Additionally, capital providers may include a premium in the cost of capital to reflect the risk of an average investment, which eventually can result in rejection of good investment opportunities. This is confirmed by Stiglitz & Weiss (1981), who developed a similar rationale by showing that asymmetric information may lead to the rationing of debt finance. Another concern stemmed from the discussed agency conflict. Management's corporate objective can be growth rather than value, since the

utility of a manager increases along with the companies' size and since they have limited liability (Renneboog & Trojanowski, 2004). Therefore, managers who are company owners of a levered firm at the same time tend to choose too risky and unprofitable (negative NPV) projects to keep more resources under their own control, known as *overinvestment* (Jensen & Meckling, 1976; Jensen, 1986). This is reinforced by companies which have overconfident CEOs who overestimate the future returns of their corporate investment decisions and the amount of internal funds managers have access to (Malmendier & Tate, 2005; Hovakimian, 2009). Additionally, Vogt (1994) document that overinvestment (underinvestment) dominates for larger (smaller) firms. Although the sources of both are different, they lead to similar empirical effects. Using panel data, research of Morado & Pintado (2003) points out that an optimal level of investments exists, since the relationship of over- and underinvestment to investments is quadratic. Moreover, Pawlina & Renneboog (2005) add to the literature that agency costs of ownership have effect on the investment-to-cashflow sensitivity.

To overcome agency problems and information asymmetries which lead to undesired investment policies, PE might be able to solve the concerns. Jensen (1986, 1989) documents that high levels of debt, equity holdings by management and monitoring by PE professionals contribute to an organizational structure with management incentives that lead to firm value maximization. This is confirmed in the studies of Kaplan (1989b) and Harris et al. (2005). Wruck (2008) considers debt only as a secondary driving force in establishing the right governance structure in buyouts. According to Wruck (2008), debt enables the design of a concentrated equity ownership structure, since debt usage for the acquisition of a target company enables the PE firm to reduce the amount of equity, allowing managers to own a proportionally larger share of equity in the company. It must be acknowledged however that if a portfolio firms' leverage becomes too high, interest payment might cause financial distress, making the firm more prone to economic shocks (Engel & Stiebale, 2014). Nevertheless, a larger equity ownership by management ensures more equity upside (Kaplan & Strömberg, 2009), whereas high debt levels and interest payments ('financial constraints') prevent managers from investing in negative Net Present Value (NPV) projects because of the limited availability of free cashflow (Jensen, 1989). This guarantees alignment of interest and retention between PE firms and portfolio management, while at the same time over-investment is reduced (Jensen, 1986, 1989; Wruck, 2008). This is reinforced by the fact that financial sponsors can also exercise their control over the portfolio company through their presence in the board of directors, which facilitates better monitoring (Kaplan & Strömberg, 2009; Lahmann, 2017). Also, PE firms acquire majority stakes in target companies allowing them to gain more information about the firm, reducing the information asymmetry (Shleifer & Vishny, 1997). In short, PE firms can solve the principle-agent problem by decreasing agency costs, contributing to superior investment decision-making.

2.3.2 Financial constraints

As pointed out under section 2.3.1, investment decisions are dependent on capital structure and firms must choose between external and internal capital to finance them. Potential financial constraints can arise because of difficult access to external capital markets or because firms took on too much debt and cannot meet their financial obligations. These financial constraints directly influence the amount of investments a firm can make. Although there are a lot of measures for financial constraints, the most important literature in conjunction with the measures used in this paper will be discussed below.

A well-documented phenomenon within the corporate investment literature is the sensitivity of investments to internal cashflows. According to Hovakimian (2009), its aim is to capture economic significance of variation in investment associated with variation in cashflow. Consequently, the investment-cashflow sensitivity will be low if there exists little variation in cashflows with a higher amount of investments and vice versa. Fazzari et al. (1988) were one of the first to use this measure as a signal for the existence of financial constraints, concluding that the strong positive effect of internal funds on investment is due to the liquidity constraints firms face which experience significant differences in costs of internal capital (cashflow) and external capital (debt). Using dividend pay-out ratios as proxies for financial constraints, they conclude that the investment-cashflow sensitivity is higher for firms who have more financial constraints, meaning that they have a more difficult time in meeting their financial obligations. A number of other papers support this finding. Shin & Kim (2002) observe a higher investment-cashflow sensitivity for firms that are young or small and Hoshi et al. (1991) find a higher sensitivity for firms that are less affiliated with industrial groups. Other research conducted by Himmelberg & Petersen (1994) focuses on R&D investments and internal finance and find a positive relationship, while Carpenter & Petersen (2002a) document that growth of small firms is constrained by the availability of internal finance. Cincera & Ravet (2010) report that for European firms, R&D investments are sensitive to the firm's cashflow. However, several papers criticised the approach of Fazzari et al. (1988). Kaplan & Zingales (1997) find that the investment-cashflow sensitivity is higher for companies which are less bound to financial constraints, suggesting that the measure should not be viewed as a direct signal of the impact of financial constraints, but rather as an indicator of existence of those constraints. They developed the KZ index, which is a five-factor model that measures how much a firm depends on external financing. While this measure is very prominent in the literature, Hadlock & Pierce (2010) harshly criticised this method, showing that firm size and firm age (the 'SA index') are better predictors of financial constraints levels. Cleary (1999) refined the approach of Kaplan & Zingales (1997), introducing a 'financial status' measure and also found that companies with a less favorable financial position have lower investment-cashflow sensitivity. Other criticism on the paper of Fazzari et al. (1988) comes from Almeida & Campello (2007), who show that the investment-cashflow sensitivity of financially constrained companies increases as asset tangibility

increases, whereas companies which are not financially constrained, the sensitivity is unaffected by the tangibility of assets. Furthermore, Kadapakkam et al. (1998) and Cleary (2006) extended the analysis of Fazzari et al. (1988) to an international sample and came up with results that are contradicting the Fazzari et al.'s hypothesis. This leaves ambiguity in determining the exact effect of the investment-cashflow sensitivity and the associated financial constraints. Furthermore, empirical evidence on the role of PE on portfolio firm's investments sensitivity to cashflow is limited. Long & Ravenscraft (1993) find a decrease in firm's investments if leverage increases after buyout. Wright et al. (1992) document that assets sales are offset by capital investment for management buyouts and Borell & Tykvová (2011) report evidence of tighter financial constraintment for a sample of European buyouts after the buyout-event.

Almeida et al. (2004) argue that when a firm expects financial constraints, it might begin saving cash to prevent these constraints in the future. However, more cash holdings can result in a reduction of investment in projects. Financially constrained firms will therefore choose an optimal cash holding policy to achieve a good balance between current profitable projects and future projects, which make them more sensitive to changes in incremental cashflow. Conversely, financially unconstrained firms execute all positive NPV projects and might save less cash. As a result, their amount of cash holdings will not be sensitive to variations in the incremental cashflow. Capturing financial constraints as the firm's ability to save cash out of generated cashflows is also known as "the cashflow sensitivity to cash". In their research, Almeida et al. (2004) find that financially constrained firms have a positive cashflow sensitivity to cash and that this is not different from zero for unconstrained firms, in line with their hypothesis. The outcome indicates that financial constraints have a negative effect on investment activity of firms, which is supported by Han & Qiu (2007).

Erel et al. (2015) compare financially constrained targets with unconstrained companies, and they use cash holdings, investment-cashflow sensitivity and cashflow sensitivity to cash as proxies for financial constraints. In line with Almeida et al. (2004), they consider cash holdings as a way for managers to deal with the financial position of their firm. With imperfect access to capital markets, managers who strive for value maximization will adopt investment policies which ensure that the most profitable projects will be financed. Therefore, the cash measures used exert information regarding financial constraints. Opler et al. (1999) support this by showing that the holding of cash can be explained by the ability of a firm to access the capital market. Moreover, Joseph et al. (2020) find that firms with high pre-crisis cash holdings invested significantly more than their cash-poor competitors during the financial crisis, suggesting that holding cash is beneficial for investment activity of firms in times of financial turmoil. Campello et al. (2010) report that financially constrained firms face difficulties when they need to borrow external funds during the financial crisis. Banks are more reluctant to lend, which can lead to forgone positive NPV investment opportunities for firms. In their survey, 86% of U.S. CFOs indicated that this was the case due to the tight credit resulting

from the financial crisis. In line with this, Campello et al. (2011) further argue that access to debt is associated with greater investments when companies have sufficient cash holdings during the crisis, while firms with limited access to debt must choose between saving and investing. This evidence points out that access to external finance eases the impact of a crisis on investment activity. Duchin et al. (2010) document that corporate investment declines significantly during the financial crisis, in particular for firms with low cash reserves, financially constrained firms or firms that operate in industries dependent on external finance.

Lastly, Carpenter et al. (1998) compare the empirical performance of three financial constraints measures to examine inventory investments. They use the coverage ratio (the firm's ability to meet its interest payments), cash stocks (a proxy for access to debt) and cashflow and they document that cashflow is most predictive in explaining inventory investment across firm size. Also, for UK manufacturing firms, Guariglia (2008) finds a significant link between the coverage ratio of firms and inventory investment during recessions and tight credit policy periods.

2.3.3 Empirical papers on investment activity of PE-backed companies

A sufficient body of literature on corporate investments is discussed in section 2.3.1, where is shown that investment decisions are directly linked to ownership and capital structure. However, when we combine PE and capital investments of portfolio companies during economic shocks, it appears the literature is very scarce. So far, the effects of PE on investment activity of portfolio companies have mostly been researched for early-stage VC investments (Manigart et al., 2003; Bertoni et al., 2010). Since this paper uses a sample of buyouts, the few studies conducted in the field of investment activity of PE-backed buyouts that exist will be discussed.

Lerner et al. (2011) document that PE is capable of keeping up long-run investments in innovation (measured by patenting activity) of their portfolio companies, instead of making decisions to boost performance in the short term. However, in an other paper of Hall & Lerner (2010), they find that the impact of VC on financing R&D investments and innovation has limits. Next, using a large Spanish sample of low and medium technology firms that were subject to VC and PE investments between 1995 and 2004, Bertoni et al. (2013) investigated what different roles VC and PE investors played in supporting investments of their portfolio companies before and after the deal. Looking solely at PE involvement, the researchers do not find a significant result of investment dependency on internal generated cashflows before the buyout event. Conversely, after buyout, they find a positive effect of investment dependency on cashflows. The evidence points to management's goal to increase firm value with improved corporate governance structure and debt. On the opposite side, Engel & Stiebale (2014) examined the investment-cashflow sensitivity for UK and French PE firms after buyout. Their findings are that PE-financed buyouts are neither associated with

decreases in investments nor with increases in the internal finance dependency. They also analyzed separate effects for small and large firms and conclude that small firms are more likely to be financially constrained compared to larger firms. This is supported by Carpenter & Petersen (2002a), and by Wiersema & Liebeskind (1995), who argue that larger firms have a higher potential for restructuring.

Furthermore, regarding PE involvement during economic uncertainty, Bernstein et al. (2019) compared the investment activity of PE-backed companies relative to non-PE-backed peers using a UK sample of buyouts during the global financial crisis. They found that PE-backed companies experienced more equity and debt inflows and increased investments compared to their peers, making them a stabilizing factor during times of economic uncertainty. The effects appeared larger for firms backed by those PE firms with more financial resources available and for firms which are more financially constrained. Bernstein et al. (2017) find that during the financial crisis of 2008, industries where PE is involved grow more quickly in terms of production and employment and they appear less exposed to economic shocks. Moreover, Wilson et al. (2012) researched the economic and financial performance of UK PE-backed buyouts and found that they performed better in the period before and during the financial crisis relative to their non-PE-backed peers. From the latter discussed literature, we can conclude that PE-backed companies do well in withstanding financial crises. However, it remains unclear whether this is the same for an uncertain period such as the Brexit referendum in the UK, since this has not been researched to the best of my knowledge.

2.4 Hypothesis development

This paper investigates whether PE-backed companies can act as a stabilizing factor in times of economic uncertainty by keeping up investment activity, relative to non-PE-backed companies. Answering this research question will be supported by testing the right hypotheses.

First, from a theoretical point of view, Meuleman et al. (2009) argue that agency problems can be reduced by changing ownership by introducing new management resources. They find evidence of a more entrepreneurial attitude of PE and since this is an important indicator of growth (Delmar et al., 2003), this can lead to improved investment activity (Engel & Stiebale, 2014). However, as shown in the literature by Gornicka (2018), business investment levels declined in the UK due to economic uncertainty. Nevertheless, PE firms have quick access to committed funds for sponsoring future company operations. Target companies may be more resilient to economic downturns or uncertainty since they have strong ties with the banking industry and they have committed funds from their partners which are not likely to dry out, because these capital commitments are needed to be invested over multiple years (Ivashina & Kovner, 2011; Bernstein et al., 2019). Therefore, the following research hypothesis can be derived:

Hypothesis 1: *"Investment activity for PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to non-PE-backed companies"*

Regarding funding of investments, Jens (2017) argues that during political uncertainty, firms delay their equity and debt issuances with respect to firm investment. Bernstein et al. (2019) find that in the year of the financial crisis, equity contributions decreased less for PE-backed firms relative to non-PE-backed firms, and debt issuances increased for PE-backed firms relative to non-PE-backed firms, suggesting that PE firms were willing to support investments of their portfolio companies. However, because the aim of a PE firm is to realize large returns on their invested capital, they could shy away from investing additional equity into their portfolio companies, preferring debt issuances over equity injections. Despite this, to investigate whether investment activity is explained by the amount of equity injections and debt issuances the firms have experienced, I compute the following two research hypotheses:

Hypothesis 2A: *"PE-backed companies acquired before the Brexit referendum experienced more equity injections during the Brexit referendum, relative to non-PE-backed companies"*

Hypothesis 2B: *"PE-backed companies acquired before the Brexit referendum experienced more debt issuances during the Brexit referendum, relative to non-PE-backed companies"*

Next, regarding the investment activity of target companies which are bound to financial constraints, Amess, Stiebale & Wright (2016) argue that PE firms play an important role in amplifying innovation using additional funds. This innovation can facilitate better operational performance. Also, PE firms can help alleviate financial constraints of target companies through the issue of debt and equity (Bernstein et al., 2019). Boucly, Sraer & Thesmar (2011) find evidence that target companies with financial constraints post-buyout increase their capital expenditures and company growth more relative to their financially unconstrained peers. Hence, I expect that there will be a heterogenous effect for financially constrained and financially unconstrained companies. The following research hypothesis is:

Hypothesis 3: *"Investment activity, equity injections and debt issuances for financially constrained PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to financially unconstrained non-PE-backed companies"*

Furthermore, since investment spending of companies and their dependence on internal finance is expected to vary with firm size (Hadlock & Pierce, 2010), I expect that there will be a heterogenous effect for small

and large companies. Due to information asymmetry, smaller companies experience higher cost premiums of external finance providers, making them more dependent on internally generated cashflows (Carpenter & Petersen, 2002a). Following Engel and Stiebale (2014), PE buyouts contribute to improved investment activity of small- and medium-sized target firms, because those firms are more likely to be financially constrained before a buyout. The following research hypothesis is:

Hypothesis 4: *"Investment activity, equity injections and debt issuances for small PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to non-PE-backed companies"*

3. Data

3.1 Sample construction

To examine the investment activity of UK PE-backed companies during the Brexit referendum, deal data on UK target companies complemented by their financial annual report data has been used. Since in the UK every registered limited company is required to provide financial and income information annually to the public register, it makes the country suitable to research (Brav, 2009; Michaely, 2012).

The data on PE deals is retrieved from the Zephyr database. An advantage of the Zephyr database is that it reports not only data of public firms, but also private firms. Since a lot of firms that are taken over by PE firms are private, this is beneficial to the sample size. The PE deals are identified by searching for events such as 'take private", "sale to financial sponsor", "management buy-in" and "management buy-out". Also, only firms that 1) are headquartered in the UK at the time of the deal; 2) have received a PE investment in the period of 2011 to 2015 and 3) did not experience a sale by the PE firm by the end of 2016 will be included in the sample (Bernstein et al., 2019). Furthermore, since PE buyouts desire to have control over a target company, only majority stake (>50%) deals are included in the sample.

Subsequently, the Orbis database is used to retrieve financial annual report data on the companies that are acquired by PE. The Standard Industrial Classification codes (SIC) are used to exclude companies operating in the financial industry (SICs 600-699), since this sample selection is common to the private equity literature and since financial companies have different balance sheets. To use sufficient financial data on companies experiencing a takeover, the window of the panel data ranges from 2011 to 2019. Hence, parallel trends can be identified, which is needed for the difference-in-difference framework used in this paper and will be explained in section 4. The initial sample consisted out of 955 unique firms. Because both the Zephyr and Orbis databases are products from Bureau van Dijk, the data has been merged using the common Bureau van Dijk identifier. After accounting for the conditions mentioned above and after deleting firms from the sample who lack sufficient financial data or have negative revenues, the final PE-backed firm sample led to 754 unique target firms.

3.2 Construction of variables of interest

3.2.1 Measuring investment activity, equity injections and debt issuances

A firm's asset base consists of current assets (i.e. cash, securities, inventory) which are used within a year, and non-current assets (fixed assets such as property, plant, equipment) that a firm uses for its business operations for more than a year. In particular, the fixed asset base is long-term based and consists of tangible assets and intangible assets. Tangible assets are physical assets that companies use to operate (i.e. machinery), while intangible assets are non-physical assets and represent a monetary value (i.e. a patent).

The main variable of interest in this paper is the firm's investment activity. A way to measure this is by taking a firm's capital expenditures (capex) over the years. Since the Orbis database does not report data on capex for the firms in the sample, an alternative way to define investment activity is by calculating the change in fixed assets over a year plus the reported depreciation and amortization (D&A), normalized by total assets of that year, following Michaely & Roberts (2012). For each separate firm, the investment activity will be calculated.

Two variables regarding corporate funding are computed as follows. Equity injections is defined as the change in equity (total shareholder funds) over a year minus profit of that year, normalized by total assets. Debt issuances is defined as the change in total liabilities (total debt) over a year, normalized by total assets. PE firms can easily inject more equity in their portfolio companies through their committed funds, whereas non-PE-backed companies must issue equity on the public market if they need additional funding. Also, since PE firms have strong ties with the banking industry, debt issuances should be easier to conduct for PE-backed companies (Bernstein et al., 2019). Therefore, it is expected that PE-backed firms experienced more equity injections and debt issuances during the Brexit referendum.

3.2.2 Measuring financial constraints

Since a firm's level of financial flexibility cannot be observed directly, studies rely on indirect measures. As shown in section 2.3.2, finding an accurate proxy for financial constraints is difficult. Since the majority of the sample contains data on private companies (they do not have share prices) and since therefore data on dividend pay-out policies and firm age are not available through Orbis, measure of the investment-cashflow sensitivity used by Fazzari et al. (1988) and the SA index of Hadlock & Pearce (2010) cannot be used in this paper. Therefore, various other measures of financial constraints are used in this research.

The first measure for financial constraints is the cashflow sensitivity of cash, used by Almeida et al. (2004) to examine a firm's tendency to save cash from incremental cashflows. They argue that a financially constrained firm will use a part of cashflow as financing source for new investment projects, whereas financially unconstrained firms can undertake all investment projects, regardless of their new cashflow. The measure is calculated by dividing a target firm's change in cash and cash equivalents by total assets. Because PE firms can alleviate financial constraints of portfolio companies, it is expected that PE-backed companies have lower sensitivity of cashflow to cash after buyout, which in turn leads to higher investment activity, equity injections and debt issuances. Following Erel et al. (2015), the second measure for financial constraints is the amount of cash a company holds. The idea behind this measure is that the amount of cash firms hold should be reduced when firms expect lower financial constraints in the future. I expect this to be the case for PE-backed firms, as PE has access to funds which allows them to keep less

money in reserve for their portfolio companies to cope with financial setbacks driven by periods of economic uncertainty such as the Brexit. Additionally, this will positively affect investment activity, equity injections and debt issuances. The measure is calculated by dividing the cash and cash equivalents a firm holds at year-end by total assets. The third proxy for financial constraints is the coverage ratio of firms (Carpenter et al., 1998; Guariglia, 2008). The coverage ratio is defined as the Earnings Before Interest and Taxes (EBIT) divided by the amount of interest a firm needs to pay. The measure indicates whether a firm is able to meet its financial obligations. The higher the ratio, the more capable the firm is of paying off interest payments. PE firms create value for their portfolio firms to increase the EBIT. Also, with a LBO, they take on new debt to acquire companies against more favorable terms which lead to lower interest payments. Therefore, I expect that PE-backed firms experience higher coverage ratios after buyout compared to their peers, which will positively influence investment activity, equity injections and debt issuances.

3.2.3 Measuring firm size

To test hypothesis 4, firm size is measured as the logarithm of total assets. The expectation is that investment activity and funding policies of companies vary with firm size, as larger companies generally can choose from more investment opportunities and can negotiate better terms for funding. Therefore, PE ownership could be particularly effective for smaller companies, as those companies experience more information asymmetry, higher financial constraints, higher cost premiums and more dependence on internal cashflows which can be mitigated by PE (Carpenter & Petersen, 2002a). I expect that smaller PE-backed companies experience more investment activity, equity injections and debt issuances. Additionally, in section 5.3, a robustness check is performed by using total employees as a measure of firm size.

3.3 Control variables

Several control variables are included in this paper to capture the heterogeneity across the firms in important characteristics before the Brexit referendum. In the investment research field it is very important to control for unobservable investment opportunities. These opportunities are likely to be correlated with investment activity. Therefore, firm size is included in the models, measured as the logarithm of total revenue. Since total revenue reflects the amount of investment opportunities and this differs across firms, the amount of investments companies make can also differ (Engel & Stiebale, 2014). However, realizing large revenues does not necessarily mean that firms grow or make the right investments decisions if revenue is stable or declines over the years. Therefore, the models also include a variable of revenue growth, which is calculated as the percentage change of revenue for a firm taken over two years. In general, larger companies should have more stable revenues, more investment and innovation opportunities to choose from and firms that

experience higher revenue growth are better at exploiting growth opportunities. Therefore, it is expected that firm size and revenue growth should have a positive effect on investment activity. Furthermore, in investigating a firm's level of investments, it is also important to control for internal capital availability, since this is one common finance source used to for potential investment projects (Jensen, 1986). The following indicators for internal available liquid funds (and therefore uncertainty in investment project outcomes) and profitability are therefore included in the models: cashflow over total assets ratio, profit margin (net income divided by total revenue) and changes in net working capital (current assets less cash minus current liabilities less short-term debt over a year subtracted by this number the previous year). Net working capital is a measure for a company's liquidity and financial health (the ability to pay off short-term creditors) and is calculated as follows: current assets less cash minus current liabilities less short-term debt over a year subtracted by this number the previous year. A positive net working capital means that the company can fund its operations and invest in future growth projects. Thus, changes in net working capital affect cashflow, which in turn affects investment activity (Górnicka, 2018). It is expected that the effect of cashflow over assets could be both positive and negative. A positive effect would mean that the more cashflow a firm has available, the more investments it can make, while a negative effect would be the opposite. An explanation for a negative effect is that a firm a higher cashflow numbers is an indicator of a firm leaving money on the table instead of investing it. Profit margin and changes in working capital are expected to have a positive effect on investment activity. Lastly, I control for firm leverage, since the amount of leverage and its cost highly affect investment choices. Leverage is measured as a ratio of total liabilities to total assets and is expected to be negatively related to investment activity.

4. Methodology

To understand what the effect of a PE-buyout on investment activity is, a difference-in-difference (DiD) design is used to examine the hypotheses. DiD is a tool to estimate certain treatment effects between a 'treatment group' and a 'control group' and investigate their changes in outcomes pre- and post-treatment (Myer, 1995). For this paper, the treatment is whether a firm in the sample has experienced PE investment in the pre-treatment period 2011-2015. The control group does not receive treatment, meaning that these firms do not receive PE investment. The post-treatment period ranges from 2017-2019, the period after the Brexit referendum as exogenous shock in 2016. During this entire post-treatment period, the economic uncertainty existed, which makes it an appropriate period to research. Consequently, the differences in outcome of the treatment group pre- and post-treatment are compared with the differences of the control group pre- and post-treatment. Drawing on prior research, DiD is seen as a suitable research framework (Roberts & Whited, 2013). The ideal research would be to compare identical firms during the Brexit referendum, with the sole difference that one of the companies is backed by a PE firm. To achieve this, a matching group of non-PE-backed companies must be constructed. I will first describe how the sample is constructed and then discuss the empirical specification of my research.

4.1 Construction of a matching control group

PE invests in a target company if it meets specific requirements. For instance, PE-backed companies are more likely to be larger, have higher profit margins and are more levered compared to their peers. Therefore, to properly execute the difference-in-difference method, a vital step in my analysis is the construction of a matching control group that is similar to the sample of PE-backed companies. The control group of non-PE-backed companies has been constructed using financial company data on a large sample of UK companies from Orbis. Using one-to-one[2] propensity score matching in STATA with randomly sorted data, the PE-backed firms are matched to control firms based on similar firm characteristics such as size (total revenue), profitability (profit margin), leverage (ratio) and industry type (SIC code) in 2016, following Boucly, Sraer & Thesmar (2011). Since PE-backed firms are bought through LBO transactions which typically include high amounts of leverage, I choose to also match on the leverage ratio, following Bernstein et al. (2019).

Table 1 shows the industry distribution of all PE-backed and matched control firms. The majority of the sample firms are active in the Services (41%) or Manufacturing (29%) industries. Other firmly present industries include Wholesale & Retail trade (15%) and Transportation, Communication, Electric, Gas &

[2] Additional checks with one-to-five and one-to-many matching procedures have been performed to test which measure gives the most appropriate results. However, one-to-five and one-to-many matching has not been used, since for both methods the parallel trend assumption is not satisfied.

Sanitary (12%). Both the PE-backed and matched control firms have the same industry distribution because the matching process has been conducted on industry.

Table 1 – Industry distribution for the PE sample and the matched sample

Table 1 provides the industry distribution for the PE sample and matched sample at the macro industry level (1-digit SIC). The Financial, Insurance, Regulated or Public Administration are excluded from the sample. Both samples contain 315 unique firms, generating a total sample of 630 observations.

Industry distribution	Observations	*Frequency*
Agriculture, Forestry and Fishing	2	*0.3%*
Mining & Construction	24	*3.8%*
Manufacturing	180	*28.6%*
Transportation, Communication, Electric, Gas, Sanitary	74	*11.8%*
Wholesale & Retail trade	92	*14.6%*
Services	258	*40.9%*
Total	630	*100%*

Furthermore, table 2 compares firm characteristics of the PE sample and the matched sample in 2016. The average firm has approximately €100 million in revenue and both samples have similar leverage ratios. The average profit margin is slightly higher for the matched sample and regarding funding policies, the PE sample experiences lower equity injections and debt issuances, while investment activity is increasing relative to the matched sample. Overall, the descriptives from table 2 suggest that the PE sample and the matched sample do not show large differences in firm characteristics.

Table 2 – Firm characteristics for the PE sample and matched sample in the Brexit year (2016)

Table 2 provides descriptives of the firm characteristics of the PE sample and the matched sample in the Brexit year (2016). The firm characteristics include investments, equity injections, debt issuances, total revenue, profit margin and leverage ratio. Investments, equity injections and debt issuances are normalized by total assets. The table gives the count of observations, mean, median and standard deviation for the PE sample and the matched sample.

	PE sample				Matched sample			
	N	Mean	Median	SD	N	Mean	Median	SD
Investments/assets	300	0.028	0.0147	0.129	282	0.016	0.003	0.115
Equity inj./assets	304	-0.076	-0.059	-0.059	297	-0.101	-0.065	0.178
Debt iss./assets	304	-0.039	-0.022	0.241	297	-0.023	-0.022	0.184
Total revenue (€m)	315	101.16	29.132	280.66	315	103.44	16.41	197.69
Profit margin (%)	315	9.098	6.526	20.425	315	11.596	6.649	20.222
Leverage (ratio)	315	0.864	0.751	0.629	315	0.853	0.793	0.595

The one-to-one propensity score matching method computes accurate matches because of the matching on parallel trends and similar firm characteristics. The difference with the approach of Boucly, Sraer & Thesmar (2011) is that my match is based on total revenue, profit margin and leverage instead of total assets and the return on assets (ROA) ratio. Reason for this is that the validity of the DiD method lies on the parallel trend assumption. The parallel trend assumption entails that there should exist no time-varying differences between PE-backed and matched control firms in the pre-Brexit period (2012 - 2016) and it is the critical assumption for the DiD design in order to interpret causal effects of the models. When I construct a control group using total assets to control for firm size and ROA to control for profitability, this assumption is violated. After the matching procedure is completed, the average effect between PE-backed and matched control firms is estimated:

$$y_i = \Delta\bar{Y}_T - \Delta\bar{Y}_C$$

where $\bar{Y}_T$ is the average for the treatment group and $\bar{Y}_C$ is the average for the control group. It shows the mean of the matching variables and by conducting a t-test, the difference between the treatment and the control group is estimated. Table 3 shows the baseline descriptives for the matched sample (column 2) and the PE sample (column 3) in 2016. Column 4 shows the differences between the two groups, which are not statistically significant, meaning that the parallel trend assumption for the DiD approach holds and allowing causal effects to be inferred. However, the parallel trend assumption cannot be tested intrinsically, since the true outcomes that would have occurred if there was no Brexit shock cannot be observed. I strengthen the interpretation of my analysis by showing evidence of the parallel trend assumption graphically in figures B.5 – B.10 in Appendix B. From the figures, it can be concluded that the parallel trend assumption holds for the dependent variables (investment activity, equity injections, debt issuances) and the matching variables (logarithm of total revenue, profit margin and leverage ratio), since the growth in the variables for both the PE and matched group follows a similar walk in the years leading to the Brexit referendum.

Table 3 - Baseline descriptives of variables for parallel trend assumption

Table 3 provides the baseline descriptives for the PE sample and the matched sample for investment activity, equity injections, debt issuances, logarithm of total revenue, profit margin and leverage ratio. One-to-one propensity score matching is used to match the PE sample with the control group based on logarithm of total revenue, profit margin, leverage ratio and industry. The table gives the mean for the matched sample, PE sample and combined sample in the Brexit year (2016). The difference in column 4 shows to what extent the groups match. The difference cannot be significant as this would violate the parallel trend assumption.

	All	Matched sample	PE sample	Difference
Investment activity	-0.356	-0.386	-0.331	0.055
	(1.286)	(1.316)	(1.263)	
Equity injections	0.023	0.230	-0.184	-0.414
	(1.898)	(2.363)	(1.325)	

Debt issuances	-0.244	-0.119	-0.331	-0.212
	(1.596)	(1.920)	(1.329)	
Log(total revenue)	-0.005	-0.007	-0.003	0.004
	(0.038)	(0.029)	(0.044)	
Profit margin	-0.017	0.018	-0.055	-0.073
	(0.913)	(0.883)	(0.947)	
Leverage ratio	0.011	0.025	-0.003	-0.027
	(0.317)	(0.366)	(0.258)	
	(0.593)	(0.623)	(0.563)	
Observations	630	315	315	

Using this methodology, 315 of the 754 PE-backed firms were matched, generating a total sample of 630 unique firms. Because the year 2011 has too few observations for each variable, it is excluded from the sample. For the control group, the exact same financial data is retrieved from Orbis. After inspecting the distribution of all variables, it seemed some variables had a non-normal distribution. To address this concern and thereby limiting the influence of outliers, the variables are winsorized at 5% to shape the distribution into a normal distribution. Overall, the PE-backed companies are similar to the control group and follow similar paths before the Brexit referendum, which alleviate potential concerns that the PE sample was outperforming the matched sample in the period before the Brexit referendum.

4.2 Empirical strategy

Data ranging from 2011 to 2019 is used to examine the effect of the Brexit referendum as exogenous shock on investment activity of the treatment group relative to the control group. Evaluating the hypotheses requires a more formal analysis of the data and answering each hypothesis is associated with a different model. These will be explained in this section following the methodologies of Górnicka (2018) and Bernstein et al. (2019).

This paper contributes to the literature in various ways. Finance and investments have been an interesting topic of research over the past years, as both fields contribute largely to the real economy. However, economic uncertainty in a country almost always negatively impacts the effect of finance and investments on the economy. For example, various studies (as also shown in section 2.2.3) confirm that if there is political or economic uncertainty, firm investment and consumption is postponed, leading to less wealth for corporates, corporate owners and shareholders in the short-term (Julio & Yook, 2012; Jens, 2017; Smietanka et al., 2018). It is important for us to know what the consequences of firm financing and investment decisions are for the real economy when such an economy copes with economic or political

uncertainty, so that companies can react to this and improve their decision-making for the future. PE can mitigate these negative consequences as they take on a stabilizing role in times of financial turmoil. However, this research field has not been examined to a large extent, partly due to data availability constraints. Thus, by examining the impact of PE firms on firm investment and financing for UK companies around the political and economic uncertainty that came with the Brexit referendum of 2016, a research is conducted that has never been conducted before, thereby filling in a gap that existed in the PE literature.

To test hypothesis 1 *"Investment activity for PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to non-PE-backed companies"*, the following equation (1) is estimated using a difference-in-difference fixed effects regression model:

$$\text{Investment activity}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \theta X_{it} + \varepsilon_{it} \quad (1)$$

where Investment activity$_{it}$ is the dependent variable defined as the change in fixed assets over a year plus the reported depreciation and amortization (D&A), normalized by total assets of firm *i* in year *t*; α_i is a firm-fixed effect; α_t is a year-fixed effect; β_0 is the intercept; $PE\text{-}firm_i$ is a dummy variable which equals 1 if firm i in the sample is backed by a PE firm; $Post\text{-}Brexit$ is a dummy variable which equals 1 if the observation is after the year of the Brexit referendum (2017 – 2019) and it explains the difference of investment activity after the year of the Brexit referendum event relative to the period before the Brexit referendum (2011-2015); β_1 is an interaction term which explains the difference of investment activity of the treatment group compared to the control group in the period before and after the Brexit referendum; and ε_{it} is the error term. To account for potential heteroscedasticity, all the models include robust standard errors. A Hausman test has been performed to examine which model is suitable for the data. Because the null hypothesis of the test is rejected, the fixed effects model will be used. Another reason why all the models are fixed effects regressions is because the fixed effects regressions control for the average differences across firms in observable and unobservable predictors. The fixed effects estimate absorbs all across-group variation and therefore only estimates the within-group variation. Because you want to estimate the difference between a treatment and a control group with one-to-one matching, the within-group variation is exactly what you want to estimate with the difference-in-difference analysis. All variables that influence the dependent variable but are not included in the model are captured in the error term. However, if these variables vary with the dependent variables and are excluded from the model, the estimates can be biased, which lead to a wrongful estimate of the causal effect. This is called omitted variable bias. By using the fixed effects models, potential omitted variable bias is highly reduced.

X_{it} represents various control variables that capture the heterogeneity across the firms in characteristics before the Brexit referendum. Included are firm size (logarithm of total revenue), growth of

revenue, cashflow over assets, profit margin, leverage ratio and change in working capital. Furthermore, all beta coefficients are interpreted in the presence of control variables. Correspondingly, θ contains the estimated coefficient for each of the control variable. Firm size is expected to have a positive effect on investment activity, as firms with larger revenue numbers have more investment opportunities to choose from. Revenue growth is expected to have a positive effect, since firms that experience higher revenue growth are better at exploiting growth opportunities. I expect that cashflow over assets and profit margin will have a positive effect on investment activity, because firms can undertake more investment projects if they have more cash available and if they are more profitable. Furthermore, leverage is expected to be negatively related to investment activity, as firms with more leverage have less room for making capital investments due to interest payments. Lastly, positive working capital changes are expected to have a positive effect on investments, as it makes it easier for a company to fund its operations and invest in future growth projects. Furthermore, after investigating all the relationships between the dependent variables, the independent variable of interest and the control variables using scatter plots, it seems the independent and control variables are linear related to the dependent variable.

For this hypothesis, the interest is on β_1, which represents the difference of investment activity of the treatment group relative to the control group during the Brexit referendum. Specifically, hypothesis 1 is to investigate β_1 as follows:

H_0: there is no significant difference in investment activity of PE-backed firms compared to non-PE-backed firms during the Brexit referendum ($\beta_1 = 0$).
H_1: there is significant difference in investment activity of PE-backed firms compared to non-PE-backed firms during the Brexit referendum ($\beta_1 \neq 0$).

The decision is taken at 1%, 5%, or 10% significance level and this is the same for each hypothesis. This means that the null hypothesis is rejected if the p-value of β_1 is less than any of the three significance levels.

To test hypothesis 2A *"PE-backed companies acquired before the Brexit referendum experienced more equity injections during the Brexit referendum, relative to non-PE-backed companies"* and 2B *"PE-backed companies acquired before the Brexit referendum experienced more debt issuances during the Brexit referendum, relative to non-PE-backed companies"*, the following two equations are estimated using a difference-in-difference fixed effects model:

$$\text{Equity injections}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \theta X_{it} + \varepsilon_{it} \quad (2)$$

$$\text{Debt issuances}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \theta X_{it} + \varepsilon_{it} \quad (3)$$

where Equity injections$_{it}$ is the dependent variable defined as the change in equity minus profit normalized by total assets of firm *i* in year *t*. Debt funding$_{it}$ is the dependent variable defined as the change in total liabilities normalized by total assets of firm *i* in year *t*. All other equation parameters are the same as under equation (1). Equity injections$_{it}$ and Debt issuances$_{it}$ represent the increase or decrease in the amount of equity and debt companies experience. It is expected that PE-backed firms experience more equity injections and debt issuances, because they have easier access to committed equity funds from their PE firms and to debt because of the well-established relation PE firms have with banks. For this hypothesis, the interest is on β_1, which represents the difference of equity injections and debt issuances of the treatment group relative to the control group during the Brexit referendum.

To examine hypotheses 2A and 2B with equations (2) and (3), β_1 is investigated as follows:

H_0: there is no significant difference in equity injections and debt issuances of PE-backed firms compared to non-PE-backed firms during the Brexit referendum ($\beta_1 = 0$).
H_1: there is significant difference in equity injections and debt issuances of PE-backed firms compared to non-PE-backed firms during the Brexit referendum ($\beta_1 \neq 0$).

To test hypothesis 3 *"Investment activity, equity injections and debt issuances for financially constrained PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to financially unconstrained non-PE-backed companies"*, a difference-in-difference fixed effects model is computed similar to equations (1), (2) and (3):

$$\text{Investment activity}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \beta_2(Post\text{-}Brexit \times Fin.Con_i) + \beta_3(PE\text{-}firm_i \times Post\text{-}Brexit \times Fin.Con_i) + \theta X_{it} + \varepsilon_{it} \quad (4)$$

$$\text{Equity injections}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \beta_2(Post\text{-}Brexit \times Fin.Con_i) + \beta_3(PE\text{-}firm_i \times Post\text{-}Brexit \times Fin.Con_i) + \theta X_{it} + \varepsilon_{it} \quad (5)$$

$$\text{Debt issuances}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \beta_2(Post\text{-}Brexit \times Fin.Con_i) + \beta_3(PE\text{-}firm_i \times Post\text{-}Brexit \times Fin.Con_i) + \theta X_{it} + \varepsilon_{it} \quad (6)$$

where $Fin.Con_i$ is a dummy that represents financial constraints. For the definition of financial constraints, three proxies are used in this paper: the cashflow sensitivity of cash, cash holdings and the coverage ratio.

The cashflow sensitivity of cash is defined as the change in cash and cash equivalents normalized by total assets for firm *i*. Cash holdings is defined as the amount of cash and cash equivalents firm *i* holds at year-end, normalized by total assets. The coverage ratio is defined as the EBIT divided by interests paid for firm *i*. For the cashflow sensitivity of cash and the cash holdings measure, a firm is considered financially constrained if the firm is at the top quartile of the measure versus the rest of the sample. For the coverage ratio, a firm is considered financially constrained if the firm is at the lowest quartile of the measure versus the rest of the sample. For this hypothesis, the interest is on β_3, which represents the difference of investment activity, equity injections and debt issuances of financially constrained treatment firms relative to financially unconstrained, control firms during the Brexit referendum.

To examine hypothesis 3 with equations (4), (5) and (6), β_3 is investigated as follows:

H_0: there is no significant difference in investment activity, equity injections and debt issuances of financially constrained PE-backed firms compared to financially unconstrained non-PE-backed firms during the Brexit referendum ($\beta_3 = 0$).
H_1: there is significant difference in investment activity, equity injections and debt issuances of financially constrained PE-backed firms compared to financially unconstrained non-PE-backed firms during the Brexit referendum ($\beta_3 \neq 0$).

To test hypothesis 4 *"Investment activity, equity injections and debt issuances for small PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to non-PE-backed companies"*, a difference-in-difference fixed effects model is computed and the following equations are estimated:

$$\text{Investment activity}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \beta_2(Post\text{-}Brexit \times Firmsize_i) + \beta_3(PE\text{-}firm_i \times Post\text{-}Brexit \times Firmsize_i) + \theta X_{it} + \varepsilon_{it} \quad (7)$$

$$\text{Equity injections}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \beta_2(Post\text{-}Brexit \times Firmsize_i) + \beta_3(PE\text{-}firm_i \times Post\text{-}Brexit \times Firmsize_i) + \theta X_{it} + \varepsilon_{it} \quad (8)$$

$$\text{Debt issuances}_{it} = \alpha_i + \alpha_t + \beta_0 + \beta_1(PE\text{-}firm_i \times Post\text{-}Brexit) + \beta_2(Post\text{-}Brexit \times Firmsize_i) + \beta_3(PE\text{-}firm_i \times Post\text{-}Brexit \times Firmsize_i) + \theta X_{it} + \varepsilon_{it} \quad (9)$$

where $Firmsize_i$ is a dummy that represents firm size, measured as the logarithm of total assets. The dummy variable equals 1 if the firm is at the top quartile of the measure versus the rest of the sample. For this hypothesis, the interest is on β_3, which represents the difference of investment activity, equity injections and debt issuances of small treatment firms relative to control firms during the Brexit referendum.

To examine hypothesis 4 with equations (7), (8) and (9), β_3 is investigated as follows:

H_0: there is no significant difference in investment activity, equity injections and debt issuances of small PE-backed firms compared to non-PE-backed firms during the Brexit referendum ($\beta_3 = 0$).
H_1: there is significant difference in investment activity, equity injections and debt issuances of small PE-backed firms compared to non-PE-backed firms during the Brexit referendum ($\beta_3 \neq 0$).

For linear regressions, several assumptions must be met to interpret the models in a proper way. All the models and variables are tested on normal distribution, linearity and heteroscedasticity, with the latter solved through using robust standard errors and clustering them at firm-level. Also, the variables used must be independent from each other. If variables are too highly correlated, the estimates of the results can be biased, which is called multicollinearity. To test whether this is true for the models, the correlation matrix of the most important variables in this paper is shown in table A.1 of the appendix. It can be seen that the correlations between the variables are relatively low. In addition, a VIF test with investment activity as dependent variable has been conducted to check whether the multicollinearity assumption is not violated (table A.2 of the appendix[3]). Since all values are below 10 and this is generally seen as acceptable in data analysis (Hair et al., 1995), the models do not contain multicollinearity. Lastly, the independent assumption of regressions in panel data is often violated because of correlation of observations of a variable with lagged observations of that variable, also known as autocorrelation. To account for this, standard errors are clustered at firm-level (Petersen, 2005).

[3] For the sake of this paper, only the VIF test has been shown for a regression with investment activity as dependent variable. VIF tests using equity injections and debt issuances as dependent variables have similar outcomes.

5. Results

5.1 Aggregate investment and funding in the UK

Before looking into the results, it is important to give an overview of aggregate firm-level investment of and aggregate lending to UK businesses around the Brexit referendum to understand the real-world situation.

In figure B.11, the total quarterly business investment volume in the United Kingdom from 2011 to 2019 is shown. It can be seen that there has been a recovery in aggregate investment after the financial crisis towards 2016, where investment kept between levels £50 and £55 billion per quarter after 2016. However, slight drops can be seen in the second half of 2016 and 2018. Figure B.12 shows the monthly percentage change in total lending to businesses in the United Kingdom from 2011 to 2019. On average, lending volume started to decline with 2% per month after the financial crisis, but recovered in 2016 and kept on growing with 3%. More specifically, loans to SMEs reached its peak in 2016 but slightly declined and stayed on 1% growth per month after. Loans to large businesses followed a similar path to 2016, but realized more volatile growth (around 3%) in the period after. Furthermore, UK Private Non-Financial Corporations (PNFCs) did not experience a sharp decline in total amounts of business finance raised, as all lines (commercial paper, bond issues, equity issues and loans) move around the zero change line (figure B.13). However, commercial paper, bond issues and loan change became more volatile from 2017 to 2019. The above shows that aggregate business investment of UK firms kept relatively stable with a few small drops, which could be driven by decisions of firms who postpone their investments due to the uncertainty of Brexit as firms might be reluctant to invest if they expect higher costs or larger financial constraints. From the lending figures, it can be concluded that financial institutions still lend out money regardless of Brexit on an aggregate level, with SMEs' growth in lending being less compared to growth in lending to large corporations. The figures also imply that the period around the Brexit referendum has not been such a harsh crisis compared to the financial crisis of 2008. As this is all on an aggregate level, the relevance of this paper is to investigate if PE follows the aggregate national numbers or if PE experiences different activities in firm-level investment and funding of their portfolio companies. Therefore, in the next section, the results of this paper are discussed.

5.2 Regression results and testing of hypotheses

5.2.1 Investment activity

The start of the results section discusses whether PE firms were more capable of keeping up investment activity of their portfolio companies relative to their non-PE-backed peers. Hypothesis 1 is formulated as "Investment activity for PE-backed companies acquired before the Brexit referendum improves after the

Brexit referendum, relative to non-PE-backed companies". Table 4 presents the regression results for the difference in investment activity of PE-backed companies versus non-PE-backed companies.

Table 4 – Difference-in-difference analysis for investment activity

Table 4 presents the results of the difference-in-difference fixed effects regression on the dependent variable investment activity over total assets. The main parameter of interest β_1 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not) and the Post-Brexit dummy (the years 2017-2019) and represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. Odd column presents the model without control variables, while the even column presents the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. Both models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

	Investment activity/total assets	
	(1) Model 1	(2) Model 2
β_0 (constant)	0.0545***	0.0082
	(0.0028)	(0.0587)
β_1 PE-firm x Post-Brexit	0.0079*	0.0076**
	(0.0043)	(0.0044)
Log(totalrevenue)		0.0042
		(0.0058)
Revenue growth		0.0492***
		(0.0077)
Cashflow/total assets		-0.0559**
		(0.0272)
Profit margin		0.0006**
		(0.0003)
Leverage ratio		-0.0093**
		(0.0044)
Change in working capital		$-4.67e^{-07}$
		$(8.43e^{-07})$
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Adjusted R-squared	0.091	0.123
Observations (N)	4,272	3,927
Clusters	616	606

The main variable of interest is β_1, which represents the differential estimate for the treatment group (PE-backed) relative to the control group (non-PE-backed). All the results from the table include year fixed effects to control for factors changing each year that are common to the sample and firm fixed effects. In column 1 of table 4, model 1 is presented where only the interaction term is included in the regression. The coefficient is 0.0079, positive and significant at the 10% level. This means that PE-backed companies increased their investment activity (measured as change in fixed assets plus D&A normalized by total assets) 0.8% more post-Brexit, relative to non-PE-backed companies in the sample. The adjusted R-squared of the model is 9.1% and represents a goodness-of-fit measure, indicating how well the dependent variable is

explained by the independent variables (the strength of the relationship). However, the coefficient of β_1 is only statistically significant at the 10% level, which is not enough to reject the null hypothesis of hypothesis 1. Nevertheless, in column 2 of table 4, model 2 is presented, including various control variables. While still small in magnitude, the coefficient of β_3 (0.0076) is now statistically significant at the 5% level. Also, the adjusted R-squared increased to 12.3%, indicating an improved explanation of the dependent variables by the independent variables which is due to the inclusion of the control variables. While total revenue and the change in working capital are not statistically different from zero and thus have no significant effect on investment activity, revenue growth, cashflow/total assets, profit margin and leverage do have significant effects. If a firm's revenue growth increases by 1%, investment activity increases with 4.9%, which is in line with expectation. It implies that higher growth firms invest more aggressively, have more growth opportunities to choose from and are better at exploiting them. Furthermore, cashflow to total assets is negative, meaning that the more internal funds a company has available relative to its total assets, the less the company invests. The coefficient for profit margin is positive but almost negligible (0.0006), implying that higher profitability leads to more investments. Lastly, leverage is also small and negative (-0.0093), meaning that if a firm has a higher leverage level, it invests 0.9% less. Reason for this is that firms who have high levels of leverage have less money to invest due higher interest payments. Overall, model 2 yields the interesting finding that the main interaction of interest is positive and significant. This allows me to reject the null hypothesis and accept hypothesis 1, because there is a significant difference of 0.8% in investment activity of PE-backed firms compared to non-PE-backed firms during the Brexit referendum. This is consistent with what Bernstein et al. (2019) found in their research (5.6%) that PE firms can act as a stabilizing factor in periods of economic uncertainty by keeping up firm investments. It is also in line with the idea of Boucly, Sraer & Thesmar (2011) that PE-backed companies take advantage of unexploited growth opportunities and with the findings of Engel & Stiebale (2014). However, I must acknowledge that the difference I found is very small in magnitude. An explanation for this could be that we did not see a severe increase or decrease in business investment of UK companies during the Brexit referendum as shown in figure B.11. The ability of PE to withstand crises for their portfolio companies might be more present in times of more severe economic turmoil.

5.2.2 Funding policies

In investigating hypothesis 1, we have seen that there is a difference in investment activity for companies that are owned by PE and their peers. To learn more about the drivers behind this difference, I examine if the difference in investment activity is caused by a difference in funding policy. In table 5, the regression

results for equity injections (change in equity minus profit) over total assets and debt issuances (change in total liabilities) over total assets are shown.

Table 5 - Difference-in-difference analysis for funding policies

Table 5 presents the results of the difference-in-difference fixed effects regressions on the dependent variables equity injections over total assets and debt issuances over total assets. The main parameter of interest β_1 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not) and the Post-Brexit dummy (the years 2017-2019) and represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

	Equity injections/total assets		Debt issuances/total assets	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
β_0 (constant)	-0.0148***	0.0750	0.0436***	0.178
	(0.0026)	(0.0540)	(0.0058)	(0.134)
β_1 PE-firm x Post-Brexit	-0.0053	-0.0061*	0.0264***	0.0153**
	(0.0037)	(0.0037)	(0.0087)	(0.0087)
Log(totalrevenue)		-0.0061		-0.0121
		(0.0053)		(0.0133)
Revenue growth		0.0324***		0.207***
		(0.0066)		(0.0154)
Cashflow/total assets		-0.2540***		-0.657***
		(0.0294)		(0.0608)
Profit margin		0.0001***		0.0024***
		(0.0003)		(0.0006)
Leverage ratio		-0.0319***		0.0567***
		(0.0039)		(0.0102)
Change in working capital		$3.66e^{-07}$		$8.40e^{-06}$***
		($7.19e^{-07}$)		($1.96e^{-06}$)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.102	0.174	0.059	0.201
Observations (N)	4,229	3,927	4,491	3,927
Clusters	630	606	630	606

Hypothesis 2A is "PE-backed companies acquired before the Brexit referendum experienced more equity injections during the Brexit referendum, relative to non-PE-backed companies". For models 1 and 2, the adjusted R-squared numbers are 10.2% and 17.4%, which indicate a good explanation of the dependent variables by the independent variables. For equity injections over assets, we do not see a significant effect of a firm being PE-backed observed after the Brexit (column 1). When the set of control variables are included (column 2), the interaction coefficient (-0.0061) becomes more significant, still only at the 10% level. This allows me to reject the null hypothesis. Although there is a significant difference in equity injections between PE-backed an non-PE-backed firms, the amount of equity funding PE provided for their

portfolio companies is lower. The coefficient is negative and goes against hypothesis 2A. Therefore, I do not accept hypothesis 2A. PE provided lower equity amounts to their portfolio companies (0.6%) relative to non-PE-backed companies after the referendum, which is against the theory that PE-backed firms have quick access to committed funds from their partners to use for their operations (Bernstein et al., 2019). Instead, the evidence points more towards the findings of Jens (2017), who states that during a period of political uncertainty, firms delay their equity issuances with respect to firm investment. The negative effect can also be explained by the fact that once a PE firm has invested money in a target company, they shy away from investing additional equity during the holding period, as this will negatively affect their return on invested capital (and eventually compensation) when they look for an exit of the company (Gilligan & Wright, 2020). Notable is that revenue growth, cashflow to total assets, profit margin and leverage all are strong and significant at the 1% level, while the logarithm of total revenue and the change in working capital are not statistically different from zero. Higher growth firms experiences more equity inflows, since those firms are more attractive to invest in. Furthermore, an increase in cashflow by one unit leads to a large decrease in equity injections since the firm does not need additional funds if its cashflow increases. The effect of profit margin is negligible, while increasing leverage leads to a reduction in equity injections, as there is less equity needed if a firm takes on more debt.

Hypothesis 2B is "PE-backed companies acquired before the Brexit referendum experienced more debt issuances during the Brexit referendum, relative to non-PE-backed companies". Adjusted R-squared increases from 5.9% to 20.1% when the control variables are included (column 3 and 4). The interaction term of interest is positive and significant at the 1% level (0.0264). Including control variables (model 4) in the regression slightly weaken the coefficient to 0.0153, but stays significant at the 5% level. PE-backed firms experienced 1.5% more debt issuances compared to their peers post-Brexit, which is consistent with the rationale that PE firms have strong relationships with banks (Ivashina & Kovner, 2011). The evidence is also in line with the amount of lending to businesses the UK experienced (figures B.12 and B.13). It appears PE firms used additional debt funds to support their portfolio firm's investment in the years after Brexit, which makes this finding in line with Bernstein et al. (2019) and inconsistent with the research of Jens (2017), who argued that firms delay debt issuances tied to firm investment during political uncertainty. Therefore, the null hypothesis is rejected, since PE-backed companies experienced more debt issuances (1.5%) during the Brexit relative to their peers. Regarding control variables, all of them must be interpreted in a similar way as under hypothesis 2A, except for the leverage ratio and the change in working capital. The coefficient of leverage is now positive and highly significant, meaning that the more debt a firm takes on relative to its total assets, the higher its debt issuances are, both for PE-backed and non-PE-backed firms. In addition, in figures B.7 and B.10, it can be seen that the PE-backed sample experienced more debt issuances, but also has higher leverage numbers post-Brexit. This might be the driver for the result that PE-

backed companies experienced more debt issuances post-Brexit compared to their peers. Change in working capital has a very small (almost negligible) but highly significant positive effect on debt issuances. An increase in working capital has a positive influence on debt issuances, as an improved working capital number is a signal of a more financially sound company and allows for more debt issuances.

5.2.3 Financial constraints

We have seen that PE-backed companies do better in keeping up investment activity relative to their peers during the Brexit. Part of this is due to the funding policy (in particular debt issuances) PE-backed firms experienced. Next, we want to investigate whether investment activity is linked to the amount of financial constraints of a particular firm. Hypothesis 3 therefore is formulated as "Investment activity, equity injections and debt issuances for financially constrained PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to financially unconstrained non-PE-backed companies". In table 6, the regression results for investment activity and three financial constraints measures are shown.

Table 6 - Difference-in-difference analysis for investment activity with financial constraints

Table 6 presents the results of the difference-in-difference fixed effects regressions on the dependent variable investment activity over total assets. The main parameter of interest β_3 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not), the Post-Brexit dummy (the years 2017-2019) and a financial constraint dummy. It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. The financial constraints dummies are the cashflow sensitivity of cash, cash holdings and coverage ratio. Cashflow sensitivity of cash and cash holdings equal one if the firm is in the top quartile of the distribution, while coverage ratio equals one if the firm is at the lowest quartile of the distribution. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	Investment activity/total assets					
Financial constraints measures	Cashflow sensitivity of cash		Cash holdings		Coverage ratio	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
β_0 (constant)	0.0580***	0.0235	0.0590***	0.0165	0.0552***	0.0078
	(0.0031)	(0.0592)	(0.0031)	(0.0591)	(0.0029)	(0.0587)
β_1 PE-firm x Post-Brexit	0.0080	0.0083	0.0075*	0.0072*	0.0096**	0.0086**
	(0.0050)	(0.0051)	(0.0050)	(0.0053)	(0.0042)	(0.0044)
β_2 Post-Brexit x Fin.constraints	0.0012	0.0053	0.0075*	0.0057*	0.0018*	0.0029*
	(0.0066)	(0.0069)	(0.0065)	(0.0070)	(0.0108)	(0.0112)
β_3 PE-firm x Post-Brexit x Fin. constraints	-0.0007	-0.0015	0.0013*	0.0018*	0.0072**	0.0063**
	(0.0089)	(0.0093)	(0.0096)	(0.0010)	(0.0141)	(0.0145)
Log(totalrevenue)		0.0030		0.0037		0.0042
		(0.0058)		(0.0058)		(0.0058)

Revenue growth		0.0529***		0.0489***		0.0491***
		(0.0078)		(0.0078)		(0.0077)
Cashflow/total assets		-0.0486*		-0.0484*		-0.0539*
		(0.0266)		(0.0272)		(0.0277)
Profit margin		0.0006**		0.0006**		0.0006**
		(0.0003)		(0.0003)		(0.0003)
Leverage ratio		-0.0084*		-0.0093**		-0.0095**
		(0.0044)		(0.0044)		(0.0044)
Change in working capital		$-8.17e^{-07}$		$-5.41e^{-07}$		$-4.60e^{-07}$
		$(8.46e^{-07})$		$(8.41e^{-07})$		$(8.43e^{-07})$
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.096	0.131	0.095	0.126	0.092	0.123
Observations (N)	4,272	3,927	4,272	3,927	4,272	3,927
Clusters	616	606	616	606	616	606

The adjusted R-squared for all the models is relatively constant, increasing from approximately 9% to 12%. First, regarding the cashflow sensitivity of cash (change in cash and cash equivalents divided by total assets) in column 1 and 2, from β_3 we observe a negative coefficient. This means that a financially constraint PE-backed firm has a 0.2% lower investment activity post-Brexit compared to a financially unconstrained, non-PE-backed firm, making it more dependent on internal cashflows. However, the coefficient is not statistically significant and very small, meaning we cannot interpret it. The difference between PE-backed and non-PE-backed companies with respect to the cashflow sensitivity of cash is therefore negligible. The second measure of financial constraints is the cash holdings proxy (cash and cash equivalents divided by total assets). The interaction term in columns 3 and 4 is positive, but now significant at the 10% level. Financially constrained PE-backed companies invest 0.1% (column 3) and 0.2% (column 4) more relative to their control firms post-Brexit. This is in line with the findings of Boucly, Sraer & Thesmar (2011), who state that financially constrained PE-backed firms increased capital expenditures of their portfolio companies more compared to peers and it suggests that PE helps overcoming financing constraints of their portfolio companies. The interpretation must be viewed with caution however, as the difference is small and only significant at the 10% level. Third, we can see that the coefficients for the coverage ratio (EBIT divided by interest paid) are positive and significant at the 5% level. Post-Brexit, financially constrained PE-backed firms made 0.7% (column 5) and 0.6% (column 6) larger investments compared to their peers, in line with the previous finding. The coefficients stay relatively small. From the above, it is clear that investment activity for financially constrained PE-backed companies has improved after the Brexit referendum relative to financially unconstrained non-PE-backed companies. However, this does not apply to all financial constraints measures, as the cashflow sensitivity of cash coefficients are not significant and the cash holdings coefficients at the lower 10% level. Only the coverage ratio has significant explanatory power.

To test whether the higher investment activity for financially constrained PE-backed firms is explained by the amount of equity and debt funding, additional regressions with equity injections over total assets and debt issuances over total assets as dependent variables have been performed and can be viewed in table A.3 and A.4 of the appendix. Under section 5.2.2 we saw that firms that were owned by PE particularly benefited from debt issuances and that they benefited more equally from equity funding similar to other firms in the sample. However, this is different for PE owned firms that cope with financial constraints. In table A.3 of the appendix, the columns entail both significant and insignificant financial constraint interactions, with the significant coefficients being positive as expected. This entails interesting evidence of financially constrained firms benefiting from PE ownership by receiving additional equity to reduce financial constraints. We cannot say this is true for the amount of debt issuances (table A.4). Neither of the (both positive and negative) coefficients are statistically significant, which implies that PE firms were not willing to take on additional debt for their financially constrained portfolio companies, but instead that debt issuances benefited every PE-backed company in the sample similarly. Reason for this could be that taking on additional debt for companies that already have higher absolute debt levels can lead to detrimental interest payments and financial distress. PE firms prefer to turn to equity for additional funding when their portfolio firm is already financially constrained. The result however is against the result of Bernstein et al. (2019), who found that financially constrained firms who were owned by PE particularly benefited from debt instead of equity. This allows me to accept hypothesis 3, but only for the part regarding investment activity and equity injections.

5.2.4 Firm size

Finally, hypothesis 4 is tested and is formulated as follows: "Investment activity, equity injections and debt issuances for small PE-backed companies acquired before the Brexit referendum improves after the Brexit referendum, relative to non-PE-backed companies". In table 7, the regression results for investment activity, equity injections and debt issuances are shown using an dummy variable that represents firm size, which equals one if a firm is in the top quartile of the size distribution (logarithm of total assets) in the sample.

Table 7 - Difference-in-difference analysis for investment activity, equity injections and debt issuances with firm size

Table 7 presents the results of the difference-in-difference fixed effects regressions on the dependent variables investment activity over total assets, equity injections over total assets and debt issuances over total assets. The main parameter of interest β_3 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not), the Post-Brexit dummy (the years 2017-2019) and the firm size dummy. It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. Firm size is measured as the logarithm of total assets and the firm size dummy equals one if the firm is in the top quartile of the distribution. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in

working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	Investment activity/total assets		Equity injections/total assets		Debt issuances/total assets	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
β_0 (constant)	0.0494***	0.0311	-0.0180***	0.0822	0.0291***	0.228*
	(0.0032)	(0.0578)	(0.0031)	(0.0552)	(0.0064)	(0.136)
β_1 PE-firm x Post-Brexit	0.0096*	0.0087*	-0.0045**	-0.0057*	0.0283***	0.0193*
	(0.0050)	(0.0051)	(0.0045)	(0.0043)	(0.0108)	(0.0104)
β_2 Post-Brexit x Firmsize	0.0122	0.0098	-0.0026	-0.0016	0.0193	0.0093
	(0.0074)	(0.0077)	(0.0060)	(0.0065)	(0.0118)	(0.0134)
β_3 PE-firm x Post-Brexit x Firmsize	-0.0118	-0.0076	-0.0032	-0.0007	-0.0234	-0.0193
	(0.0097)	(0.0099)	(0.0079)	(0.0082)	(0.0181)	(0.0191)
Log(totalrevenue)		0.0014		-0.0071		-0.0183
		(0.0057)		(0.0055)		(0.0135)
Revenue growth		0.0501***		0.0327***		0.209***
		(0.0077)		(0.0066)		(0.0155)
Cashflow/total assets		-0.0449*		-0.251***		-0.634***
		(0.0270)		(0.0296)		(0.0611)
Profit margin		0.0005*		0.0010***		0.0022***
		(0.0003)		(0.0003)		(0.0006)
Leverage ratio		-0.0097**		-0.0319***		0.0561***
		(0.0044)		(0.0039)		(0.0102)
Change in working capital		$-4.61e^{-07}$		$3.93e^{-07}$		$8.40e^{-06}$***
		($8.36e^{-07}$)		($7.20e^{-07}$)		($1.94e^{-06}$)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.097	0.129	0.104	0.175	0.068	0.206
Observations (N)	4,272	3,927	4,229	3,927	4,491	3,927
Clusters	616	606	630	606	630	606

If we look at the interaction term of interest β_3 in column 1 and 2 of table 7, we see that the coefficient is negative and insignificant. This is not line with the idea that smaller firms benefited more from PE relative to larger firms because smaller firms face higher cost premiums of external capital providers (Carpenter & Petersen, 2002a) or more financial constraints (Engel & Stiebale, 2014). Thus, the effect of PE on investment activity is not stronger for smaller companies in the sample, meaning we cannot reject the null hypothesis of hypothesis 4. Also, there is no statistical difference in funding policy (columns 3 to 6 of table 7) for small PE-backed firms compared to other firms in the sample. PE equally contributes to smaller companies as it does to larger companies, meaning that firm size is not an explanation for particular firms benefiting from PE ownership with regards to investment activity, equity and debt funding.

Overall, the conclusion is that during the economic uncertainty around the Brexit referendum, PE did contribute to the investment activity of their portfolio companies relative to non-PE-backed companies.

Part of this can be explained by PE taking on additional debt to support investments. However, when looking at financially constrained PE-backed companies, it appears PE acts differently. If a company is financially constrained, PE prefers to inject equity in their portfolio companies rather than taking on more leverage. Lastly, PE contributes similarly to large companies as it does to small companies.

5.3 Robustness checks and extensions

In this section, several robustness checks and extensions are performed. First, time-varying fixed effects regressions are executed to capture potential significant differences between PE-backed and non-PE-backed companies prior to the Brexit referendum (table A.5 of the appendix). From table A.5, we can conclude that the results are not driven by already existing differences among PE-backed and non-PE-backed companies for investment activity (columns 1 and 2), equity injections (columns 3 and 4) and debt issuances (columns 5 and 6), since both groups lack a statistically significant pattern before the referendum. Second, accounting performance analyses are conducted using EBITDA margin (EBITDA divided by total revenue), ROA (return on assets; net income divided by total assets) and ROE (return on equity; net income divided by total equity) as dependent variables to assess whether the larger investment by PE-backed companies has led to improved firm performance relative to their peers (table A.6 of the appendix). There is no significant difference in performance measured by EBITDA margin or ROE for PE-backed companies compared to their peers in the sample. Furthermore, the coefficient of the interaction term for ROA is significant (at the 10% level) and negative. PE-backed companies have slightly lower ROA (0.9%) after the Brexit referendum, which could indicate that the increase in investments of PE-backed companies were detrimental for the ROA number and thus did not always lead to high quality or low risk projects. However, the difference is small and only significant at the 10% level and given the long-term nature of receiving returns on invested projects, these measures of accounting performance might not be able to fully absorb the underlying changes in asset quality. An explanation could be that the PE-backed companies and the control companies are not matched on total assets, meaning that the existing difference in average total assets of PE-backed companies and non-PE-backed companies could drive the difference in ROA[4]. Also, in my prior findings PE-backed companies experienced more debt issuances (table 5) and they have higher leverage ratios post-Brexit (figure B.10 of the appendix), suggesting that they might experience higher interest costs which could be an explanation for the lower ROA number post-Brexit. This suggests that the performance of PE-backed companies was not differentially affected by the uncertainty of Brexit. Third, an additional difference-in-difference regression is performed by measuring firm size as the total amount of firm employees to test whether the results for hypothesis 4 will change (table A.7 of the appendix). It appears

[4] The mean of total assets of PE-backed companies equals €52 million, whilst this number is €40 million for non-PE-backed peers in the sample.

that using firm employment as a measure for firm size does not alter the results in section 5.2.4. Neither of the coefficients are significant, meaning that PE still equally contributes to smaller companies as it does to larger companies with regards to investment activity, equity injections and debt issuances. Lastly, while not shown, the results also do not change when controlling for firm size as the logarithm of total assets instead of the logarithm of total revenue.

6. Conclusion

This paper sheds new light on how PE contributes to investments and funding of their portfolio companies in the UK during the Brexit referendum. The main objective of the paper is to explore whether PE-backed firms were able to cope with the economic and political uncertainty during the transition period of the Brexit referendum outcome by examining their investment activity, equity injections and debt issuances from 2012 to 2019. The paper is particularly relevant as it researches a modern-day topic such as the Brexit, it examines the UK PE market which is the largest of Continental Europe and it shows what the relation between political and economic uncertainty stemmed from the Brexit and financial intermediaries such as PE practitioners entails, a relation which has not been researched to a large extent yet.

Building upon the scarce empirical literature on PE, investments, funding and financial constraints (Boucly, Sraer & Thesmar, 2011; Engel & Stiebale, 2014; Jens, 2017; Bernstein et al., 2019), the paper serves as the foundation for answering the research question: *"Can PE act as an economic stabilizing factor by keeping up investment activity and funding of their portfolio companies relative to non-PE-backed companies during the Brexit referendum?"*. Using a difference-in-difference framework with a sample of 630 companies of which half received PE investment in the period ranging from 2011 to 2015, the research question is addressed through the analysis of 4 hypotheses. The paper finds evidence that PE-backed companies increased their investment activity more relative to non-PE-backed companies in the post-Brexit period (2017 – 2019), which is in line with the notion that PE takes advantage of unexploited growth opportunities. Furthermore, in examining the drivers of the increased investment activity, the results indicate that PE-backed companies experienced lower equity injections compared to their peers, in line with the ideas that firms delay their equity issuances with respect to firm investment in uncertain periods and that PE dislikes investing additional equity in their portfolio companies as this could negatively affect their return on invested capital. Conversely, PE took on more debt for their portfolio companies relative to non-PE-backed companies, consistent with the thought that PE firms have strong ties with the banking industry, making debt issuances the sole explanatory factor of the increased investment activity. Next, regarding the investment activity and funding policies of PE-backed companies which are bound to financial constraints, the findings suggest that post-Brexit, financially constrained PE-backed companies are better at keeping up investment activity compared to non-PE counterparts in the sample. However, when looking at funding policies to explain the increased investment activity for financially constrained PE-backed companies, the evidence points towards a different direction compared to the previous findings. If a PE-backed company is financially constrained, it favors to turn to equity for financing its investments instead of debt, since the firm could be brought into financial distress if it takes on additional debt. Moreover, this paper did not find evidence of PE contributing more to small firms as it does to large firms. Altogether, we may conclude that PE can act as a stabilizing factor by keeping up investment activity and funding of their portfolio companies

during the Brexit uncertainty and the paper highlights the ability of PE to create economic value for companies in times of financial and economic turmoil.

Although the paper finds new evidence within the PE, investment and funding literature, addressing its limitations is necessary to improve the validity and integrity of it. As shown in the literature in section 2.2.3, several consequences of the Brexit uncertainty are already visible, for example that political uncertainty can lead to companies postponing their investments and consumers their consumption (Julio & Yook, 2012; Jens, 2017). However, since the Brexit referendum vote is only formal and business investment and lending levels stayed relatively constant during the transition period (figures B.11 – B.13 of the appendix), the event might not be such a detrimental exogenous shock compared to the global financial crisis back in 2008, where business investment and lending levels decreased heavily in the UK (Bernstein et al., 2019). Nevertheless, this notion is in line with the results found in this paper, as all effects found are relatively small, indicating a moderate impact of the Brexit uncertainty. Furthermore, this paper measured investment activity as the change in fixed assets plus D&A normalized by total assets. However, investment activity can also entail R&D, patents and capital expenditures. Since the Zephyr and Orbis databases lack sufficient data on these measures, the paper does not contain an in-depth split of the different types of investment activity. Also, various well-known measures for financial constraints could not be used, since those measures require public data (i.e. dividends) and the majority of the sample consists of private companies. Moreover, future research could build on this study in various ways. The current impact of COVID-19 has devastating consequences for the world population and the majority of companies worldwide, including those that are backed by PE. In contrast with the global financial crisis, during the COVID-19 crisis, lending levels started to rise as banks were pleased to provide liquidity for their clients to withstand the large drops in investment (Bank of England, 2021). Therefore, an interesting follow-up of this paper would be to conduct a research on the effects of the COVID-19 crisis on PE activity, investments and funding, with data before and after the crisis to examine the choices PE professionals make for their portfolio companies. Besides, in the current financial climate it is relatively easy for PE firms to receive funding from investors and banks. As we saw in figure B.1 of the appendix, the amount of funds PE firms are raising is increasing and currently, there is a lot of dry powder (funds that are ready to be invested) available. Interesting would be to construct a dry powder variable to investigate whether PE firms with more resources available react differently to a crisis compared to PE firms which have less resources available. Looking closer to the various types of limited partners could also be of value, since differences between investors in willingness to support portfolio companies' investments during periods of economic uncertainty might be present. Lastly, additional research can be conducted in further countries, since there is very little evidence on PE practices in countries other than the UK and US.

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Appendix

A. Tables

Table A.1 – Correlation matrix

Table A.1 presents the correlation numbers for all variables. 'TA' is the abbreviation of 'total assets'.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Investment activity	1.00												
(2) Equity injections	0.18	1.00											
(3) Debt issuances	0.33	-0.06	1.00										
(4) Cashfl. sens. of cash	-0.05	0.07	0.19	1.00									
(5) Cash holdings	-0.09	-0.10	-0.00	0.38	1.00								
(6) Coverage ratio	-0.06	-0.18	-0.03	0.13	0.33	1.00							
(7) Log (total revenue)	0.07	0.02	0.05	0.00	-0.09	0.00	1.00						
(8) Cashflow	0.24	0.11	0.31	0.18	0.05	0.13	0.10	1.00					
(9) Revenue growth	0.13	-0.35	-0.16	0.12	0.22	0.39	-0.02	0.20	1.00				
(10) Profit margin	0.03	-0.21	-0.10	0.11	0.14	0.33	-0.09	0.13	0.49	1.00			
(11) Leverage ratio	0.07	0.02	0.20	-0.01	-0.01	-0.33	0.05	0.04	-0.28	-0.41	1.00		
(12) Change in working capital	0.02	0.03	0.12	-0.06	-0.03	0.06	0.04	0.15	0.04	0.04	-0.02	1.00	
(13) Log (TA)	0.06	0.09	0.07	-0.03	-0.22	-0.10	0.42	0.00	-0.14	0.07	-0.02	0.03	1.00

Table A.2 – VIF values

Table A.2 presents the VIF values for the linear regression with investment activity as dependent variable.

Variables	VIF	1/VIF
Cashfl. sens. of cash	1.26	0.794241
Cash holdings	1.32	0.755727
Coverage ratio	1.51	0.664067
Log (total revenue)	3.23	0.309480
Cashflow	2.70	0.370631
Revenue growth	1.35	0.743052
Profit margin	2.53	0.394582
Leverage ratio	1.38	0.725732
Change in working capital	1.06	0.939658
Log (total assets)	3.51	0.284818
Mean VIF	1.87	

Table A.3 - Difference-in-difference analysis for equity injections with financial constraints

Table A.3 presents the results of the difference-in-difference fixed effects regressions on the dependent variable equity injections over total assets. The main parameter of interest β_3 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not), the Post-Brexit dummy (the years 2017-2019) and a financial constraint dummy. It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. The financial constraints dummies are the cashflow sensitivity of cash, cash holdings and coverage ratio. Cashflow sensitivity of cash and cash holdings equal one if the firm is in the top quartile of the distribution, while coverage ratio equals one if the firm is at the lowest quartile of the distribution. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	Equity injections/total assets					
Financial constraints measures	Cashflow sensitivity of cash		Cash holdings		Coverage ratio	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
β_0 (constant)	-0.0170***	0.0641	-0.0151***	0.0707	-0.0154***	0.0745
	(0.0029)	(0.0530)	(0.0029)	(0.0537)	(0.0027)	(0.0542)
β_1 PE-firm x Post-Brexit	-0.0109**	-0.0107**	-0.0088**	-0.0075*	-0.0045	-0.0069*
	(0.0043)	(0.0042)	(0.0041)	(0.0041)	(0.0043)	(0.0041)
β_2 Post-Brexit x Fin.constraints	-0.0135**	-0.0136**	-0.0074	-0.0048	0.0054	0.0033
	(0.0063)	(0.0064)	(0.0066)	(0.0066)	(0.0078)	(0.0081)
β_3 PE-firm x Post-Brexit x Fin.constraints	0.0187**	0.0153*	0.0138	0.0071*	0.0077	0.0015
	(0.0087)	(0.0088)	(0.0105)	(0.0105)	(0.0097)	(0.0098)
Log(totalrevenue)		-0.0053		-0.0059		-0.0058
		(0.0052)		(0.0053)		(0.0053)
Revenue growth		0.0293***		0.0324***		0.0320***
		(0.0065)		(0.0066)		(0.0066)
Cashflow/total assets		-0.258***		-0.258***		-0.256***
		(0.0295)		(0.0294)		(0.0294)
Profit margin		0.0001***		0.0010***		0.0009***
		(0.0003)		(0.0003)		(0.0003)
Leverage ratio		-0.0325***		-0.0319***		-0.0315***
		(0.0039)		(0.0039)		(0.0040)
Change in working capital		$6.05e^{-07}$		$4.10e^{-07}$		$3.29e^{-07}$
		($7.29e^{-07}$)		($7.21e^{-07}$)		($7.21e^{-07}$)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.106	0.180	0.103	0.176	0.103	0.175
Observations (N)	4,229	3,927	4,229	3,927	4,229	3,927
Clusters	630	606	630	606	630	606

Table A.4 - Difference-in-difference analysis for debt issuances with financial constraints

Table A.4 presents the results of the difference-in-difference fixed effects regressions on the dependent variable debt issuances over total assets. The main parameter of interest β_3 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not), the Post-Brexit dummy (the years 2017-2019) and a financial constraint dummy. It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. The financial constraints dummies are the cashflow sensitivity of cash, cash holdings and coverage ratio. Cashflow sensitivity of cash and cash holdings equal one if the firm is in the top quartile of the distribution, while coverage ratio equals one if the firm is at the lowest quartile of the distribution. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	Debt issuances/total assets					
Financial constraints measures	Cashflow sensitivity of cash		Cash holdings		Coverage ratio	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
β_0 (constant)	0.0307***	0.151	0.0484***	0.177	0.0394***	0.171
	(0.0063)	(0.135)	(0.0067)	(0.134)	(0.0059)	(0.134)
β_1 PE-firm x Post-Brexit	0.0266***	0.0211**	0.0285***	0.0244**	0.0186**	0.0091
	(0.0102)	(0.0099)	(0.0099)	(0.0096)	(0.0090)	(0.0090)
β_2 Post-Brexit x Fin.constraints	0.0046	0.0284	0.0097	0.0178	-0.0119	-0.0024
	(0.0142)	(0.0135)	(0.0135)	(0.0146)	(0.0218)	(0.0235)
β_3 PE-firm x Post-Brexit x Fin.constraints	-0.0039	-0.0160	-0.0080	-0.0323	-0.0312	-0.0288
	(0.0209)	(0.0203)	(0.0224)	(0.0233)	(0.0289)	(0.0301)
Log(totalrevenue)		-0.0099		-0.0120		-0.0112
		(0.0133)		(0.0132)		(0.0132)
Revenue growth		0.200***		0.208***		0.207***
		(0.0157)		(0.0155)		(0.0155)
Cashflow/total assets		-0.671***		-0.658***		-0.663***
		(0.0611)		(0.0610)		(0.0604)
Profit margin		0.0023***		0.0024***		0.0024***
		(0.0006)		(0.0006)		(0.0006)
Leverage ratio		0.0548***		0.0564***		0.0563***
		(0.0101)		(0.0102)		(0.0102)
Change in working capital		9.34e^{-06}***		8.34e^{-06}***		8.37e^{-06}***
		(1.95e^{-06})		(1.96e^{-06})		(1.96e^{-06})
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.072	0.213	0.060	0.202	0.064	0.202
Observations (N)	4,491	3,927	4,491	3,927	4,491	3,927
Clusters	630	606	630	606	630	606

Table A.5 – Time-varying difference-in-difference analysis for investment activity and funding policies

Table A.5 presents the results of the time-varying difference-in-difference fixed effects regressions on the dependent variables investment activity over total assets, equity injections over total assets and debt issuances over total assets. The main parameter of interest is the interaction term between the PE-firm dummy (if a firm is PE-backed or not) and year. It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed). Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	Investment activity/total assets		Equity injections/total assets		Debt issuances/total assets	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
PE-firm x 2013	0.0067	0.0072	-0.0060	-0.0038	-0.0053	-0.0120
	(0.0073)	(0.0075)	(0.0075)	(0.0073)	(0.0178)	(0.0176)
PE-firm x 2014	0.0043	0.0095	0.0047	0.0032	-0.0117	-0.0147
	(0.0069)	(0.0068)	(0.0076)	(0.0075)	(0.0161)	(0.0161)
PE-firm x 2015	0.0034	0.0040	0.0082	0.0010	0.0231	0.0086
	(0.0079)	(0.0080)	(0.0077)	(0.0078)	(0.0172)	(0.0165)
PE-firm x 2016	0.0109	0.0109	0.0085	0.0042	-0.0117	-0.0364*
	(0.0084)	(0.0086)	(0.0078)	(0.0081)	(0.0179)	(0.0174)
PE-firm x 2017	0.0136*	0.0163**	-0.0093	-0.0122*	0.0343**	0.0107**
	(0.0078)	(0.0079)	(0.0071)	(0.0074)	(0.0168)	(0.0165)
PE-firm x 2018	0.0091	0.0080	0.0007	-0.0021*	0.0279*	0.0123
	(0.0079)	(0.0080)	(0.0072)	(0.0075)	(0.0168)	(0.0170)
PE-firm x 2019	0.0178**	0.0191**	0.0053	0.0013	0.0121	-0.0175*
	(0.0082)	(0.0085)	(0.0076)	(0.0074)	(0.0173)	(0.0180)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.092	0.124	0.104	0.176	0.061	0.204
Observations (N)	4,272	3,927	4,229	3,927	4,491	3,927
Clusters	616	606	630	606	630	606

Table A.6 – Accounting performance analysis

Table A.6 presents the results of the accounting performance difference-in-difference fixed effects regressions on the dependent variables EBITDA margin (EBITDA divided by total revenue), ROA (return on assets; net income divided by total assets) and ROE (return on equity; net income divided by total equity). The main parameter of interest β_1 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not) and the Post-Brexit dummy (the years 2017-2019). It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	EBITDA margin		ROA		ROE	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
β_0 (constant)	0.125***	0.0592	0.107***	-0.0324	0.259***	-0.146
	(0.0042)	(0.0510)	(0.0044)	(0.0332)	(0.0105)	(0.172)
β_1 PE-firm x Post-Brexit	-0.0075	0.0032	-0.0263	-0.0094*	-0.0169	0.0022
	(0.0073)	(0.0039)	(0.0078)	(0.0034)	(0.0175)	(0.0158)
Log(totalrevenue)		-0.0009		0.0022		0.0180
		(0.0051)		(0.0033)		(0.0173)
Revenue growth		0.0021		0.0246***		0.0670***
		(0.0053)		(0.0045)		(0.0225)
Cashflow/total assets		0.213***		0.807***		1.102***
		(0.0249)		(0.0305)		(0.144)
Profit margin		0.0061***		0.0019***		0.0035***
		(0.0003)		(0.0003)		(0.0009)
Leverage ratio		0.0031		0.0009		0.126***
		(0.0042)		(0.0042)		(0.0205)
Change in working capital		$-2.19e^{-07}$		$1.28e^{-06}$***		$2.39e^{-06}$
		($5.19e^{-07}$)		($4.92e^{-07}$)		($2.94e^{-06}$)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.013	0.651	0.054	0.769	0.026	0.261
Observations (N)	4,243	3,927	4,392	3,927	4,385	3,925
Clusters	614	606	630	606	630	606

Table A.7 - Difference-in-difference analysis for investment activity, equity injections and debt issuances with firm size

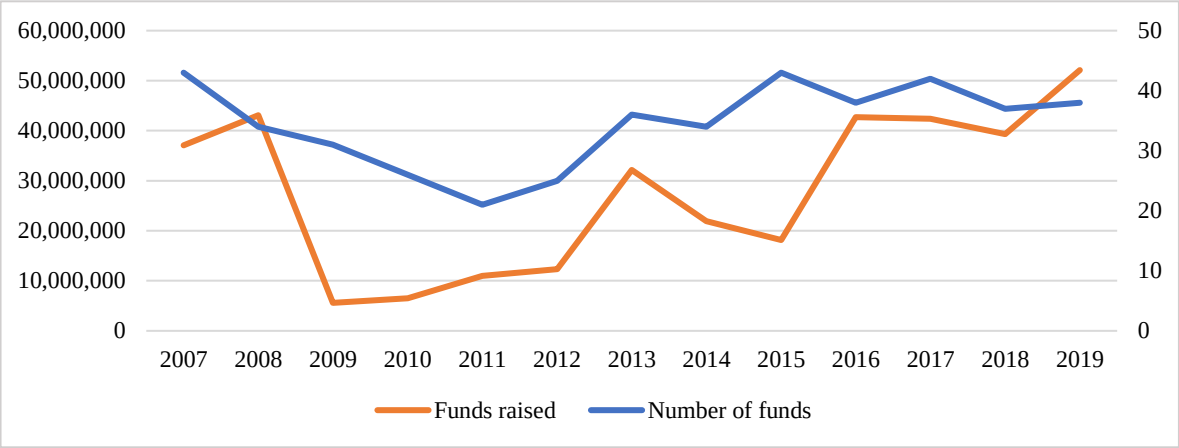
Table A.7 presents the results of the difference-in-difference fixed effects regressions on the dependent variables investment activity over total assets, equity injections over total assets and debt issuances over total assets. The main parameter of interest β_3 is the interaction term between the PE-firm dummy (if a firm is PE-backed or not), the Post-Brexit dummy (the years 2017-2019) and the firm size dummy. It represents the differential for the treatment group (PE-backed) and control group (non-PE-backed) after the Brexit referendum. Firm size is measured as the total amount of employees and the firm size dummy equals one if the firm is in the top quartile of the distribution. Odd columns present the models without control variables, while even columns present the model with control variables, which include the logarithm of total revenue, revenue growth, cashflow to total assets, profit margin, leverage and change in working capital. All models include year fixed effects and firm fixed effects. Robust standard errors are clustered at firm-level and reported in parentheses. 1%, 5% and 10% significance levels are indicated by ***, **, *, respectively.

Dependent variable	Investment activity/total assets		Equity injections/total assets		Debt issuances/total assets	
	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
β_0 (constant)	0.0500***	0.0112	-0.0170***	0.0796	0.0343***	0.183
	(0.0033)	(0.0596)	(0.0032)	(0.0546)	(0.0072)	(0.136)
β_1 PE-firm x Post-Brexit	0.0112**	0.0093*	-0.0032	-0.0065	0.0254**	0.0178*
	(0.0048)	(0.0051)	(0.0045)	(0.0043)	(0.0104)	(0.0099)
β_2 Post-Brexit x Firmsize	0.0048	0.0039	-0.0023	-0.0050	-0.0033	0.0080
	(0.0076)	(0.0075)	(0.0061)	(0.0064)	(0.0128)	(0.0131)
β_3 PE-firm x Post-Brexit x Firmsize	-0.0142	-0.0074	-0.0068	-0.0013	-0.0022	-0.0105
	(0.0102)	(0.0100)	(0.0082)	(0.0083)	(0.0193)	(0.0196)
Log(totalrevenue)		0.0035		-0.0068		-0.0128
		(0.0059)		(0.0054)		(0.0136)
Revenue growth		0.0491***		0.0325***		0.207***
		(0.0077)		(0.0066)		(0.0155)
Cashflow/total assets		-0.0535**		-0.252***		-0.654***
		(0.0272)		(0.0293)		(0.0611)
Profit margin		0.0006**		0.0001***		0.0024***
		(0.0003)		(0.0003)		(0.0006)
Leverage ratio		-0.0095**		-0.0319***		0.0569***
		(0.0044)		(0.0039)		(0.0102)
Change in working capital		$-4.76e^{-07}$		$3.71e^{-07}$		$8.39e^{-06}$***
		($8.40e^{-07}$)		($7.21e^{-07}$)		($1.96e^{-06}$)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.094	0.125	0.103	0.175	0.061	0.201
Observations (N)	4,272	3,927	4,229	3,927	4,491	3,927
Clusters	616	606	630	606	630	606

B. Figures

Figure B.1 – Total funds raised by UK PE buyout firms

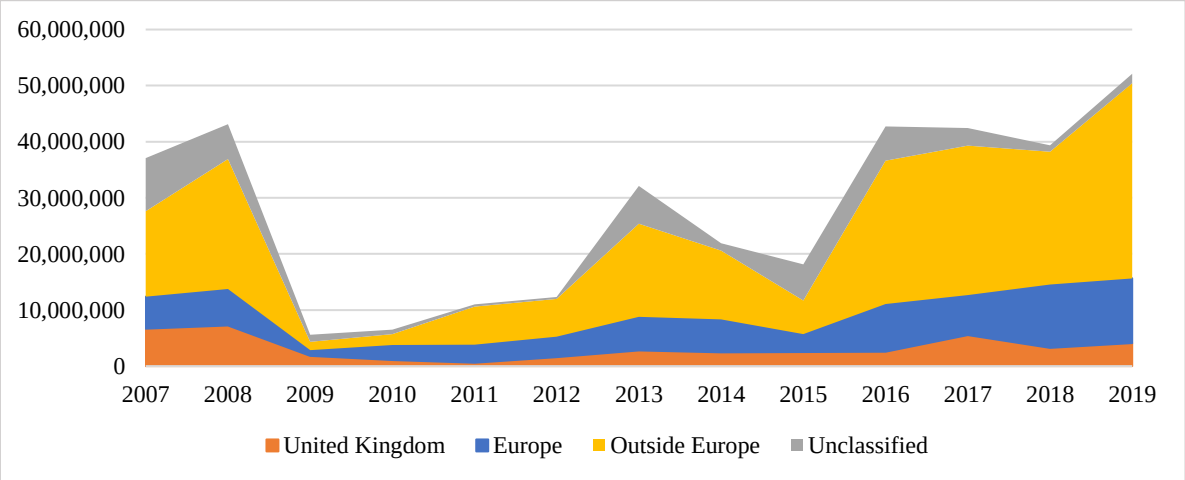
This figure shows the total number and value of funds raised in the United Kingdom from 2007 to 2019. Amounts are in € thousands.



Source: Invest Europe / EDC, 2020

Figure B.2 – Geographic breakdown of fund sources of UK PE buyout firms

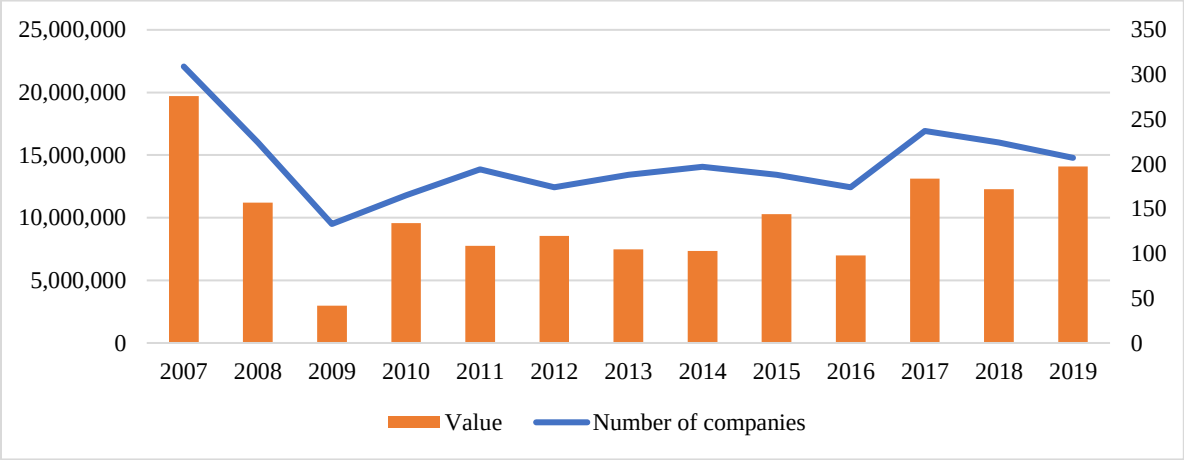
This figure shows the geographic breakdown of fund sources of PE buyout firms in the United Kingdom from 2007 to 2019. The fund sources are from the United Kingdom, Europe, outside Europe or are unclassified. Amounts are in € thousands.



Source: Invest Europe / EDC, 2020

Figure B.3 – Total UK PE-backed buyouts

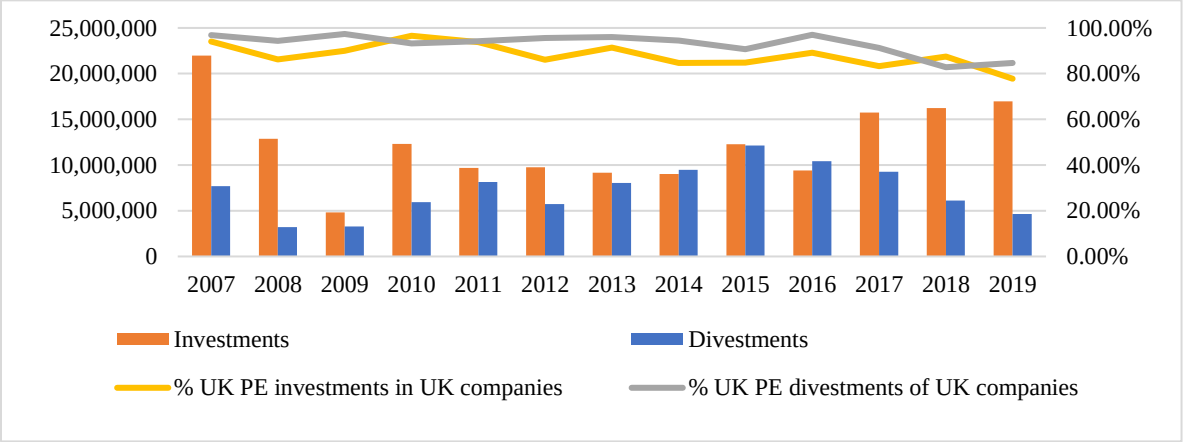
This figure shows the total number and value of PE-backed buyouts in the United Kingdom from 2007 to 2019. Amounts are in € thousands.



Source: Invest Europe / EDC, 2020

Figure B.4 – Total investments and divestments of UK portfolio companies by UK PE firms

This figure shows the total investments in (orange bar) and divestments of (blue bar) PE-backed companies in the United Kingdom by UK PE firms[5] from 2007 to 2019. It also shows the share of UK PE firms investing in (yellow line) and divesting of (grey line) UK PE-backed companies relative to foreign PE firms. Amounts are in € thousands.



Source: Invest Europe / EDC, 2020

[5] This includes all UK PE firms (buyout, venture capital and growth capital), however, UK PE buyout firms accounted for ±75% of all investments and divestments (Invest Europe / EDC, 2020).

Figure B.5 – Parallel trend for investment activity of PE-backed companies over time
This figure shows the average parallel trend of investment activity for PE-backed companies (red line) versus non-PE-backed companies (blue line) in the sample. The average investments are taken for each year pre- and post-Brexit for each of the groups. Specifically, the figure estimates the following equation: $y_{it} = \alpha_i + \alpha_t + \varepsilon_{it}$ separately for PE-backed and non-PE-backed companies, where α_i captures firm fixed effects and α_t captures year fixed effects.

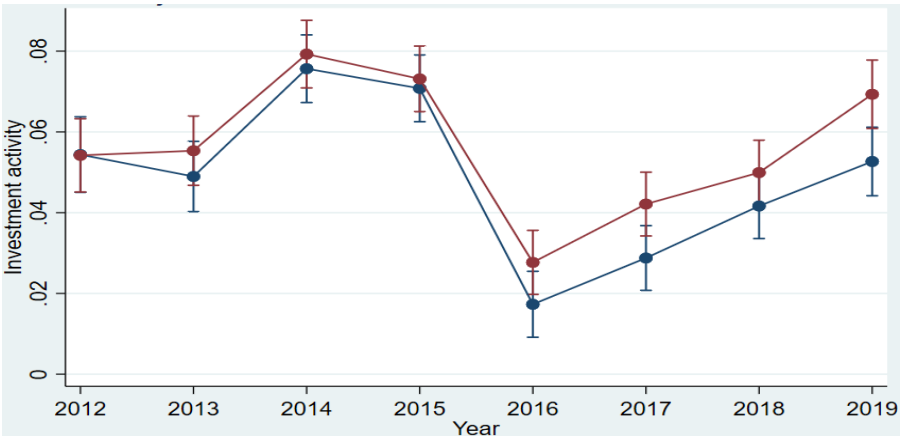


Figure B.6 – Parallel trend for equity injections of PE-backed companies over time
This figure shows the average parallel trend of equity injections for PE-backed companies (red line) versus non-PE-backed companies (blue line) in the sample. The average equity injections are taken for each year pre- and post-Brexit for each of the groups. Specifically, the figure estimates the following equation: $y_{it} = \alpha_i + \alpha_t + \varepsilon_{it}$ separately for PE-backed and non-PE-backed companies, where α_i captures firm fixed effects and α_t captures year fixed effects.

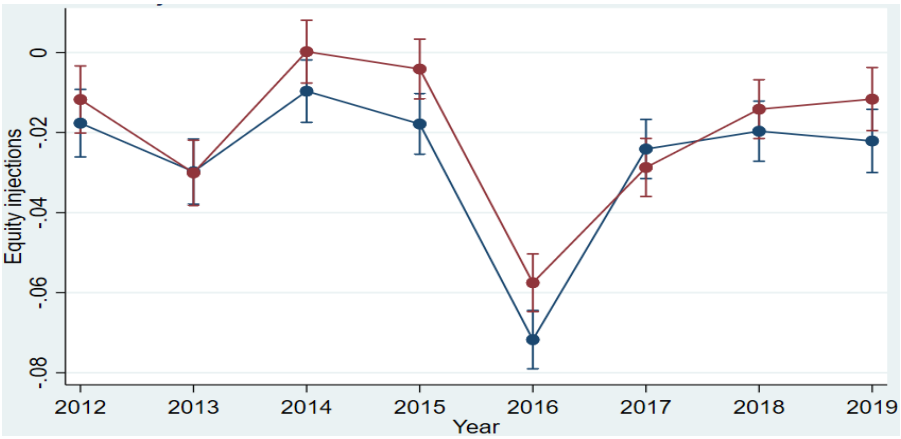


Figure B.7 – Parallel trend for debt issuances of PE-backed companies over time

This figure shows the average parallel trend of debt issuances for PE-backed companies (red line) versus non-PE-backed companies (blue line) in the sample. The average debt issuances are taken for each year pre- and post-Brexit for each of the groups. Specifically, the figure estimates the following equation: $y_{it} = \alpha_i + \alpha_t + \varepsilon_{it}$ separately for PE-backed and non-PE-backed companies, where α_i captures firm fixed effects and α_t captures year fixed effects.

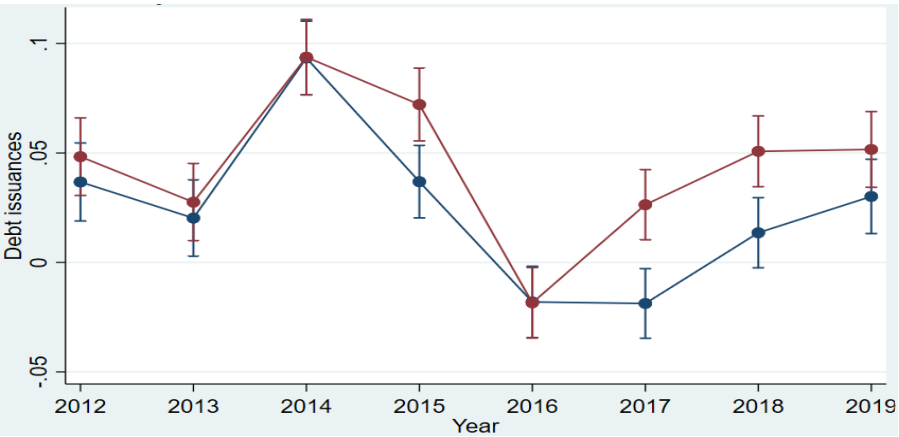


Figure B.8 – Parallel trend for logarithm of total revenue of PE-backed companies over time

This figure shows the average parallel trend of total revenue for PE-backed companies (red line) versus non-PE-backed companies (blue line) in the sample. The average revenues are taken for each year pre- and post-Brexit for each of the groups. Specifically, the figure estimates the following equation: $y_{it} = \alpha_i + \alpha_t + \varepsilon_{it}$ separately for PE-backed and non-PE-backed companies, where α_i captures firm fixed effects and α_t captures year fixed effects.

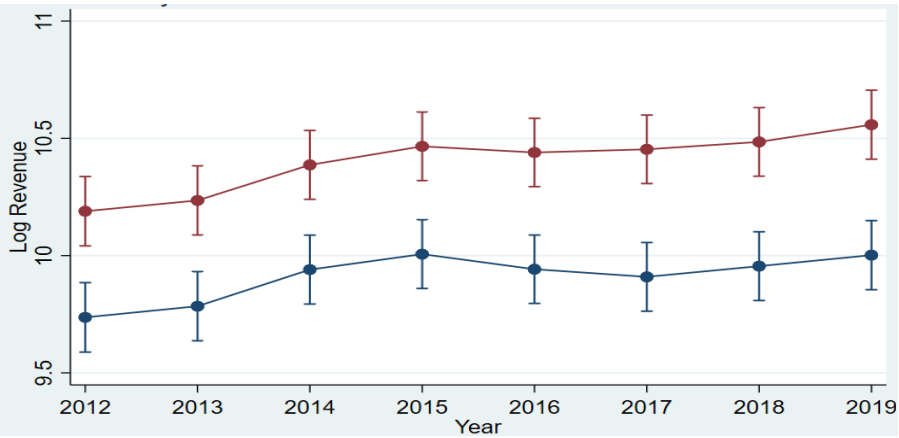


Figure B.9 – Parallel trend for profit margin of PE-backed companies over time

This figure shows the average parallel trend of profit margin for PE-backed companies (red line) versus non-PE-backed companies (blue line) in the sample. The average profit margins are taken for each year pre- and post-Brexit for each of the groups. Specifically, the figure estimates the following equation: $y_{it} = \alpha_i + \alpha_t + \varepsilon_{it}$ separately for PE-backed and non-PE-backed companies, where α_i captures firm fixed effects and α_t captures year fixed effects.

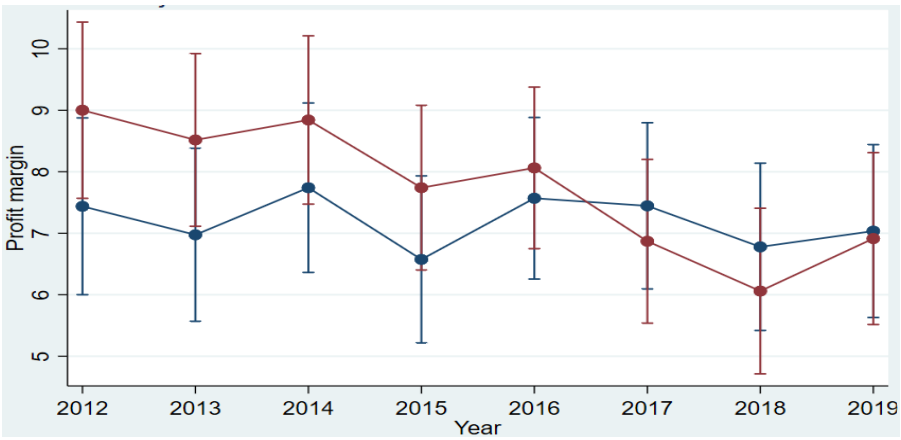


Figure B.10 – Parallel trend for leverage of PE-backed companies over time

This figure shows the average parallel trend of leverage for PE-backed companies (red line) versus non-PE-backed companies (blue line) in the sample. The average leverage ratio is taken for each year pre- and post-Brexit for each of the groups. Specifically, the figure estimates the following equation: $y_{it} = \alpha_i + \alpha_t + \varepsilon_{it}$ separately for PE-backed and non-PE-backed companies, where α_i captures firm fixed effects and α_t captures year fixed effects.

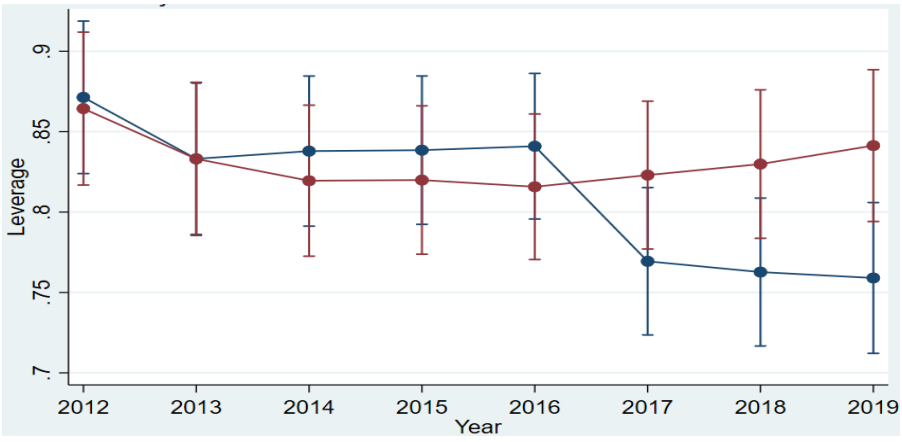
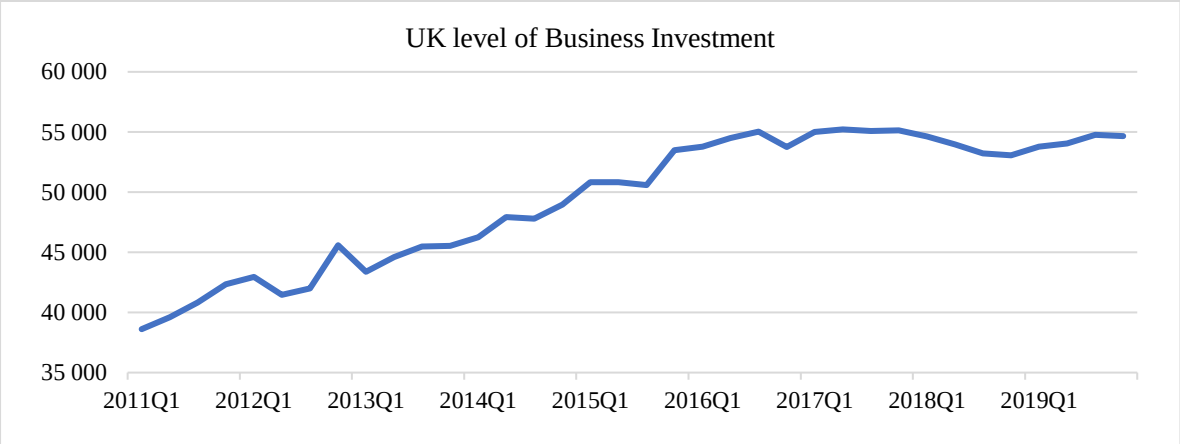


Figure B.11 – Business investment in the UK around the Brexit referendum

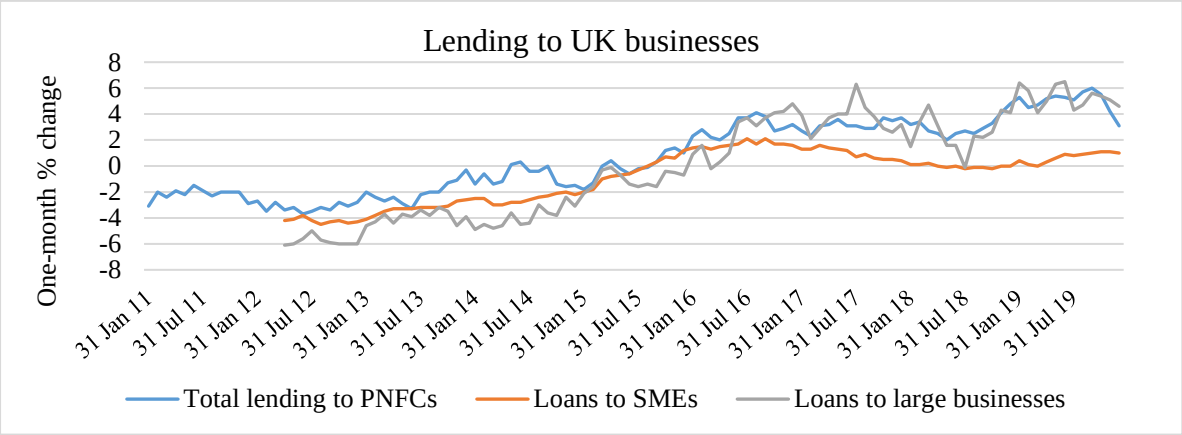
This figure shows the quarterly business investment volume in the United Kingdom from 2011 to 2019. Currency values are at 31 Dec. 2018. The data does not include expenditure on dwellings, land and existing buildings and costs of ownership transfer of non-produced assets. The data is available at the "Office of National Statistics" in the UK. Amounts are in £ millions.



Source: Office of National Statistics in the UK

Figure B.12 – Lending growth in UK around the Brexit referendum

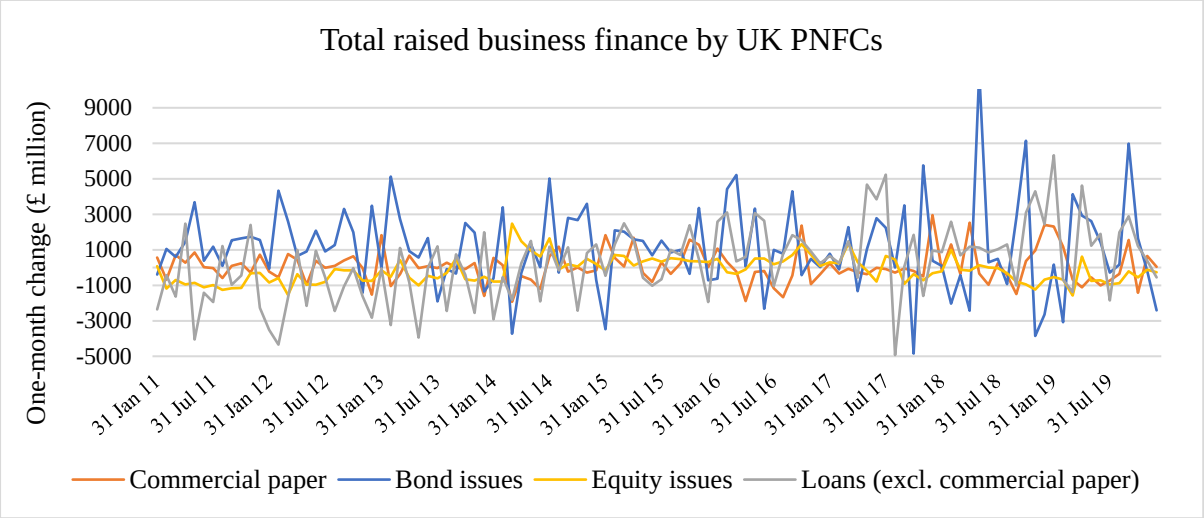
This figure shows the monthly percentage change in total lending to businesses in the United Kingdom from 2011 to 2019. It shows the total lending to Private Non-Financial Companies (PNFCs), total loans to Small- and Medium-sized Enterprises (SMEs) and total loans to large businesses. Data is seasonally adjusted.



Source: Bank of England

Figure B.13 – Total raised business finance by UK Private Non-Financial Corporations around the Brexit referendum

This figure shows the monthly change in total issues of business finance by PNFCs in the United Kingdom from 2011 to 2019. It shows the total issues of commercial paper, bonds, equities and loans. Data is seasonally adjusted and amounts are in £ million.



Source: Bank of England