All You Need is Cash: Corporate Cash Holdings and Investment after the Global Financial Crisis*

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Abstract

This paper studies how cash holdings at the onset of the global financial crisis affected the investment behavior of SMEs after the shock. Using balance sheet data for UK SMEs, we find that cash-rich SMEs maintained their capital stock during the global financial crisis, while cash-poor rivals reduced theirs. This gave cash-rich SMEs an advantage when the economy rebounded, resulting in a persistent investment gap that grew over the recovery period. Competition dynamics, borrowing constraints and adjustments in cash balances contributed to this amplification effect. The amplification effect was more pronounced for younger and smaller firms and in industries for which credit conditions tightened more. We do not observe a persistent effect of cash in non-crisis periods or for publicly listed firms. Our findings show that when financial constraints tighten after crises, cash holdings are a key determinant of investment by SMEs in the long term.

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1. Introduction

In many countries, small and medium-sized enterprises (SMEs) account for the lion's share of employment and output and play a central role in driving innovation and growth (Haltiwanger, Jarmin, and Miranda, 2013; Acemoglu et al., 2018). They are, however, particularly vulnerable during economic downturns. Their activities tend to be less diversified and downsizing is often difficult, making them more vulnerable to a sudden fall in demand. They also typically require more intensive screening and monitoring by lenders, so banks tend to cut credit to SMEs more aggressively during crises (Chodorow-Reich, 2014; Chodorow-Reich et al., 2022; Greenwald, Krainer, and Pascal, 2024). When they do so, SMEs are less able to switch to other types of external funding and have to rely on internal funds instead (Iyer et al., 2014; Cingano, Manaresi, and Sette, 2016). This suggests that cash buffers could be a key driver of SME performance following financial crises.

This paper examines the role of cash holdings in SME performance during the global financial crisis and its aftermath. We find that SMEs with higher cash holdings at the onset of the crisis invested more during the crisis, and this pattern was more pronounced over the recovery period. We show that the persistent and growing investment gap between initially cash-poor and initially cash-rich SMEs is consistent with a self-reinforcing feedback loop: SMEs with low initial cash holdings cut back on investment during the crisis, leading to market share losses, lower profitability, and tighter borrowing constraints in the recovery period, which further widened the investment gap. A preference for balance sheet repair and precautionary savings over new investment exacerbated the effect. Notably, we do not observe such patterns outside crisis periods or among publicly listed firms, suggesting that access to external finance which would have allowed SMEs to break out of the feedback loop, is crucial in driving these dynamics.

There are several reasons why having cash buffers at the onset of a crisis enables firms to continue to operate and invest. First, cash serves as an internal source of finance when credit conditions tighten, external finance becomes more costly and cash flow declines. Second, unlike other assets that may lose their value during a downturn, cash preserves its value which supports the firm's net worth. This, in turn, reduces lenders' exposure to losses and can ease borrowing constraints (Bernanke and Gertler, 1989). Third, a cash-rich firm faces less pressure to increase cash holdings for precautionary motives following a negative shock and can use these funds for investment instead (Almeida, Campello, and Weisbach, 2004; Berg, 2018). Cash-rich SMEs are therefore in a better position to replace

depreciated fixed assets and to seize profitable investment opportunities compared to their cash-starved peers that may struggle to finance investment and even survive.[1]

Differences in firm behavior during the crisis can affect investment dynamics when the recovery sets in. Cash-rich firms, having maintained their productive capacity, are well-positioned to meet rising demand and can reinvest earnings to expand further. By contrast, cash-poor firms that lost productive capacity, struggle to meet demand, resulting in reduced revenue, limited funds for reinvestment and a further weakening of their positions. These effects are exacerbated if financial constraints remain tighter for cash-poor firms or if these firms choose balance sheet repair over investment. Due to these feedback effects, the investment gap that opens up during the crisis can widen further during the recovery period.

Simple correlations between initial cash and subsequent investment suggest that having cash when a crisis hits has long-term implications. Ranking SMEs by their cash holdings relative to industry peers just before the global financial crisis reveals a strong relationship between initial cash holdings and investment over the period 2007-2014 (Figure 1, top panel). Cash-rich SMEs maintained or even expanded their fixed assets between 2007 and 2009, while cash-poor firms cut theirs. This investment gap widened during the recovery period. The relationship is much weaker during normal periods. Ranking firms by cash holdings in 2000 shows little correlation with investment from 2001 to 2007, as both cash-rich and cash-poor firms increased their fixed assets (Figure 1, bottom panel).[2]

To formally assess whether pre-crisis cash holdings were associated with investment during the global financial crisis and its aftermath, we employ a local projections framework (Jordà, 2005). Specifically, we estimate how investment over different horizons between 2007 and 2014 responded to the crisis, conditional on the firm's cash holdings just before the crisis. We control for various firm characteristics that could have influenced both cash management and investment decisions and include 4-digit industry and regional fixed effects.

We find that SMEs with higher initial cash holdings invested more during the crisis, with this effect being driven by two opposing forces. Firms with large cash buffers (90th percentile of the distribution) maintained their fixed assets between 2007 and 2009, whereas those with low cash buffers (the 10th percentile) reduced theirs, resulting in an

[1] While not focusing explicitly on the role of cash, Campello, Graham, and Harvey (2010) show that firms identifying as financially constrained during the crisis planned deeper cuts in employment and capital spending, forwent attractive investment opportunities and sold assets to fund operations.

[2] The variation in cash holdings within industry is very similar in the two years. As such the differential pattern cannot be explained by sharp differences in initial cash holdings in the two periods.

investment gap of nearly 5 percentage points. By 2014, cash-rich SMEs had increased their fixed assets by 4.4 percent relative to 2007, while cash-poor SMEs had reduced theirs by 7.4 percent. The size of the investment gap thus more than doubled to 11.8 percentage points during the recovery period.

We address potential endogeneity concerns in several ways. We measure a firm's cash holdings before the crisis. Since the sharp credit contraction following Lehman Brothers' collapse was largely unanticipated, it is unlikely that firms accumulated cash in advance to shield themselves from a future credit supply shock. Furthermore, a crisis of this scale likely weakened the link between firms' actual investment during the crisis and the investment they had planned, and possibly built up cash reserves for, before the crisis.

To further address concerns that pre-crisis cash holdings might capture unobserved factors we exploit the empirical regularity that for a significant number of UK SMEs cash holdings fluctuate substantially year-on-year (Figure 2). For these firms, cash holdings in one year have little predictive value for cash holdings in the next year, making it less likely that pre-crisis cash balances reflect persistent unobserved characteristics like prudent management or long-term savings for a large investment project. Focusing on our sample of SMEs with volatile cash holdings, we also document a persistent investment gap between initially cash-rich and cash-poor firms that widened during the recovery period.

To assess whether a potential correlation between investment opportunities in the error term and pre-crisis cash holdings could bias our results, we match firm balance sheet data with survey data from the UK Decision Maker Panel (DMP) which contains information about firms' investment plans. Since information from the DMP is only available after 2016, we focus on the relationship between cash holdings and investment plans for the period 2017-2019. We find no significant relationship between current cash levels and future investment plans for the full sample of SMEs. When we compare SMEs with volatile and persistent cash holdings, we only observe a significant relationship for the latter. If this relationship is stable over time, these results suggest that the omission of direct controls for investment opportunities (which are not readily available for SMEs) is unlikely to introduce significant bias. Oster (2019) lower bound estimates provide additional reassurance. They show that, even when allowing for substantial unobserved heterogeneity, the estimated relationship between pre-crisis cash holdings and long-term investment remains positive and of a similar or greater magnitude for both the full sample and the subset of SMEs with volatile cash holdings.

Next, we examine whether access to external finance played a key role in driving the investment patterns of cash-rich and cash-poor SMEs we observe during and after

the global financial crisis. Our finding of no persistent and widening investment gap between initially cash-rich and cash-poor SMEs during the pre-crisis period supports this. Furthermore, for publicly listed UK firms we find no relationship between initial cash holdings and investment beyond the 2007-2009 period. This is consistent with evidence for large firms in the US (Duchin, Ozbas, and Sensoy, 2010). Unlike SMEs, cash-poor publicly listed firms were able to tap into external finance, allowing them to avoid the self-reinforcing feedback loops that constrained cash-poor SMEs.

The strength of the cash effect also varies across SMEs and industries in ways consistent with financial constraints driving our results. For both the full sample of SMEs and the subset of SMEs with volatile cash holdings, the cash effect was larger for young and small SMEs, in line with the well-documented fact that young and small firms tend to be more affected by credit supply shocks (Chodorow-Reich, 2014, Ongena, Peydro, and Van Horen, 2015, Cingano, Manaresi, and Sette, 2016). Similarly, the effect was somewhat more pronounced in industries in which credit conditions were likely tighter during and after the crisis.

Our evidence supports three potential mechanisms that could explain the persistence and widening of the investment gap during the recovery period. The first relates to shifts in competition dynamics. Cash-rich SMEs were better able to maintain their productive capacity during the crisis, while cash-poor rivals were forced to contract theirs. This advantage may have allowed them to generate more income, which they could reinvest to capture additional market share over time. They may have further strengthened their competitive position by acquiring discounted assets, adjusting prices, or making strategic investments (Campello, 2006; Gilchrist et al., 2017). In line with this mechanism, we document a positive relation between pre-crisis cash holdings and both market share growth and profits during the crisis, with these effects becoming more pronounced in the recovery period.

The second mechanism relates to borrowing constraints. Tighter credit conditions during the crisis likely affected cash-poor SMEs more than their cash-rich peers. Larger cash reserves help preserve firms' net worth, reducing their riskiness to lenders. In addition, even as credit conditions improved during the recovery, banks might have favored lending to firms with more fixed assets to pledge as collateral and stronger earning histories (Ivashina, Laeven, and Moreno, 2022; Lian and Ma, 2021). Consistent with this, we find that cash-poor SMEs experienced a sharper decline in debt levels both during the crisis and recovery period. We also document a persistent deterioration of their credit scores relative to cash-rich firms. While part of these effects may reflect weaker credit

demand, this evidence, in combination with the variation across SMEs and industries, suggests that tighter borrowing constraints likely played a role in limiting investment for cash-poor SMEs.

The third mechanism relates to adjustments of firms' cash balances during and after a crisis. Following downturns, firms tend to increase their cash reserves due to heightened uncertainty, limited access to external finance, and the need for greater operational flexibility (Almeida, Campello, and Weisbach, 2004; Berg, 2018; Xiao, 2024). Negative shocks can also lead managers to shift from over-optimism to over-pessimism and to reassess risks accordingly (Bordalo, Gennaioli, and Shleifer, 2018). Although firms also adjust their cash holdings in normal times, during a crisis such adjustments occur under tighter constraints. For SMEs entering the crisis with very low cash reserves, rebuilding liquidity may therefore have taken priority over investment. Consistent with this, we find that cash-poor SMEs increased their cash holdings during the crisis and the recovery period. These adjustments slightly smaller than in the pre-crisis period, likely reflecting weaker cash flow and tighter credit conditions. Cash-rich firms, by contrast, drew down existing reserves during and after the crisis to support operations and investment.

Lastly, we examine the relationship between cash holdings and survival. UK SMEs with high cash reserves were less likely to exit during the crisis and recovery period. By 2009, 3.4 percent of the firms in our sample had exited, with significantly higher exit rates among cash-poor firms (4.7 percent) than among cash-rich ones (2 percent). This gap widened until 2011, when 13 percent of cash-poor SMEs had exited compared to 8 percent of cash-rich firms. From 2012 onward the cash effect declined slightly. While cash-rich firms were more likely to survive by 2014, this advantage stemmed primarily from the period before 2012.

The main contribution of our paper is to document a persistent relationship between initial cash-holdings and investment that is unique to SMEs and crisis periods. This finding extends the literature on the real effects of financial crises, which has mainly focused on short-term effects, the role of leverage and publicly listed firms (e.g. Campello, Graham, and Harvey, 2010; Almeida, Campello, Laranjeira, et al., 2012; Giroud and Mueller, 2017; Wix, 2023; Kalemli-Ozcan, Laeven, and Moreno, 2022; Duval, Hong, and Timmer, 2020). The role of cash has received little attention, but there is evidence for publicly listed US firms that limited cash holdings reduced investment (Duchin, Ozbas, and Sensoy, 2010) and employment (Schoefer, 2015) during the global financial crisis. Our study complements these findings by focusing on SMEs and comparing short-term and long-term effects. We show that balance sheet conditions at the onset of a crisis have

different long-term implications for SMEs and publicly listed firms. To our knowledge, this is the first paper to highlight how tight financial constraints faced by SMEs after crises can create self-reinforcing feedback loops, making initial cash holdings a key determinant of SMEs' long-term performance.

Our findings on competition dynamics as a potential driver of the widening investment gap relate to Fresard (2010), who documents a positive effect of cash holdings on future market shares of publicly listed US firms following a shock to industry competition. We examine SMEs' responses to a credit supply shock instead, linking the widening investment gap in the recovery period to changes in competition dynamics. We also complement Fresard (2010) by showing that, after a credit supply shock, large cash holdings provide a sustained advantage to SMEs but not to publicly listed firms.

Our paper also contributes to the literature on corporate liquidity management which has largely focused on publicly listed firms due to data constraints. Previous research shows that financially constrained firms hold more cash for precautionary reasons (e.g., Opler et al., 1999; Faulkender and Wang, 2006; Acharya, Almeida, and Campello, 2007; Cunha and Pollet, 2020). Following a negative macroeconomic or funding shock, firms tend to increase cash holdings (Almeida, Campello, and Weisbach, 2004, Song and Lee, 2012) and reduce investment and employment (Berg, 2018; Bacchetta, Benhima, and Poilly, 2019; Melcangi, 2024).[3] Cash reserves also enable financially constrained firms to invest more, particularly when hedging needs are high (Denis and Sibilkov, 2010), and they provide a buffer against contractionary monetary policy or credit supply shocks (Jeenas, 2018; Ottonello and Winberry, 2020; Beck, Da-Rocha-Lopes, and Silva, 2021).[4] Our paper extends this literature by offering new insights into the role of cash holdings for SMEs' long-term investment and survival following a major financial shock.

The remainder of the paper is structured as follows. The next section introduces the data and Section 3 presents our empirical methodology. Section 4 reports the results on the long-term relationship between cash and investment. Section 5 presents evidence on three potential underlying mechanisms and Section 6 studies how cash is associated with firms' long-term survival. Section 7 concludes.

[3]Related, Begenau and Palazzo (2021) show that firms dynamically adjust the proportion of cash flow they save to avoid having to finance their growth in the future at a higher cost.

[4]These findings are consistent with the view that higher cash holdings are a value-increasing response to costly external finance. An alternative view suggests that financially constrained firms accumulate cash due to agency problems and empire-building behavior by managers (Jensen and Meckling, 1976; Harford, 1999; Pinkowitz, Stulz, and Williamson, 2006; Dittmar and Mahrt-Smith, 2007; Harford, Mansi, and Maxwell, 2008).

2. Data and Summary Statistics

2.1 Firm Balance Sheet Data

Our primary data source is the FAME database from Bureau van Dijk (BvD), which is a subset of the frequently used Amadeus (European firms) and Orbis (global firms) datasets. It includes balance sheet information, cash flow statements and profit and loss accounts of UK companies. The data are collated from publicly available filings with Companies House, the official UK firm registrar, and capture most UK firms.[5] Unlike Compustat and Worldscope, which only contain information on large, publicly listed firms, the vast majority of companies in FAME are SMEs and privately owned businesses. This dataset therefore allows us to study the type of firms most vulnerable to financial tightening during crises.

To examine whether SMEs' cash-investment sensitivities shift following a crisis, a comparison with the pre-crisis period is necessary. We therefore require a relatively long time series. Since FAME is a live database and retains data on inactive or dissolved companies only five years, relying on recent downloads would introduce survival bias in the earlier years of our analysis. To mitigate this, we use archived vintages, merging firm accounts using unique identifiers and filing dates.[6] Whenever balance sheet information for a firm and year is available from multiple vintages, we use the latest available information.[7] This method reduces survival bias and substantially improves data coverage.[8] Our final dataset spans the period 1999-2014.

UK reporting requirements vary by firm size. While basic information is available for all firms, variables like EBITDA, turnover (i.e., revenue or gross sales) and employment are only reported by larger firms.[9] Firms are classified using 4-digit UK SIC 2007.

[5] Companies House collects and publishes data on registered companies subject to the Companies Act 2006, including limited liability firms and partnerships, but excluding sole traders.

[6] As discussed in great detail by Kalemli-Ozcan, Sorensen, et al. (2015) and implemented for the UK by Bahaj, Foulis, and Pinter (2020), the use of historical information and careful treatment of the data is crucial to construct an accurate firm-level panel using data provided by BvD.

[7] We use the following vintages: March 2007, April 2012, and May 2017.

[8] Another complicating factor is that UK firms are not required to file accounts in a specific month, resulting in varying 12-month reporting periods. However, most firms file at the end of the calendar year or fiscal year. We assign accounts submitted in the first half of a year to the previous calendar year and those in the second half to the current year (e.g., filings until June 2007 are assigned to 2006). While most accounts cover 12 months, some filings are irregular or occur multiple times in a year. For irregular filings, we assign as the accounting year the year into which most of the accounting period falls. For multiple filings, we calculate weighted averages to match the standard 12-month reporting period.

[9] See Bahaj, Foulis, and Pinter (2020) for details on UK firm reporting requirements.

We follow the literature and exclude financial services, real estate, and public sector-dominated industries.[10] We also exclude industries with fewer than 30 firms. To avoid double counting, we use unconsolidated accounts, focusing on the domestic part of international businesses. Ten percent of the firms in our sample are part of a corporate group. These firms may be able to access capital from their parent, potentially affecting the cash-investment relationship. We test for this by excluding SMEs that are part of a group in a robustness test.

As employment data is often missing, we classify SMEs by total assets, using the £18 million threshold set out in the UK Companies Act. Our main analysis focuses on firms that survived both the crisis and the recovery period until 2014 and for which we have complete information. This ensures that changes in the cash-investment sensitivity over time cannot be attributed to market entry or exit. Our baseline investment analysis covers 204,412 SMEs. Our pre-crisis sample consists of 135,617 SMEs that were active during the full pre-crisis period. For our survival analysis, we include all SMEs with complete information for each year they have been active, yielding a sample of 259,416 firms.

To assess representativeness, we compare our baseline sample with the UK SME population in 2006 using data from the UK Office for National Statistics (ONS).[11] Industry and regional distributions closely align, though our sample has fewer service firms and slightly more firms in the construction and manufacturing sectors (Appendix Table A.1). This difference stems from our exclusion of certain service sectors, such as financial services and real estate. Our sample also contains fewer very young firms. This is due to two reasons. First, our analysis includes two lags of investment as control variables, meaning firms have to be active since 2005. Second, we require firm survival until 2014. As many firms do not survive their early years, this criterion naturally excludes younger firms from the sample.

To compare our results for SMEs to those for publicly listed firms, we construct a dataset of publicly listed UK firms. We focus only on those that were listed every year between 2005 and 2014 to avoid distortions from listings or delistings. We apply the same industry exclusions as for SMEs and require a minimum of 20 firms per industry, yielding a sample of 259 listed firms.

[10]Specifically, we exclude firms operating in finance and insurance, real estate, public administration, education, human health and social work, activities of households as employers and activities of extraterritorial organizations and bodies.

[11]https://www.data.gov.uk/dataset/4780d791-4523-4842-93a6-8b7ead12440b/uk-business-activity-size-and-location

2.2 Regression Variables

Our dependent variable is the growth of fixed assets measured over different horizons. Investment in fixed assets can be gross or net, i.e., with or without depreciation. We focus on net investment, since net investment determines a firm's productive capacity.

Our key variable of interest is firms' cash holdings at the onset of the global financial crisis. Cash holdings vary significantly across sectors, in part because of differences in the importance of cash holdings to mitigate financial constraints. Cash buffers are, for example, particularly valuable in industries with volatile cash flows (Kim, Mauer, and Sherman, 1998; Opler et al., 1999; Han and Qiu, 2007) or in industries in which cash flow and investment opportunities are weakly correlated (Acharya, Almeida, and Campello, 2007).

However, cash holdings also vary widely within narrowly defined 4-digit industries. Figure 3 shows that industries differ not only in their average cash positions but also in the dispersion around those averages. In practice, this means that even firms operating in the same industry can face very different liquidity positions. Such within-industry variation is central to our analysis, as it allows us to identify the relative advantage that SMEs with higher cash reserves may hold over their immediate competitors when financial constraints tighten.

To measure relative cash holdings, we follow MacKay and Phillips (2005) and Fresard (2010) and standardize the cash-to-asset ratio within each 4-digit industry. We compute *Relative cash* by subtracting the industry mean from the firm's ratio and divide by the industry standard deviation, all measured in 2006. This measure takes into account that cash holdings of a firm with a cash-to-total asset ratio that exceeds the industry mean by 5 percentage points provides more value in an industry with a standard deviation of 3 percent than in an industry with a standard deviation of 10 percent. We show that our results are robust to using alternative measures of cash holdings, including the simple cash-to-total asset ratio and a measure of excess cash (Section 4.5).

We include several firm-specific control variables. Since small and young SMEs tend to rely more on internal funds to finance their investment, we control for firm size and age. We define the variable *Size* as the log of total assets in 2006. We define two dummy variables to capture firms at different stages of their life cycle: *Mature* which is one if the firm was between 10 and 19 years old in 2006 and *Old* which is one if the firm was 20 years or older.

There is evidence that debt negatively affected investment during the crisis (e.g., Du-

val, Hong, and Timmer, 2020, Kalemli-Ozcan, Laeven, and Moreno, 2022). Since leverage may be correlated with cash holdings, we control for *Leverage* measured as the firm's total liabilities over total assets in 2006. To control for a firm's pre-crisis performance, we include *ROA* as measured by the firm's profits over total assets in 2006. Some SMEs belong to a corporate group and may have access to funds of their parent company. To control for this, we include the dummy variable *Group* which is one if the firm reports an ultimate owner in FAME. [12]

Investment is often lumpy and partly financed using internal funds. Firms with low cash holdings in 2006 may have invested in previous years, reducing their future investment needs. We account for this with *Pre-Investment,* which equals the log difference of fixed assets between 2005 and 2006 and between 2006 and 2007. For the subset of firms that report turnover (i.e., revenue), we also construct a measure of their pre-crisis performance, *Pre-Turnover,* which equals the log difference of turnover over the same period. To limit the effect of outliers, we drop observations below the first and above the 99th percentile for the continuous firm variables. Descriptive statistics are shown in Table 1 and variable definitions and sources are presented in Appendix Table A.2.

3. Empirical Methodology

In this section, we present the empirical methodology for our investment regressions and discuss how we address the possibility that a firm's cash position may be endogenously related to its investment decisions.

3.1 Local Projections

We use a local projections framework (Jordà, 2005) to examine how an SME's pre-crisis cash position is associated with its investment during and after the financial crisis.[13] This approach allows us to estimate how investment over horizon $j > 0$ responded to the crisis, conditional on initial cash holdings relative to industry peers. The regression model is as follows:

[12] We thank Bahaj, Foulis, and Pinter (2020) for sharing this information with us.

[13] Local projections have several advantages over computing impulse responses using vector autoregressions (VAR). They can be estimated by simple regression techniques, are more robust to misspecification, analytical inference is simple and they can easily accommodate non-linearities and multiple fixed effects (Jordà, 2005).

$$\Delta lnFA_{i,07+j} = \beta_j Relative\ cash_{i,06} + \gamma_j X_i + \sum_{k=0}^{1} \theta_{kj} \Delta lnFA_{i,07-k} + \rho_s + \vartheta_r + \varepsilon_{i,j} \quad (1)$$

where i indexes the firm and j the horizon (1 to 7 years after 2007). The dependent variable, $\Delta lnFA_{i,07+j}$, is the log difference of fixed assets between 2007 and 2007+j. The key independent variable, *Relative cash,* captures a firm's cash holdings in 2006 relative to other SMEs in its 4-digit industry. The matrix X_i includes firm-level controls: two age dummies, *Mature* and *Old*, a *Group* dummy, *Size*, *Leverage* and *ROA* (all measured in 2006), as well as *Pre-Investment* (measured between 2005-2006 and 2006-2007). In an extension, we also add turnover (i.e., revenue) growth over the same period.

We estimate separate regressions for each horizon using OLS. The coefficients of interest (β_j) capture the sensitivity of investment over horizon j to pre-crisis cash holdings. All specifications include 4-digit industry fixed effects (ρ_s) and regional fixed effects (ϑ_r), which absorb industry- and region-specific demand and productivity shocks that could affect investment during the crisis and its aftermath. Standard errors are clustered at the 4-digit industry level.

To assess whether cash-investment sensitivities are different in crisis versus non-crisis periods, we estimate a similar model for the pre-crisis period. *Relative cash* is then defined as the firm's cash holdings in 2000, and the dependent variable, $\Delta lnFA_{i,01+j}$, as the log difference of fixed assets between 2001 and year 2001+j.[14] We set j to range from one to six years, ensuring our pre-crisis analysis does not overlap with the financial crisis. Control variables remain the same as in Equation (1) but are measured in 2000, with *Pre-Investment* capturing annual fixed asset growth between 1999-2000 and 2000-2001.

3.2 Addressing Endogeneity

Firms' cash holdings could be endogenous if they are influenced by factors that also affect investment decisions. Firms with strong investment opportunities may accumulate larger cash reserves and invest more in the future. Firms expecting tighter external financial constraints may build cash buffers to safeguard future investment capacity. Moreover, persistently high cash balances may reflect unobservable firm characteristics, such as prudent management, which can influence both cash management and investment decisions.

We address these concerns in several ways. First, we measure a firm's cash holdings

[14]The distribution of cash holdings at the 4-digit industry level is very similar in 2000 and in 2006.

before the crisis. Since the sharp credit contraction following the collapse of Lehman Brothers was largely unanticipated, it is unlikely that firms accumulated cash in advance to shield themselves from a future credit supply shock. Furthermore, a crisis of this magnitude likely weakened the link between actual firm investment during the crisis and the investment they had planned, and for which they possibly built up cash reserves, before the crisis.

To further address endogeneity concerns, we exploit the empirical regularity that, for a significant number of UK SMEs, cash holdings exhibit low year-on-year correlation. Figure 2 shows the distribution of autocorrelation coefficients for the cash holdings of our sample of firms, measured over the period 2000-2006. Low autocorrelation implies that a firm's cash holdings in one year offer little predictive value for its cash holdings in the next year, making it less likely that cash holdings at the onset of the crisis reflect stable, unobserved characteristics like prudent management or long-term savings for a large investment project.

Since endogeneity bias is likely smaller for firms with volatile cash holdings, we test whether our results hold for SMEs with plausibly low year-on-year correlation in their cash holdings. We classify cash holdings as volatile when the autocorrelation coefficient lies between -0.3 and 0.3. Among the 154,480 firms for which autocorrelation can be computed, 60,976 meet this criterion (39 percent). For robustness, we also use wider (-0.4 to 0.4) and narrower (-0.2 to 0.2) bands, which select 52 percent and 26 percent of these firms, respectively.

As Table 1 shows, SMEs with volatile cash holdings have balance sheet characteristics similar to those of the full sample, but they tend to be somewhat larger and older. This reflects the fact that autocorrelation coefficients are calculated over the pre-crisis period and hence for older and larger firms with longer time series of cash holdings.

Table 2 suggests that cash-rich and cash-poor SMEs with volatile cash holdings do not differ substantially in terms of their characteristics. It presents means, variances, and normalized differences for firms in the top and the bottom quartiles of the relative cash distribution. Cash-rich firms tend to be smaller, slightly younger, less leveraged, and marginally more profitable. Their pre-crisis investment behavior closely matches that of cash-poor firms. Normalized differences in means indicate that leverage is the only characteristic where cash-rich and cash-poor firms differ significantly. This is to some extent a consequence of splitting the sample based on firms' liquid asset ratios.[15]

[15]As a rule of thumb, Imbens and Wooldridge (2009) suggest that a normalized difference with an absolute value of 0.25 or less should not raise concerns about the variables being unbalanced.

We present results for firms with volatile cash holdings alongside our results for the full sample of SMEs. While analyzing SMEs with volatile cash holdings helps mitigate endogeneity concerns, the full sample is more representative of the UK SME population. Larger and older firms are typically less financially constrained and less dependent on internal funds. This influences the magnitude of the cash effect, as discussed in Section 4.4. Furthermore, we cannot compare cash-investment sensitivities for the crisis period with the pre-crisis period using the subset of SMEs with volatile cash holdings as the dataset only begins in 1999.

As a final exercise, we assess whether unobserved investment opportunities could bias our results. Firms could accumulate cash buffers to fund investment if they anticipated future investment opportunities. A common approach to control for investment opportunities is Tobin's Q, the ratio of a firm's market value to the replacement cost of its assets. Since SMEs are not publicly traded, such market-based measures are unavailable, making it difficult to construct a proxy for investment opportunities.

To address this limitation, we draw on the UK Decision Maker Panel (DMP). The DMP is a monthly panel survey of senior executives and owners of British businesses that started in 2016 (Bloom et al., 2018). It follows a representative sample of UK firms and the median firm participates about three years in the survey. Crucially, the survey records firms' planned capital expenditure growth in the year ahead, providing a proxy for near-term investment opportunities.

Since DMP does not cover our sample period, we cannot use the DMP proxy as a control in our regressions. Instead, we examine the relationship between cash holdings and planned investment more generally and use the survey to examine if firms with higher cash holdings systematically reported higher planned investment for the period 2017-2019. Assuming a stable relationship over time, this helps determine whether omitting a direct control for investment opportunities could bias our main results.

To construct our dataset, we merge the DMP responses with annual balance sheet information from FAME. We match firms' annual accounts with the first available DMP response following the filing date of the firms' accounts.[16] If a firm did not respond in the month of filing, we select the nearest observation in the same quarter. If a firm did not respond in the same quarter, we drop the observation. After dropping outliers and excluding firms based on the same criteria as in our main analysis, our final dataset consists of 900 SMEs. We also construct a dataset of firms with volatile cash holdings

[16]As noted in Section 2.1, UK firms are not required to file accounts in a specific month, leading to varying year-ends.

consisting of 389 firms whose cash-autocorrelation coefficients, calculated over 2011-2016, fall between -0.3 and 0.3. We also identify firms with persistent cash holdings, defined as those whose cash-autocorrelation exceeds 0.7. This group comprises 116 SMEs.[17]

We then examine how a firm's cash holdings at time t correlate with its planned investment for the year ahead over the period 2017 to 2019. Planned investment is measured using three variables: (1) the expected growth in capital expenditure, (2) the probability that a firm assigns to increasing its capital expenditure, and (3) a dummy equal to one if the firm assigns a probability of at least 50 percent to increasing its capital expenditure.[18]

Table 3 presents the results from regressions of each measure of planned investment on cash holdings for the three samples: all SMEs (columns (1)-(2)), SMEs with volatile cash holdings (columns (3)-(4)) and SMEs with persistent cash holdings (columns (5)-(6)). The even-numbered columns report results without controls, while the odd-numbered columns includes controls for leverage, size, age category, group and profits in addition to year fixed effects.[19] Standard errors are clustered at the 2-digit industry level.

For the full sample and for SMEs with volatile cash, the relationship between cash holdings and planned investment for the year ahead is insignificant. For firms with persistent cash holdings, however, we document a positive and statistically significant relationship. This is intuitive as firms that consistently hold large cash reserves are likely managing their liquidity with future investment in mind. These results are consistent across all three dependent variables. Additional regressions examining planned investment two and three years ahead show that the relationship remains insignificant for the full and volatile samples; for the persistent-cash sample, the estimates decline and are not statistically significant anymore (Appendix Table A.3).

If the relationship between cash holdings and planned investment did not fundamentally change, the insignificant effects observed in the full and volatile cash samples suggest

[17]The remaining firms either do not fall into these categories or lack a sufficiently long time series for calculating autocorrelation coefficients.

[18]The DMP collects investment data in levels, from which Davis, Haltiwanger, and Schuh (1996) growth rates are calculated. These symmetric DHS growth rates mitigate biases in traditional measures by scaling changes relative to the average of the initial and final values, thereby bounding growth rates between -200% and 200% and ensuring consistency across firms of different sizes. Firms estimate growth in capital expenditure under five scenarios (lowest, low, medium, high and highest), These scenarios are not predefined and firms estimate the growth rates themselves and assign a probability to each. Expected growth in capital expenditure is then computed as the weighted sum of these scenarios. For further details, see Bunn et al. (2024).

[19]For consistency across specifications, we do not include industry or region fixed effects because the sample of firms with persistent cash holdings is too small to yield reliable estimates with additional fixed effects.

that the absence of direct controls for investment opportunities is unlikely to bias our main regressions. Examining Oster (2019) lower bounds also suggest that omitted variable bias of reasonable magnitudes is unlikely to explain the observed relationship between initial cash holdings and long-term investment during and after the financial crisis (Section 4.1).

4. Cash and Investment Dynamics over Time

In this section, we examine whether there is a relationship between a firm's pre-crisis cash position relative to its industry peers and its investment during the financial crisis and whether this relationship strengthened during the recovery period.

4.1 Investment and Cash During the Global Financial Crisis and its Aftermath

Figure 4 graphically presents the results from the local projection regressions specified in equation (1). The solid lines depict the β_j estimates for each horizon, while the two dotted lines represent the 90 percent confidence intervals. The panel on the left shows the estimates for the full sample of firms. The positive and significant coefficient estimates for the first two horizons indicate that the fixed assets of firms with high cash holdings at the onset of the crisis grew by more during the crisis than those of cash-poor firms. This is consistent with previous evidence of a positive relationship between cash and investment for publicly listed firms in the US (Duchin, Ozbas, and Sensoy, 2010). Our findings also align with those of Berg (2018) and Beck, Da-Rocha-Lopes, and Silva (2021) who document that firms with cash at hand reduce investment less in the short-term when faced with a credit supply shock. Appendix Table A.4 shows the full regression output for these results.

The cash coefficient remains positive after the crisis and even increases during the recovery phase. This suggests that the investment gap between cash-rich and cash-poor firms not only persisted but widened over time. SMEs with relatively high cash reserves prior to the crisis appear to have continued investing at higher rates than their low-cash rivals, even when the crisis subsided, credit became more readily available and demand returned. This indicates that focusing exclusively on the crisis period can underestimate the effect of a financial crisis. In the right-hand panel of Figure 4, we extend our model and also control for firms' pre-crisis performance, as measured by turnover (i.e., revenue) growth in the two years preceding the crisis. This reduces the sample to 27,428 medium-

sized businesses. Despite the smaller sample size, the estimated coefficients remain similar to the baseline results, with a strong amplification over longer horizons. As an additional robustness check, we also include turnover volatility (measured as the standard deviation of turnover relative to total assets between 2000 and 2006) as a proxy for risk. Appendix Figure A.1 shows that the results are materially unchanged even though the sample halves.

Figure 5 graphically illustrates the economic magnitude of our baseline results, showing the implied difference in cumulative fixed asset growth between cash-rich and cash-poor firms during the crisis period (2007–2009) and over the full crisis and recovery period (2007–2014). Cash-rich firms are defined as those at the 90th percentile of the relative cash distribution within their industry, while cash-poor firms are those at the 10th percentile. Because the dispersion of cash holdings differs across industries (see Figure 3), we calculate the implied fixed asset growth for cash-rich and cash-poor firms separately within each industry and then take the unweighted average across industries. This approach captures how investment differences between cash-rich and cash-poor SMEs typically play out within industries where firms compete most directly.

Taking the average across all industries, we estimate that cash-rich firms maintained their stock of fixed assets between 2007 and 2009, with gross investment offsetting depreciation. By contrast, cash-poor firms experienced a 4.9 percent decline in fixed assets, resulting in an investment gap of nearly 5 percentage points. This gap widened further during the recovery period as cash-rich firms increased their fixed assets by 4.4 percent, while cash-poor firms experienced a cumulative decline of 7.4 percent. By 2014, the investment gap had more than doubled to 11.8 percentage points.

Figure A.2 in the Appendix shows how initial cash holdings influenced investment on an annual basis. The investment rate of cash-rich SMEs remained significantly higher than that of cash-poor SMEs until 2013, with the difference in annual investment rates peaking around 2009. The coefficient declines gradually for the investment regressions between 2010 and 2013, before turning insignificant in the investment regression for 2014.

To mitigate endogeneity concerns, we re-estimate equation (1) using the subset of SMEs with volatile cash holdings. As before, the cash coefficient is positive and significant for the 2007-2009 investment horizons, and the investment gap continues to widen over time (Figure 6, left-hand panel).[20] The estimates are slightly smaller than those from the full sample, which could be due to sample selection effects (e.g., firms in this subset tend to be older and larger on average) or a reduction in the bias of the estimated cash coefficient.

[20]See Appendix Table A.5 for the full regression output.

Results are similar if we modify the definition of volatile cash holdings (right-hand panel) and use a narrower (autocorrelation coefficients of cash-to-asset ratios between -0.2 and 0.2) or broader (autocorrelation coefficients between -0.4 and 0.4) bands.

To further gauge how much unobservable factors could bias our estimates, we use the approach developed by Oster (2019). In essence, if the estimated β_j remains relatively stable after including controls, given the corresponding increase in the explained variation (R^2), then omitted variable bias is unlikely to be driving the observed relationship. In this framework, β_j^* denotes the lower bound of the cash effect for each horizon. The lower bound represents the effect implied by the data once we allow for bias from unobserved factors, given assumptions about their importance and the model's potential fit.

The key assumption in the Oster framework is proportional selection: unobservables sort on cash holdings in proportion to observables. To operationalize this, we follow the literature and benchmark at $\delta = 1$, implying that unobservables are as important as observables in explaining pre-crisis cash holdings. In our setting, this choice is conservative. First, as shown in Section 3.2, evidence from the DMP shows that cash holdings are only very weakly correlated with firms' planned investment, suggesting cash is not proxying for unobserved investment opportunities. Second, for firms with volatile cash balances, pre-crisis cash balances are unlikely to reflect stable, unobserved traits such as prudent management or long-term savings for large projects. Both observations imply that unobservables are plausibly less predictive of cash than observables, so that $\delta < 1$ is likely more realistic. To examine sensitivity to the chosen δ, we also report bounds when $\delta = 0.5$ and $\delta = 1.5$.

The second assumption concerns the model's maximum explanatory power, $R_{\max}$. Since we never observe all relevant confounders, the method requires specifying how high the R^2 could rise if every relevant factor were included. Following Oster (2019), we set $R_{\max}$ equal to 1.3 times the R^2 of our baseline specification. Because firm-level investment is highly volatile and difficult to predict and R^2 values are low, this benchmark may leave limited room for unobservables to explain additional variation. We therefore also examine results under a more generous $R_{\max}$ of twice the R^2.

As shown in Table 4, the lower bounds are positive across all horizons for both the full sample and the subset of SMEs with volatile cash holdings. Like the main estimates, the lower bounds increase over longer horizons. Overall, across several values of δ and plausible choices of $R_{\max}$, the results indicate that the estimated relationship between initial cash holdings and long-term investment remains positive and of similar or greater magnitude when allowing for proportional selection on unobservables.

4.2 Investment and Cash in the Pre-crisis Period

Next, we assess whether the widening of the investment gap is a distinct feature of the financial crisis and its aftermath (henceforth referred to as "crisis sample" or "crisis period") by estimating a similar model for the pre-crisis period (2001-2007). The results, presented in Figure 7, reveal a striking contrast. Unlike the estimates for the 2007-2014 period, the β_j-coefficients for the pre-crisis period are significant for the first two years and become (mostly) insignificant thereafter.[21] Moreover, the coefficients for the pre-crisis sample are much smaller than those for the crisis sample and statistically different from them. The amplification effect observed during the crisis period is notably absent in the pre-crisis years.

A potential concern is that differences in sample composition between the crisis and pre-crisis samples could be influencing the results. To address this, we re-estimate our model using only firms present in both the crisis and pre-crisis periods. The estimates, shown in the right-hand panel of Figure 7, follow a similar pattern to those from the full samples, though the coefficients are consistently smaller across all investment horizons. As discussed further in Section 4.4, this reflects the fact that the fixed sample consists predominantly of older SMEs, which tend to be less financially constrained and therefore less dependent on internal funds for investment.[22]

Figure 8 illustrates the differences in long-term investment behavior of cash-rich and cash-poor SMEs during the pre-crisis and crisis periods, using our baseline estimates. For the pre-crisis period, the estimated β_j-coefficient at the 6^{th} horizon (the last available horizon for this sample) suggests that cash-rich firms increased their fixed assets by 4.7 percent, while cash-poor firms grew theirs by 3.2 percent. The resulting difference of 1.5 percentage points is statistically insignificant.

By comparison, cash-rich firms expanded their fixed assets by 3.1 percent during the 2007-2013 period, whereas cash-poor firms shrank theirs by 8.7 percent. This resulted in an 11.8 percentage points gap. The investment patterns of cash-poor firms seem to be the key driver of the differences across the two periods: While cash-poor firms increased their fixed assets over the long run in the pre-crisis period, they reduced them during the crisis. This highlights the increased vulnerability of financially constrained firms during downturns.

[21] See Appendix Table A.6 for the full regression output.

[22] Another potential concern is that the start of pre-crisis period coincides with the aftermath of the dot-com crash. We show in Appendix Figure A.2 that results are similar if we use 2002 or 2003 as base years instead.

To further investigate whether the relationship between initial cash holdings and long-term investment changed fundamentally due to the crisis, we examine pre-trends for both crisis and non-crisis periods. We estimate equation (1) with a dependent variable that captures fixed assets growth over two horizons: from t-2 to the reference year (2007 for the crisis period and 2001 for the pre-crisis period) and from t-1 to the reference year. Since our dataset begins in 1999, it is only possible to examine two pre-event windows and we cannot control for lagged investment in the pre-crisis period. For consistency, we exclude lagged investment as a control for both periods and all horizons, while keeping all other controls fixed t-1.[23] The results in Appendix Figure A.4 indicate that pre-trends are very similar across both periods, for both the full and the fixed samples, suggesting that the differences observed after the crisis are triggered by the crisis itself, rather than differences in pre-existing investment dynamics.

4.3 Publicly Listed Firms

We now turn to our sample of publicly listed firms. The results from estimating equation (1) for this group are shown in Figure 9. Consistent with Duchin, Ozbas, and Sensoy (2010), who examine publicly listed firms in the US, we find that publicly listed UK firms with large cash holdings invested more in the first year of the crisis compared to their cash-poor peers. This differential effect persists into the second year but disappears during the recovery phase. This suggest that the persistence of the cash effect is not only unique to post-crisis periods but also unique to SMEs.

We attribute the lack of persistence among publicly listed firms to their better access to external finance, both during the crisis and during the recovery period. Unlike cash-poor SMEs, which reduced their fixed assets by 4.9 percent between 2007 and 2009, cash-poor publicly listed firms maintained their stock of fixed assets. As a result, cash-poor listed firms did not suffer the same loss of productive capacity, reducing the likelihood of a self-reinforcing feedback loop setting in, where declines in investment lead to lower future output and further constraints on financing.

This resilience is consistent with evidence that credit conditions tightened less for listed firms during the crisis (Chodorow-Reich, 2014). When credit conditions deteriorate, large firms can draw down existing credit facilities, which often crowds out lending to smaller firms (Chodorow-Reich et al., 2022, Greenwald, Krainer, and Pascal, 2024). They can also

[23]Fixing all controls at t-1 ensures that all explanatory variables reflect the firm's conditions at the same point in time. This way we focus on whether pre-trend relationships exist relative to the firm's state at t-1, isolating how cash holdings at that time correlate with earlier investment patterns.

access bond markets to supplement bank credit (Adrian, Colla, and Shin, 2012; Becker and Ivashina, 2014).

Furthermore, credit conditions improved more quickly for publicly listed firms than for SMEs once the recovery took hold. After the crisis, banks remained pessimistic about economic conditions and loan performance, delaying credit recovery particularly for smaller, bank-dependent firms (Falato and Xiao, 2022; Ma, Paligorova, and Peydro, 2022). Data from the UK Credit Conditions Survey suggest that borrowing cost for large firms, and to a lesser extent medium-sized firms, fell almost immediately after the global financial crisis. By contrast, lenders reported that credit conditions for smaller firms did not begin improving until 2013. This suggests that unlike SMEs, cash-poor listed firms were able to bypass the negative feedback loop by securing external financing for investment and growth. In Section 5.2, we provide further evidence supporting this explanation.

4.4 Cross-sectional Analysis

To provide additional evidence that a tightening of credit conditions is a key driver of our results, we exploit cross-sectional firm and industry heterogeneity.

Firm-level

If liquid assets provided an advantage due to tighter financial conditions during the crisis, the effect should be more pronounced for SMEs most vulnerable to a reduction in bank credit. We proxy financial constraints using firm age and size, as younger and smaller firms typically face more lender scrutiny and monitoring due to their opacity (Hadlock and Pierce, 2010). Consequently, these firms should have been more affected by tighter credit conditions (Almeida, Campello, and Weisbach, 2004, Iyer et al., 2014).

First, we split the crisis sample into young firms (less than 10 years old in 2006) and old firms (20 years or older) and estimate the regressions for the longest horizon, i.e., using fixed asset growth from 2007 to 2014 as the dependent variable. The upper panel of Table 5 presents the results, with the left-hand side showing estimates for the full SME sample and the right-hand side for SMEs with volatile cash. In both cases, the cash coefficients are significantly larger for young firms. In the full SME sample, a young cash-rich SME increased its fixed assets by 15.6 percentage points more than a young cash-poor firm by 2014. For old SMEs, this difference was only 6.4 percentage points.[24]

[24]We use a common 10th – 90th percentile spread of the relative-cash variable, computed from the full firm sample (2.13).

Next, we divide firms by size, comparing small SMEs (lowest quartile of the size distribution) with large SMEs (highest quartile). The lower panel of Table 5 shows that cash-investment sensitivities are larger for small firms over the horizon 2007-2014, through the differences by size are somewhat less pronounced than those by age. The difference is statistically significant at the 1 percent level for the full sample, but insignificant for SMEs with volatile cash holdings. This is in line with previous research suggesting that financial constraints are more binding earlier in a firm's life cycle, when firms typically lack stable cash flow and a credit history (Haltiwanger, Jarmin, and Miranda, 2013; Cloyne et al., 2023). Focusing on the full sample, a small cash-rich firm increased its fixed assets by 21.3 percentage points more than a small cash-poor firm by 2014. For large SMEs, this difference was only 12.8 percentage points.

Industry-level

If cash holdings provide a strategic advantage when credit conditions deteriorate, the relationship between cash and investment should be stronger in industries where rivals have more difficulty accessing external finance. Following Fresard (2010), we measure financial constraints among a firm's rivals using the mean size and age in its 4-digit industry in 2006. We rank industries based on these variables and compare firms in the bottom and top quartile, estimating equation (1) separately for these groups, focusing on the longest horizon.

The results in Panel A of Table 6 show that for the full sample the association between cash holdings and long-term investment is stronger in industries in which firms are typically small or young. The cash coefficient is positive and significant at the 1 percent level in these industries. While still significant in industries with larger or older firms, the effect is weaker, consistent with firms in this subset being less reliant on cash for investment. When restricting the sample to firms with volatile cash holdings, however, we find no statistically significant differences across industry groups; if anything, point estimates are somewhat higher for industries with larger or older firms.

Beyond financial constraints, other industry characteristics may also shape cash-investment sensitivities. We investigate these in panel B of Table 6. First, we test whether capital intensity matters by comparing industries with high and low fixed asset-to-total asset ratios. While the cash-investment relationship is slightly stronger in capital-intensive industries, the difference is not statistically significant.

Next, we consider industry competition. Using firm-level turnover data from the ONS,

we compute the Herfindahl-Hirschman Index (HHI) at the 4-digit industry level in 2006. The HHI ranges from 0 to 1 and higher values indicate greater industry concentration.[25] Rather than imposing a threshold for competitiveness, we compare firms in the top and bottom quartiles of the HHI distribution. Cash holdings are positively associated with investment in both concentrated and competitive industries, with a slightly stronger effect in concentrated markets, though the difference is not statistically significant.[26]

Finally, we assess how industry performance during the crisis influenced the relation between cash holdings and investment. *A priori,* the effect is ambiguous. Cash may be more valuable in distressed industries, where firms can acquire fixed assets at discounted prices from struggling rivals, and where lenders are more likely to withdraw funding. However, weak demand in declining industries could also limit investment opportunities, reducing the benefits of holding cash. To test which effect dominates, we measure industry performance using value-added growth between 2007 and 2010, based on ONS data. We find a positive relationship between cash and investment for firms in both the top and bottom quartiles of the industry growth distribution, but no significant difference between the two groups.

Overall, we find some evidence that suggests that cash holdings were particularly beneficial in industries where rivals faced tighter financial constraints. Other industry characteristics played a less prominent role.

4.5 Additional Robustness Tests

The robustness tests in this section examine whether our findings are robust to alternative cash definitions or changes in sample composition. Our preferred cash measure is "relative cash" because it captures the competitive advantage that cash provides. It measures a firm's cash holdings relative to other SMEs in the same 4-digit industry. To test whether our results are robust we consider three alternative cash measures.

We first examine "excess cash", i.e., the amount of cash a firm holds beyond what is likely needed for daily operations and investment. Excess cash measures have been used in the literature to address endogeneity concerns (e.g., Duchin, Ozbas, and Sensoy, 2010, Opler et al., 1999 and Dittmar and Mahrt-Smith, 2007), but they are more challenging to

[25]We use the data from the Annual Respondents Database X, 1998-2014: Secure access. Virtual Microdata laboratory (VML), University of the West England, Bristol.

[26]Note that even in concentrated markets, often significant competition exists between small firms that compete locally. A case in point is the grocery store industry which is dominated by a few large supermarket chains, but in which many small corner stores compete with each other.

estimate for SMEs. Following Duchin, Ozbas, and Sensoy (2010) and Dittmar and Mahrt-Smith (2007), we estimate firms' normal cash needs based on balance sheet characteristics that typically influence cash holdings, with adjustments for SMEs due to data limitations. Excess cash is the difference between a firm's predicted cash holdings and its actual cash holdings.

Our cash regression controls for firm size, age, working capital, past investment, cash flow (proxied by profit), total liabilities, and cash growth, along with firm and industry-year fixed effects. We estimate this model for the period 2000–2006 and use the residuals for 2006 to capture excess cash. The results in Table 7 show that, for both the full sample (panel A) and the volatile cash sample (panel B), excess cash is positively associated with fixed asset growth during the crisis (column (1)), with this effect strengthening in the recovery (column (2)). This suggests that while holding excess cash may be costly in normal times, it can provide long-term benefits when credit conditions tighten.

Second, we replace relative cash with simple cash-to-total asset ratios, which are not z-scored. The results in columns (3) and (4) show that our results continue to hold for both samples. Third, we measure relative cash in 2007 instead of 2006. Given that problems in the UK financial sector emerged in mid-2007, leading to the run on Northern Rock, using 2006 cash holdings reduces concerns that firms were hoarding cash in anticipation of a credit supply shock. However, measuring cash in 2006 may not fully capture firms' liquidity positions at the onset of the crisis as the crisis only really took hold in 2008.[27] The results in columns (5) and (6) confirm again the robustness of our baseline results for both samples.

As a final robustness test, we assess whether group affiliation influences our results. Firms that are part of a corporate group may have access to internal capital, reducing their reliance on cash for investment. We therefore re-estimate our models excluding the 10 percent of SMEs in our sample that belong to a group. The results in columns (7) and (8) show that our finding are robust to excluding firms affiliated with a group for both the full sample and the volatile cash sample.

[27] As explained in Section 2.1, UK firms are not required to submit their accounts in a specific month. However, most firms file either at the end of the calendar year or at the end of the fiscal year in early April. We assign accounts submitted in the first half of a year to the previous calendar year and those submitted in the second half of a year to the current calendar year. As a result, accounts filed up to June 2007 are classified as 2006 filings and are included in our original pre-crisis cash measure.

5. Mechanisms

In the previous section, we have documented the emergence of an investment gap between cash-rich and cash-poor SMEs during the crisis which was widened during the recovery period. In this section, we explore three mechanisms that could explain the worsening of the position of cash-poor firms during the recovery period: competition dynamics, borrowing constraints and adjustments in cash balances.

5.1 Competition Dynamics

First, we investigate whether shifts in competition dynamics contributed to the widening investment gap. Cash-rich SMEs have the ability to invest and to thereby maintain their productive capacity during the crisis, while cash-poor SMEs see theirs decline. As a result, even if demand falls during a crisis, cash-rich firms may be able to expand their market share and strengthen their competitive position. They may improve their position further by acquiring assets at discounted prices from struggling competitors or by deterring competitors from entering or investing (Benoit, 1984). In addition, they can invest in competitive strategies, such as R&D, store or plant locations, distribution networks or advertising (Campello, 2006) at the expense of cash-poor rivals. Cash reserves may also enable firms to strategically lower their prices, capturing market share from vulnerable competitors that are forced to maintain or raise prices to sustain cash flow (Gilchrist et al., 2017).

As the economy recovers and demand rebounds, SMEs that invested and gained market share during the crisis are in a better position to meet rising demand. This can lead to higher earnings growth, which strengthens the balance sheets of initially cash-rich SMEs and enables them to invest and expand further. Conversely, firms that were cash-poor at the onset of the crisis may struggle to regain lost ground and their positions could continue to weaken. These feedback effects can reinforce the initial shift in competition dynamics.

To test this mechanism, we examine how pre-crisis cash holdings influenced firms' market shares and performance during the crisis and recovery. Due to limited data on sales, we measure market share by dividing a firm's assets by the total assets in its 4-digit industry. This competition measure assumes that firms compete with firms across the UK. Additionally, we construct a local competition measure given that SMEs in non-tradable industries mainly compete within their local markets. Following Mian and Sufi (2014),

we classify retail firms and restaurants as non-tradable and use firms' postcodes to define local markets. We then calculate "local market shares" as a firm's assets relative to the total assets of SMEs in the same postcode and 4-digit non-tradable industry.

Finally, we examine firm performance to assess whether having cash enabled firms to generate higher earnings that could be reinvested. We measure performance using cumulative profits scaled by total assets in 2007 and average return on assets (profits over total assets) over the relevant time horizon. As for the market share regressions, we examine firm performance across all industries and for non-tradable sectors only.

To determine the association between a firm's cash position and the growth of its (local) market share and performance, we estimate a model similar to our baseline specification (1), replacing fixed asset growth with these new dependent variables:

$$\Delta Y_{i,07+j} = \beta_j \textit{Relative cash}_{i,06} + \gamma_j X_i + \sum_{k=0}^{1} \theta_{kj} \Delta Y_{i,07-k} + \rho_s + \vartheta_r + \varepsilon_{i,j} \quad (2)$$

where $\Delta Y_{i,07+j}$ is the firm's (local) market share growth or profit between 2007 and year $2007{+}j$. Similar to regression model (1) we control for firm size, age, leverage, profit and group affiliation, along with pre-crisis values of the respective dependent variables (one and two periods lagged)and 4-digit industry and region or postcode area fixed effects.[28] Each regression is estimated separately for different time horizons using OLS, with standard errors clustered at the 4-digit industry level. To ensure that changes in the estimated effects over time are not driven by sample selection, we restrict the sample to SMEs with complete data on relative cash holdings, control variables, and the respective dependent variable across all horizons.

Table 8 presents the estimates for each dependent variable for the crisis period (2007–2009) and the combined crisis and recovery period (2007–2014). The left-hand side (columns (1) - (4)) reports results for the full set of firms, while the right-hand side (columns (5)–(8)) focuses on firms with volatile cash holdings. For the full sample, SMEs with higher pre-crisis cash reserves expanded their market share more during the crisis, and this effect increased further during the recovery period, with a positive and significant effect for 2007–2009 and a larger but statistically insignificant coefficient for 2007–2014 (columns (1)–(2)). Among firms with volatile cash holdings, the effect is again stronger during the recovery, with an insignificant coefficient for 2007–2009 and a significant one for 2007–2014 (columns (5)–(6)).

[28] In the regressions where cumulative profits and ROA are the dependent variables the lagged dependent variables are included in the regression and profit is excluded as a control variable.

A similar, but significantly stronger amplification effect emerges for our local competition variable (columns (3) - (4) and (7) - (8)). For both samples, the cash coefficient is insignificant for the period 2007-2009 and significant for the period 2007-2014. This could be due to industries like retail and hospitality being disproportionately affected by the financial crisis, limiting firms' ability to gain market share at its peak. However, when demand rebounded, cash-rich SMEs in these sectors were well-positioned to seize growth opportunities.

Turning to performance, we find that larger cash reserves were also associated with higher cumulative profits (Panel B) and larger average return on assets (Panel C). Our finding that the cash coefficient increases during the recovery period into account points to a self-reinforcing feedback mechanism. Reassuringly, the effects are very similar when we include all sectors and when we focus solely on non-tradable sectors. They are also similar for our full sample and the sample of SMEs with volatile cash holdings.

Overall, our evidence shows that higher initial cash holdings are associated with an increase in market share and higher profits. This competitive edge could have contributed to the persistent and widening investment gap following the financial crisis.

5.2 Borrowing Constraints

Another potential driver behind the widening investment gap that we document are differences in access to external finance for cash-rich and cash-poor firms during the crisis and recovery period. When credit conditions tighten and banking sector vulnerabilities are exposed, SMEs are more affected due to their reliance on bank lending. Compared to larger firms, SMEs are typically riskier and less transparent, making it more difficult for them to secure credit during periods of heightened uncertainty ((Iyer et al., 2014; Cingano, Manaresi, and Sette, 2016). Moreover, while large firms often benefit from pre-committed credit lines, SMEs typically face greater lender discretion when loan terms are set (Chodorow-Reich et al., 2022). This makes loan supply for SMEs more sensitive to bad news and a worsening of repayment prospects. Collateral constraints also tend to tighten during financial crises (Kiyotaki and Moore, 1997; Khan and Thomas, 2013), which disproportionally affects SMEs as their loans are more often collateralized (Chodorow-Reich et al., 2022). In the UK 75-80 percent of SME loans are collateralized (Bahaj, Foulis, and Pinter, 2020).

During a downturn, larger cash balances protect a firm's net worth and firms with liquid assets might be perceived as less risky by lenders. This can improve their chances

of securing new credit or rolling over existing debt. This financial flexibility helps them maintain liquidity and allows them to continue to invest. Cash-poor SMEs are more likely to face binding borrowing constraints, which may force them to reduce their stock of fixed assets.

These differences in borrowing constraints may persist for some time after the crisis. Cash-rich SMEs with a growing stock of fixed assets may have more collateral to pledge and may find it easier to secure further credit. Cash-poor firms with a shrinking stock of fixed assets could face tighter collateral constraints. If banks incorporate recent earnings in their lending decisions (Ivashina, Laeven, and Moreno, 2022; Lian and Ma, 2021), the stronger performance of cash-rich firms could further ease their borrowing constraints. These effects may be exacerbated if banks, emerging from the crisis with weaker balance sheets and facing stricter regulation, adopted more conservative lending standards during the recovery. The gradual easing of credit conditions observed during the recovery period may therefore not have benefited initially cash-poor SMEs, making it harder for them to escape the negative feedback loop and to catch up with their cash-rich rivals.

To assess whether differences in access to credit contributed to the widening investment gap, we first examine whether initial cash holdings influenced the growth of firms' debt stock over time. We estimate a model similar to regression model (2), replacing the dependent variable with log differences in corporate debt between 2007 and year 2007+j. We focus on three debt measures: (1) total debt, including trade credit, short-term loans, overdrafts, and long-term loans; (2) short-term debt, covering trade credit, short-term loans, and overdrafts; and (3) long-term loans.[29] The sample consists of 24,906 SMEs with complete debt data for all years from 2007 to 2014, including 7,242 firms with volatile cash holdings. We control for credit demand by including industry and region fixed effects.

Table 9 presents the estimates for the crisis period (2007-2009) and the combined crisis and recovery period (2007-2014). Panel A reports results for all firms, while panel B focuses on those with volatile cash holdings. Across all debt measures, we find a positive and significant relationship between relative cash and debt growth during the crisis. This cash coefficient becomes larger in the recovery period, consistent with the idea that borrowing constraints evolved differently for cash-rich and cash-poor firms. Results

[29]Another interesting angle to explore would be the extent to which firms drew down their credit lines during the crisis (e.g Ivashina and Scharfstein, 2010; Acharya, Almeida, Ippolito, et al., 2021; Greenwald, Krainer, and Pascal, 2024; Chodorow-Reich et al., 2022). Unfortunately, this information is not available in the dataset we use.

for SMEs with volatile cash holdings mirror those of the full sample. In Appendix Table A.7 we follow Degryse et al. (2019) and control for credit demand by using industry-location-size fixed effects. While this approach significantly reduces the sample, the results are consistent.[30]

To further examine differences in access to credit, we analyze changes in SMEs' credit scores. Our measure, the QuiScore provided by BvD, is a proprietary indicator developed by UK credit rating agency CIRF, and is primarily used to assess the creditworthiness of smaller firms. It is based on financial and non-financial information (e.g., directors' and shareholders' history, County Court Judgments) and ranges from 0 (high risk) to 100 (secure). We estimate the same model as before, replacing the dependent variable with changes in firms' credit scores between 2007 and year 2007+j. Since credit scores are not updated annually and the evolution of a firm's credit score in the run-up to the crisis may be less relevant than its score at the onset of the crisis, we control for the credit score at the onset of the crisis rather than its lagged growth rate.

The results, presented in the last two columns of Table 9, indicate that the credit scores of cash-poor SMEs deteriorated relative to those of cash-rich SMEs. This divergence increased further in the recovery period. If banks' lending decisions take credit scores into account, these findings suggest that initially cash-poor SMEs faced tighter borrowing constraints during the crisis and the recovery period.

We also find that the debt growth of cash-poor publicly listed firms and cash-poor SMEs differs. We pool SMEs and publicly listed firms with complete debt data and estimate an expanded version of regression model (2). To capture differences in debt growth by cash holdings and firm type, we define dummy variables for firms in the lowest (cash-poor) and highest (cash-rich) quartiles of their respective cash distributions. We introduce a dummy for listed firms and interact it with the cash dummies to examine how the relationship between cash holdings and debt growth varies across the two groups.

Figure 10 illustrates the differences in debt growth between cash-poor SMEs and cash-poor publicly listed firms, based on the estimates from this model. We find that debt held by cash-poor SMEs declined by 11.1 percent between 2007 and 2009, while debt held by cash-poor publicly listed firms increased by 16 percent. By 2014, debt held by cash-poor SMEs was still 18 percent below pre-crisis levels. By contrast, debt held by cash-poor publicly listed firms had increased by 53.4 percent relative to pre-crisis levels.

These findings support the idea that cash-poor publicly listed firms were able to cir-

[30]For volatile cash firms the sample becomes too small to provide meaningful estimates, we therefore only report results for the full sample of SMEs.

cumvent the negative feedback loop by financing investment with external funds. Initially cash-poor SMEs, on a downward trajectory, entered a self-reinforcing feedback loop that they could not exit by accessing external finance. Large firms often have access to pre-established credit facilities, enabling them to draw down funds even when banks restrict new lending. This, in turn, crowds out lending to smaller firms (Chodorow-Reich et al., 2022, Greenwald, Krainer, and Pascal, 2024). In addition, publicly listed firms can tap the bond markets to supplement bank credit (Adrian, Colla, and Shin, 2012; Becker and Ivashina, 2014).When the recovery set in, credit conditions improved more quickly for publicly listed firms compared to SMEs. Even as the crisis subsided, banks remained pessimistic about economic conditions and loan performance which impeded credit recovery, particularly for small and bank-dependent firms (Falato and Xiao, 2022; Ma, Paligorova, and Peydro, 2022).

While it is difficult to separate credit demand and supply effects without loan application data, our findings, together with the evidence in Section 4.4, are indicative of differences in borrowing constraints faced by cash-rich and cash-poor SMEs as a potential mechanism behind the widening of the investment gap

5.3 Cash Balance Adjustment

The final potential mechanism that could explain the widening of the investment gap relates to how firms adjust their cash balances in response to a financial crisis. Several studies indicate that firms tend to increase their cash holdings following large shocks due to heightened uncertainty, limited access to external finance, and the need for operational flexibility (Almeida, Campello, and Weisbach, 2004; Song and Lee, 2012; Berg, 2018). In the short run, these firms prioritize balance sheet repair over investment (Xiao, 2024; Melcangi, 2024). For SMEs that enter the crisis with very low cash reserves, balance sheet repair may be critical for survival.

When the recovery sets in and cash balances are higher, firms may seek to reverse these defensive decisions and resume investing. However, several factors may hinder a swift change of strategy. First, weak cash flow during the crisis may lengthen the amount of time that firms require to reach their desired cash levels. Second, firms may permanently revise their optimal level of cash reserves upwards due to increased uncertainty or shifts in risk perceptions from over-optimistic to over-pessimistic (Bordalo, Gennaioli, and Shleifer, 2018). Third, firms may not fully anticipate the long-term consequences of building up cash reserves at the expense of investment. As shown in Section 4.2, lower short-

term investment by cash-poor firms did not have long-term implications during the pre-crisis period. This may have led firms to underestimate the long-term cost of reducing investment in favor of cash accumulation.

To test whether adjustments in cash balances contribute to the persistence of the investment gap, we estimate a model similar to regression model (2), with the log difference in cash holdings between 2007 and 2007+j as the dependent variable. Table 10 presents estimates for the crisis period (2007-2009) and the combined crisis and recovery periods (2007-2014). The left-hand side reports results for all firms, while the right-hand side focuses on firms with volatile cash holdings. We find for both samples that cash-poor firms experienced a relative increase in their cash holdings during the crisis. This effect increased during the recovery period.

Figure 11 (left-hand panel) illustrates how cash-rich and cash-poor firms adjusted their liquidity. During the crisis, cash-rich SMEs reduced their cash holdings, possibly to sustain operations and to invest in capital stock, and they continued to do so at a more modest pace during the recovery period. Cash-poor SMEs increased their cash balances during the crisis period and continued to materially increase them throughout the recovery period. Between 2007 and 2014, cash-poor firms increased their cash reserves by 54 percent, and cash-rich firms reduced theirs by 27 percent. Despite this high growth rate of cash-poor SMEs, the absolute increase was modest as these firms entered the crisis with only 1 percent of assets in cash, compared to 75 percent for cash-rich SMEs.

To assess whether these dynamics merely reflect mean reversion in cash holdings rather than a shift in firm behavior in response to the crisis, we also estimate the same regression model for the pre-crisis period. The right-hand panel of Figure 11 shows that the pattern of adjustment is broadly similar across the two periods: cash-rich firms reduce cash balances, while cash-poor firms rebuild them. However, the magnitudes of adjustment differ, with cash-poor firms increasing cash somewhat less and cash-rich firms reducing it somewhat more during 2007–2014.

These findings suggest that the crisis did not fundamentally change how SMEs adjusted their cash balances, but it altered the conditions under which those adjustments took place. Weaker cash flow and tighter credit conditions likely constrained cash-poor firms' ability to rebuild liquidity, even as precautionary motives strengthened. Maintaining or rebuilding liquidity thus became more costly in terms of foregone investment, particularly for firms with limited external financing options. Cash-rich firms, by contrast, could draw down existing reserves to sustain operations and investment.

6. Firm Survival

In our previous analysis, we focused exclusively on SMEs that survived both the crisis and the recovery period. In this section, we examine whether cash holdings at the onset of a crisis are correlated with a firm's likelihood of survival. To this end, we now focus on all SMEs that entered the market before 2005 and were still active in 2007. Our sample consists of 259,416 SMEs for which we have complete data for each year during which they are active. We estimate a model similar to our baseline specification (1) but replace fixed asset growth with a survival dummy:

$$Survival_{i,07+j} = \beta_j Relative\ cash_{i,06} + \gamma_j X_i + \sum_{k=0}^{1} \theta_{kj} \Delta Y_{i,07-k} + \rho_s + \vartheta_r + \varepsilon_{i,j} \quad (3)$$

where $Survival_{i,07+j}$ is a dummy that equals one if the firm is active in year 2007+j and zero otherwise.[31] We again control for the firm's size, age, leverage, profit, and whether it is part of a group, pre-crisis investment (one and two periods lagged) as well as industry and region fixed effects. We estimate linear probability models separately for each horizon using OLS. Standard errors are clustered at the 4-digit industry level.

Figure 12 presents the results for both the full sample of SMEs and for those with volatile cash holdings. For both samples, SMEs with larger initial cash holdings exhibited a significantly higher probability of survival during the crisis. By 2009, 3.4 percent of the firms in our sample had exited. For cash-poor firms (those in the 10th percentile of the relative cash distribution) this number was significantly higher at 4.7 percent than for cash-rich firms (those in the 90th percentile) of which only 2 percent had exited. The cash coefficient increased until 2011. By then, 13 percent of the cash-poor SMEs had exited while only 8 percent of cash-rich ones did. From 2012 onward, the cash effect declined slightly, but the coefficients are not significantly different from the coefficient for the period until 2011. Therefore, while initially cash-rich firms were more likely to survive by 2014, this effect primarily stemmed from the period before 2012.

This evidence complements our main findings and suggests that initial balance sheet strength at the onset of the crisis was associated with a higher probability of survival not only during the crisis but during the recovery period as well.

[31] We thus maintain the same number of firms in each cross-sectional regression.

7. Concluding Remarks

This paper documents a strong positive relationship between pre-crisis cash holdings and long-term investment of SMEs following the global financial crisis. SMEs with large initial cash holdings continued to invest during the crisis while their cash-poor rivals were forced to reduce their fixed assets. This gave cash-rich SMEs an advantage when the economy rebounded, resulting in a persistent investment gap which grew over the seven years following the shock. We do not observe these patterns outside of crisis episodes or for publicly listed firms, suggesting that access to external finance plays a key role in shaping investment dynamics.

We present evidence consistent with three mechanisms that can explain the persistent and widening investment gap. The first mechanism relates to the ability of cash-rich SMEs to persistently outcompete their cash-poor rivals. Having cash at the onset of the crisis allowed firms to increase their market share and generate higher profits during the crisis. These profits could be reinvested to capture additional market share during the recovery. The second mechanism relates to differences in access to external finance by cash-poor and cash-rich firms. Tighter credit conditions contributed to lower investment and performance by cash-poor firms during the crisis, resulting in continued borrowing constraints during the recovery period when credit conditions improved. We find that initially cash-poor firms deleveraged more during the crisis and saw a worsening of their credit scores relative to cash-rich firms, with both effects becoming more pronounced during the recovery period. The third mechanism relates to the need for cash-poor firms to rebuild liquidity buffers during the crisis and recovery phase, constrained by weak cash flow and tight credit conditions. We find that initially cash-poor firms accumulated cash consistent with balance sheet repair, while cash-rich SMEs drew down their reserves and used retained earnings to fund investment.

These findings have several implications. First, our analysis suggests that estimates of the impact of a crisis should take long-term effects into account. Focusing only on the crisis years can underestimate the true effect of the shock, particularly if self-reinforcing dynamics amplify the initial response to the crisis. Second, our findings highlight the importance of distinguishing between firms of different sizes to understand how different segments of the corporate sector adjust to shocks. Relying solely on evidence from publicly listed firms, which tend to benefit from looser financial conditions, can obscure our understanding of a large part of the economy and can limit the effectiveness of policy interventions (see also Brunnermeier and Krishnamurthy (2020) in the context of Covid-

19). Third, our finding that cash-poor SMEs reduce their capital stock substantially during downturns underscores the importance of public lending schemes that help solvent firms bridge liquidity shortfalls. Well-designed support programs can mitigate long-term damage to the economy's productive capacity after a crisis.

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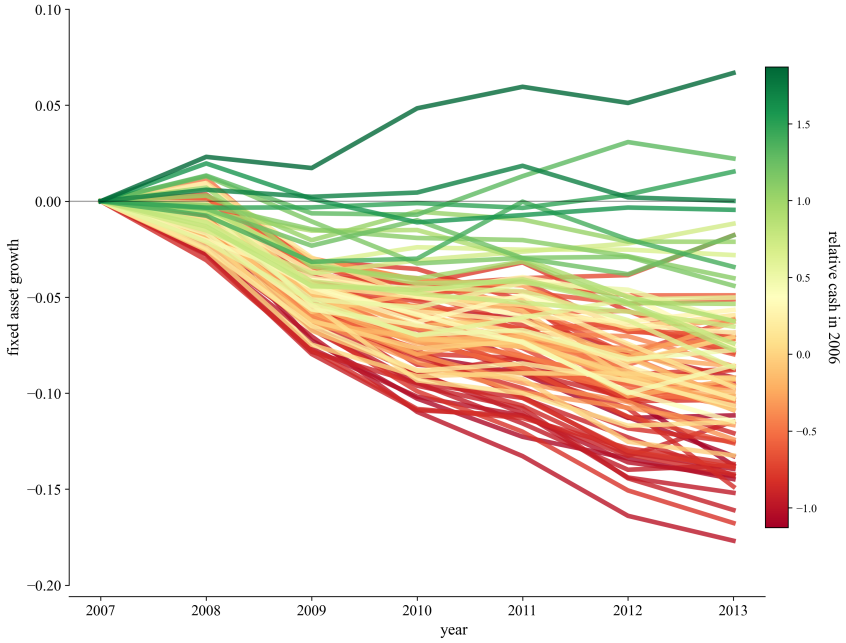
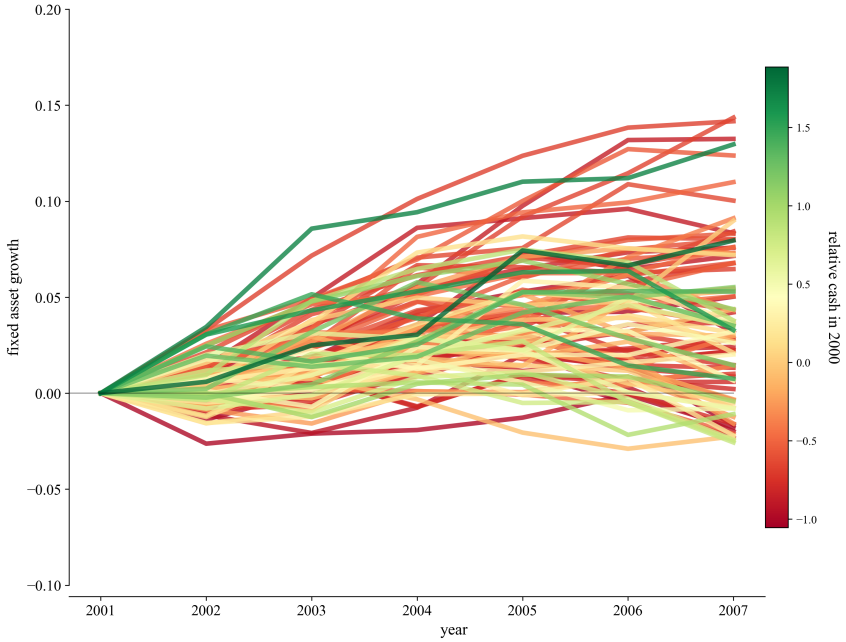
Figure 1: **Investment cash-rich vs cash-poor SMEs: crisis and pre-crisis period**

Panel A: Crisis period: 2007-2014

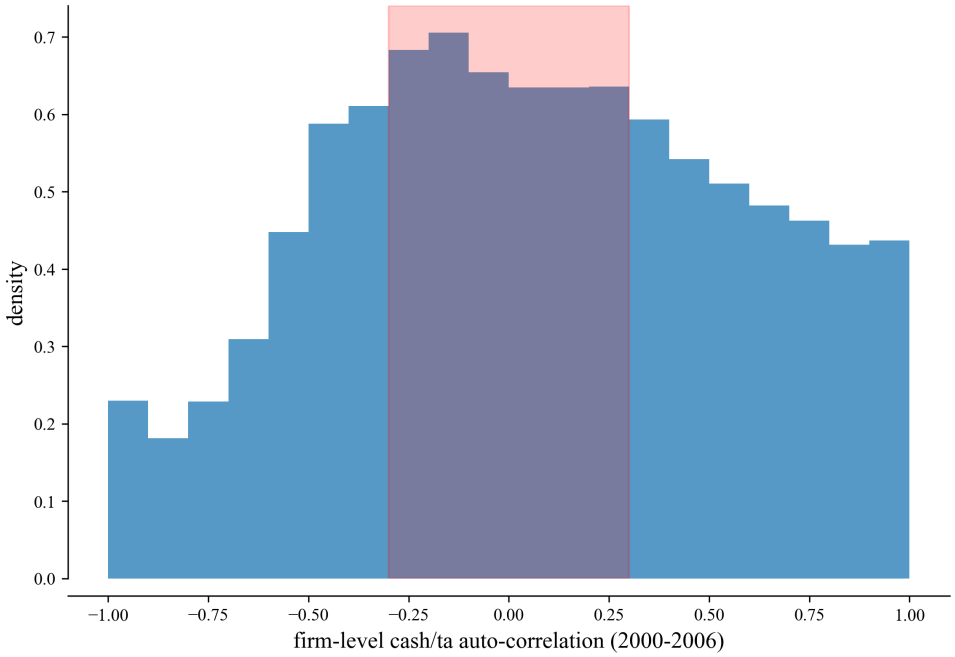


Panel B: Pre-crisis period: 2001-2007



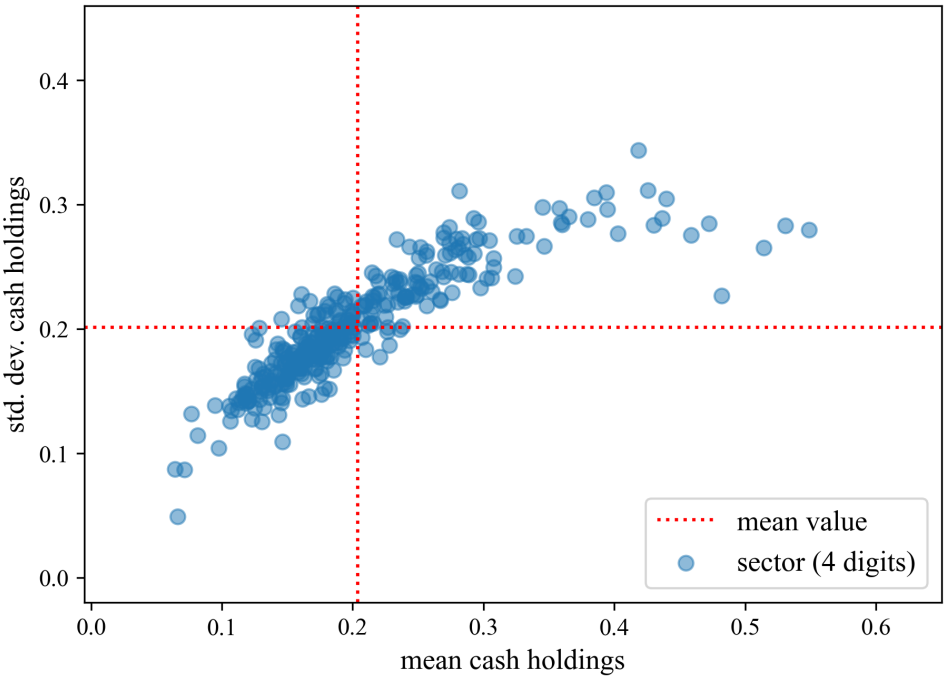
Notes: These figures plot the average fixed asset growth for SMEs in each percentile of the central 95 percent range of the *Relative cash* distribution. In panel A average fixed asset growth is tracked over the period 2007-2014 and in panel B over the period 2001-2007. Fixed asset growth is defined as the log difference between 2007 and 2007+j (crisis period) and between 2001 and year 2001+j (pre-crisis period). Relative cash is calculated by subtracting from the firm's cash holdings its industry mean and dividing the difference by the industry standard deviation and is measured in 2006 for the crisis period and in 2000 for the pre-crisis period. Industry mean and standard deviation are determined at the 4-digit level.

Figure 2: **Autocorrelation of cash holdings**



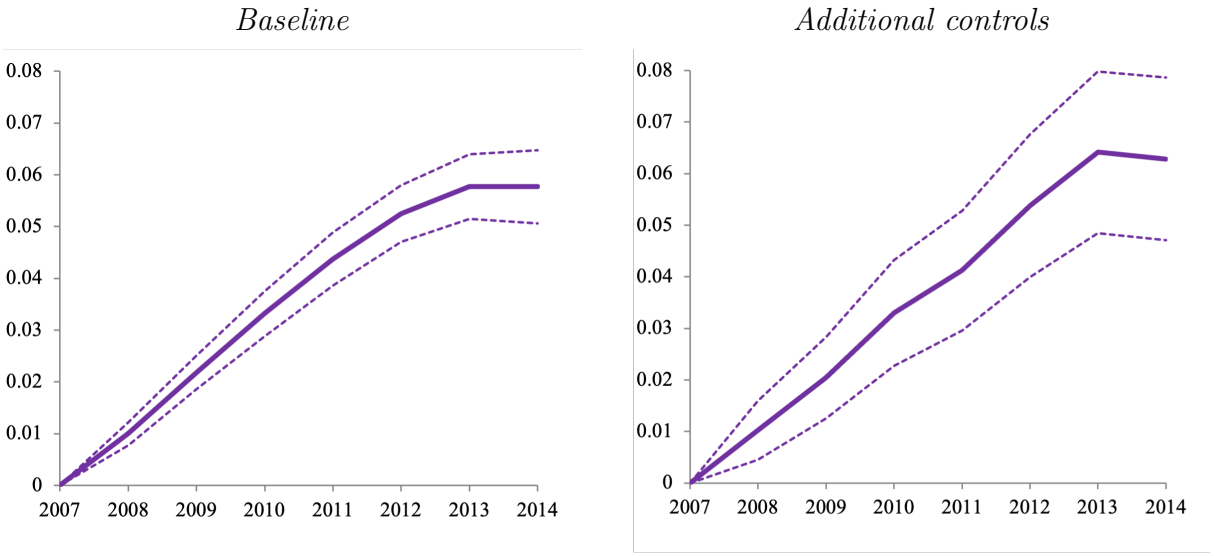
Notes: This figure plots the distribution of the one-lag autocorrelation coefficient of cash holdings over the period 2000 to 2006 for the firms in our sample. Cash holdings are defined as deposits over total assets. The shaded area marks SMEs with volatile cash holdings.

Figure 3: **Variations in cash holdings by industry**



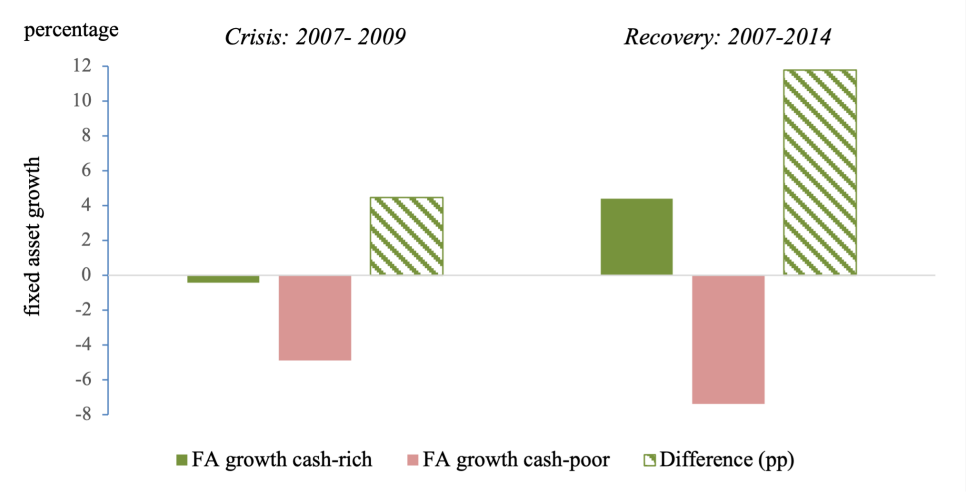
Notes: This figure plots the correlation between the mean and standard deviation of cash holdings of UK firms at the 4-digit industry level. The dotted lines depict the mean of each measure across industries. Cash holdings are defined as deposits over total assets and measured in 2006.

Figure 4: **Long-term relationship between cash and investment**



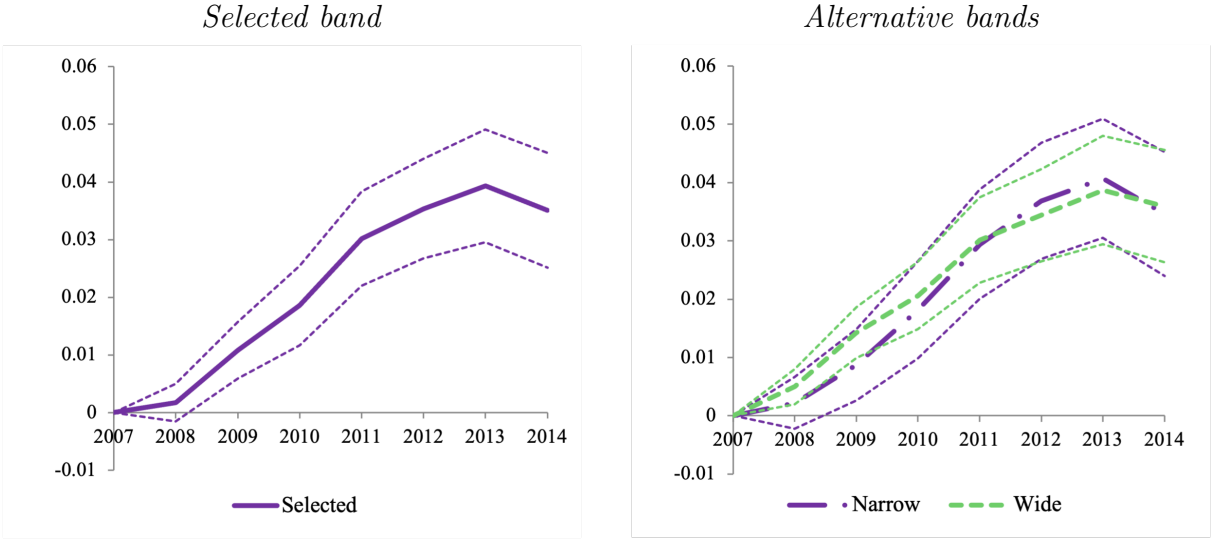
Notes: These figures plot the relationship between relative cash and investment over different horizons using local projections. The dependent variable is cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7. The model specification used in the left-hand panel includes controls for leverage, size, age category, group, profit and investment. The model specification used in the right-hand panel also includes controls for turnover growth. All variables are measured in 2006, except investment and turnover growth which are measured over 2005–2006 and 2006–2007. Both specifications include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* and the dashed lines show the 90 percent confidence intervals.

Figure 5: **Estimated investment of cash-rich and cash-poor SMEs during crisis and recovery**



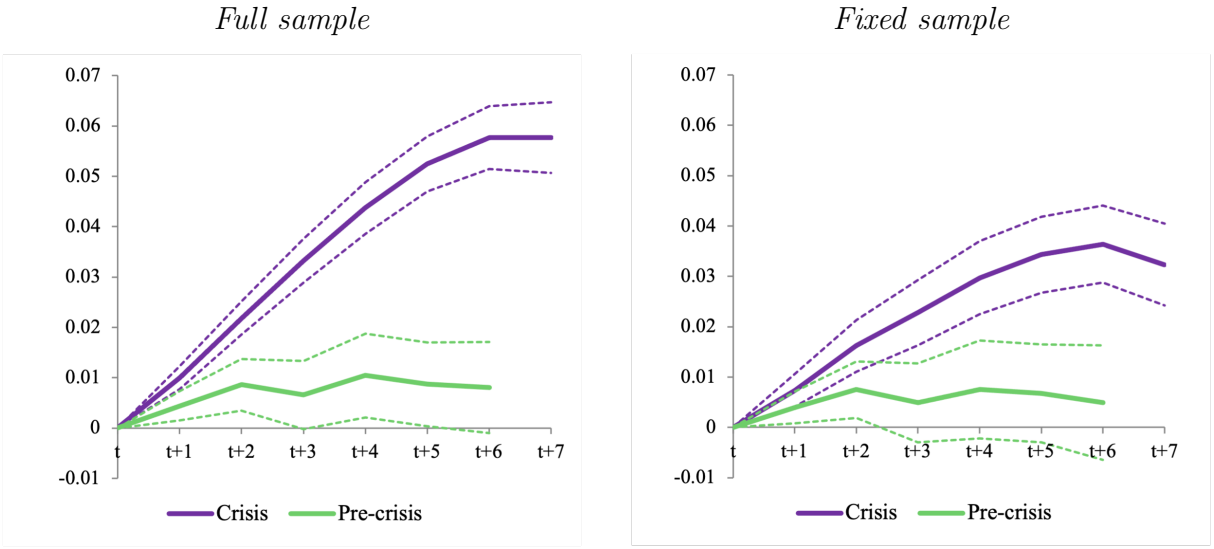
Notes: This figure plots the implied cumulative fixed asset growth of cash-rich and cash-poor SMEs, as well as the difference between the two, based on the estimated coefficients of the baseline model. The left-hand panel shows fixed asset growth between 2007 and 2009, the right-hand panel between 2007 and 2014. Cash-rich firms correspond to the 90th percentile of the *Relative cash* distribution and cash-poor firms to the 10th percentile, both defined within industries. Fixed asset growth for each group is calculated separately within each industry, and the figure reports the simple (unweighted) average across industries.

Figure 6: **Long-term relationship between cash and investment - SMEs with volatile cash holdings**



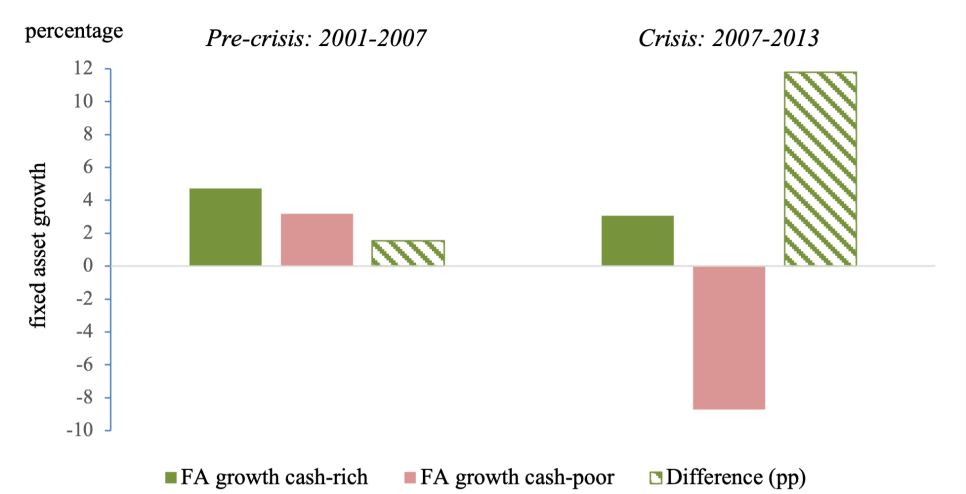
Notes: This figure plots the relationship between relative cash and investment over different horizons using local projections for subsets of firms with volatile cash holdings. Cash volatility is measured as the one-lag autocorrelation coefficient of cash to total assets over the period 2000 to 2006. The left-hand panel includes firms with a cash autocorrelation between -0.3 and 0.3, the right-hand panel includes firms with a cash autocorrelation between -0.2 and 0.2 (narrow) or between -0.4 and 0.4 (wide). The dependent variable is the cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7. All regressions include the standard control variables and region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The bold lines correspond to the estimated parameter of *Relative cash* and the dashed lines show the 90 percent confidence intervals.

Figure 7: **Long-term relationship between cash and investment - crisis vs pre-crisis period**



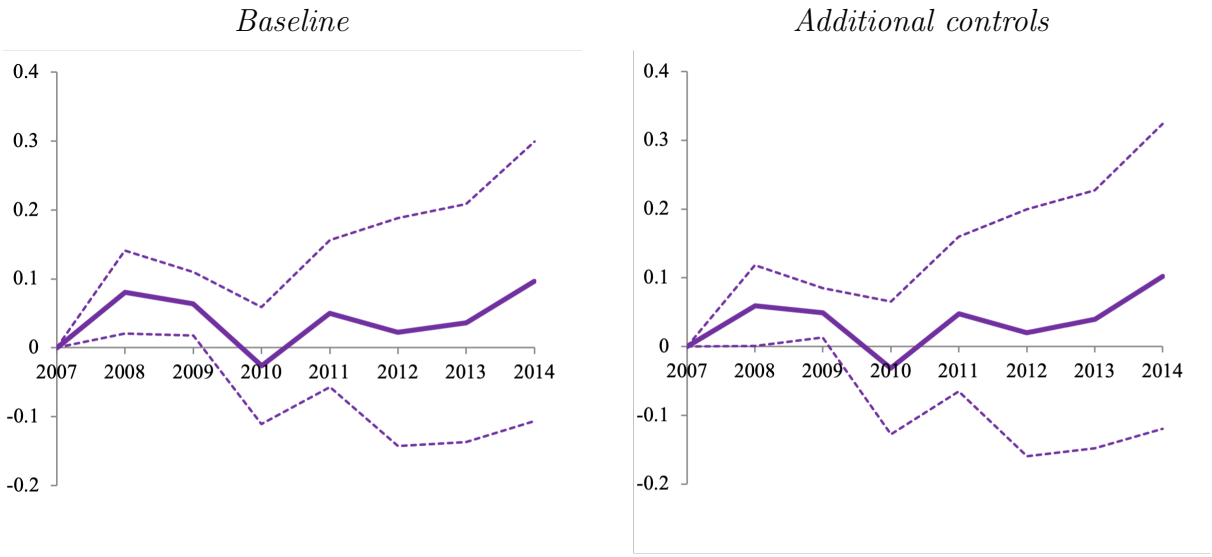
Notes: These figures plot the relationship between relative cash and investment over different horizons using local projections for the crisis and pre-crisis periods. The dependent variable is the cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7 for the crisis sample and between 2001 and 2001+j, where j ranges from 1 to 6 for the pre-crisis sample. The full sample includes all firms for which information is available. The fixed sample includes the subset of firms that are both present in the crisis and pre-crisis periods. All regressions include the standard control variables and region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* for the two periods and the dashed lines show the 90 percent confidence intervals.

Figure 8: **Estimated long-term investment of cash-rich and cash-poor SMEs - crisis vs pre-crisis period**



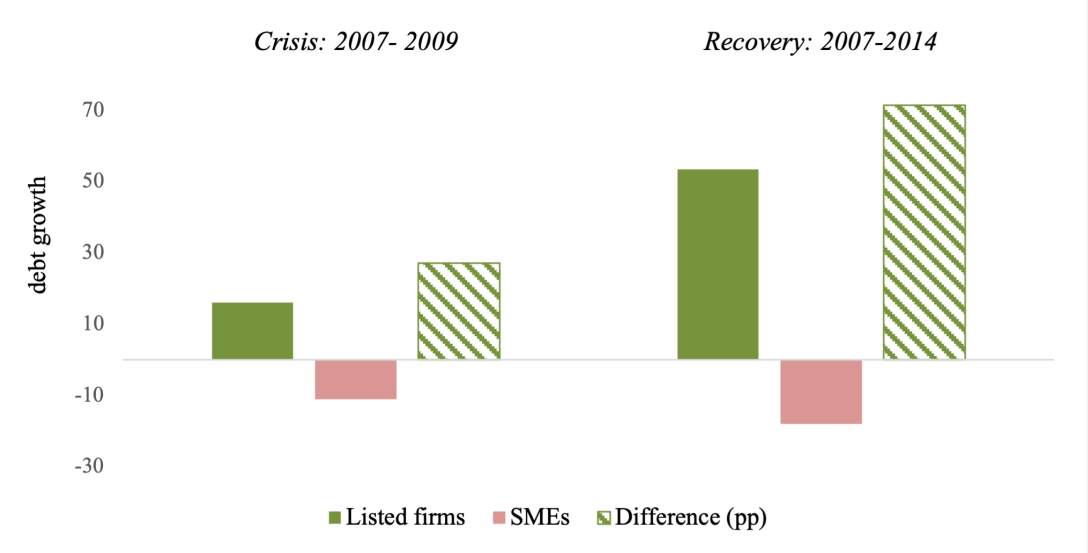
Notes: This figure plots the implied cumulative fixed asset growth of cash-rich and cash-poor SMEs and the difference between the two based on the estimated coefficients of the baseline models for the pre-crisis and the crisis periods. The left-hand panel shows fixed asset growth between 2001 and 2007 (pre-crisis) and the right-hand panel between 2007 and 2013 (crisis). Cash-rich firms correspond to the 90th percentile of the *Relative cash* distribution and cash-poor firms to the 10th percentile, both defined within industries. Fixed asset growth for each group is calculated separately within each industry, and the figure reports the simple (unweighted) average across industries.

Figure 9: **Long-term relationship between cash and investment - publicly listed firms**



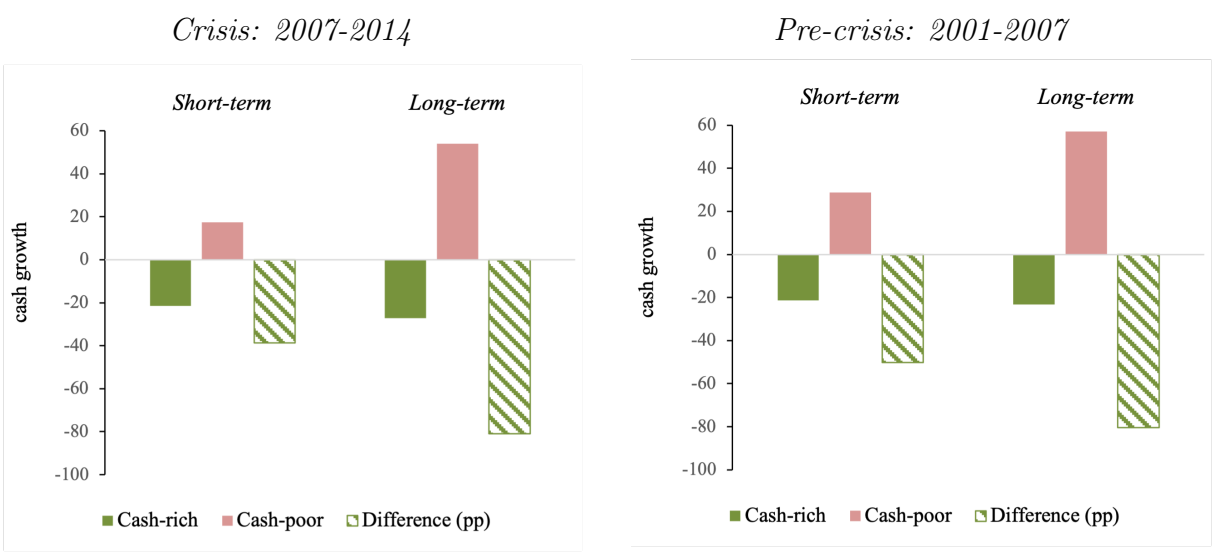
Notes: These figures plot the relationship between relative cash and investment over different horizons using local projections for the sample of publicly listed firms. The dependent variable is the cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7. The model specification used in the left-hand side panel includes controls for leverage, size, age category, group, profit and investment. The model specification used in the right-hand side panel also includes controls for turnover growth. All variables are measured in 2006, except investment and turnover growth which are measured over 2005-2006 and 2006-2007. Both specifications include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* and the dashed lines show the 90 percent confidence intervals.

Figure 10: **Estimated debt growth of cash-poor SMEs and publicly listed firms**



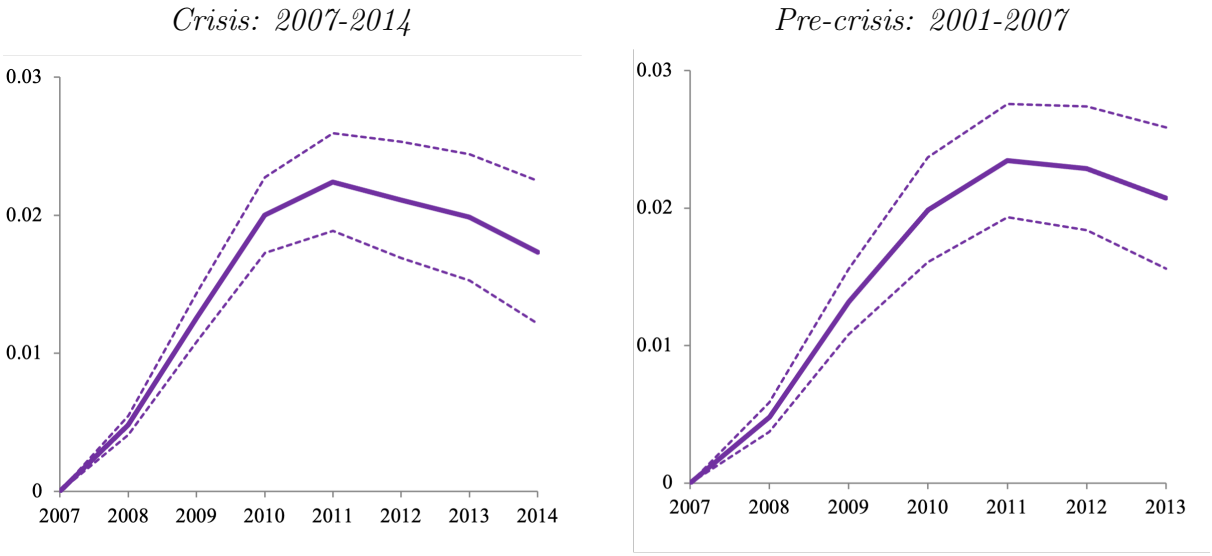
Notes: This figure plots the implied cumulative debt growth of cash-poor SMEs and publicly listed firms and the difference between the two based on the estimated coefficients for the model described in Section 5.2. The left-hand side panel shows debt growth between 2007 and 2009, the right-hand side panel between 2007 and 2014. Cash-poor SMEs/publicly listed firms are those in the bottom quartile of the respective cash distributions.

Figure 11: **Estimated cash growth of cash-rich and cash-poor SMEs - crisis vs pre-crisis period**



Notes: This figure plots the implied cumulative growth in cash holdings of cash-rich and cash-poor SMEs and the difference between the two based on the estimated coefficients for regression model (2) where the dependent variable is the log difference of cash holdings between t and the year t+j. The left-hand panel shows the results for the crisis period and the right-hand panel for the pre-crisis period. Short-term refers to growth of cash holdings over two horizons and long-term over 7 horizons for the crisis period and 6 horizons for the pre-crisis period. Cash-rich firms correspond to the 90th percentile of the *Relative cash* distribution and cash-poor firms to the 10th percentile, both defined within industries. Growth in cash holdings for each group is calculated separately within each industry, and the figure reports the simple (unweighted) average across industries.

Figure 12: **Long-term relationship between cash and survival**



Notes: These figures plot the relationship between relative cash and firm survival over different horizons using local projections. The dependent variable is a dummy that takes a value of 1 if the firm is active in 2007+j and zero otherwise, where j ranges from 1 to 7. The model specification includes controls for leverage, size, age category, group, profit and investment (one and two periods lagged). All variables are measured in 2006, except investment which is measured over 2005-2006 and 2006-2007. The left-hand panel includes all SMEs, the right-hand panel only SMEs with volatile cash holdings. All regressions include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* and the dashed lines show the 90 percent confidence intervals.

Table 1: **Summary Statistics**

	All SMEs - Crisis sample				SMEs with volatile cash holdings			
Variable Name	Obs	Mean	Median	Std Dev	Obs	Mean	Median	Std Dev
ΔlnFA (2007-2014)	204,412	-0.09	-0.07	1.03	60,977	-0.07	-0.05	1.00
Relative cash	204,412	-0.14	-0.39	0.84	60,977	-0.19	-0.44	0.80
Leverage	204,412	0.64	0.61	0.38	60,977	0.60	0.57	0.37
Size	204,412	5.39	5.38	1.56	60,977	5.71	5.77	1.55
Mature	204,412	0.19	0.00	0.39	60,977	0.28	0.00	0.45
Old	204,412	0.23	0.00	0.42	60,977	0.31	0.00	0.46
Group	204,412	0.08	0.00	0.27	60,977	0.11	0.00	0.31
Profit	204,412	0.30	0.33	0.39	60,977	0.33	0.36	0.39
Pre-Investment (1st lag)	204,412	0.03	-0.01	0.40	67,415	0.02	-0.01	0.39
Pre-Investment (2nd lag)	204,412	0.05	-0.01	0.41	67,415	0.04	-0.01	0.40
Pre-Turnover growth (1st lag)	27,428	0.06	0.06	0.40	8,851	0.05	0.05	0.39
Pre-Turnover growth (2nd lag)	27,428	0.09	0.06	0.43	8,851	0.06	0.05	0.39
Excess cash	185,667	0.00	-0.03	0.16	57,144	0.01	-0.04	0.15
Cash holdings	204,412	0.24	0.16	0.24	60,977	0.23	0.15	0.24
Relative cash (2007)	197,365	-0.14	-0.38	0.83	59,430	-0.18	-0.42	0.80
%ΔMshare (2007-2014)	195,562	0.14	-0.11	0.96	58,676	0.12	-0.10	0.90
%ΔLocal Mshare (2007-2014)	194,448	0.21	-0.12	1.25	58,359	0.19	-0.11	1.22
$\sum$ Profit (2007-2014)	189,942	2.83	2.49	3.36	57,311	2.92	2.66	3.25
ROA (2007-2014))	188,609	0.31	0.33	0.38	56,935	0.33	0.36	0.37
ΔlnDebt (2007-2014)	24,907	-0.61	0.00	1.80	7,278	-0.64	0.00	1.82
ΔlnST Debt (2007-2014)	24,907	-0.46	0.00	1.47	7,278	-0.47	0.00	1.49
ΔlnLT Debt (2007-2014)	24,907	-0.38	0.00	1.55	7,278	-0.41	0.00	1.60
ΔCredit Score(2007-2014)	149,549	4.41	4.00	10.91	42,121	4.69	5.00	10.93
ΔlnCash (2007-2014)	178,608	0.20	0.21	1.27	53,614	0.19	0.21	1.29

	All SMEs - Pre-crisis sample				Publicly listed firms			
Variable Name	Obs	Mean	Median	Std Dev	Obs	Mean	Median	Std Dev
ΔlnFA (2001-2007/2007-2014)	135,617	0.03	0.00	0.98	259	0.23	0.23	1.26
Relative cash	135,617	-0.14	-0.43	0.81	259	-0.20	-0.42	0.68
Leverage	135,617	0.65	0.63	0.37	259	0.54	0.53	0.31
Size	135,617	5.58	5.64	1.53	259	9.33	9.09	2.41
Mature	135,617	0.27	0.00	0.44	259	0.36	0.00	0.48
Old	135,617	0.30	0.00	0.46	259	0.31	0.00	0.46
Group	135,617	0.12	0.00	0.33	n.a.	n.a.	n.a.	n.a.
Profit	135,617	0.27	0.29	0.39	259	0.01	0.05	0.22
Pre-Investment (1st lag)	135,617	0.03	-0.01	0.40	259	0.17	0.06	0.49
Pre-Investment (2nd lag)	135,617	0.06	0.00	0.42	259	0.19	0.07	0.66

Notes: The table presents summary statistics for the key variables used in the empirical analyses for the full sample of SMEs (crisis and pre-crisis samples) for SMEs with volatile cash holdings and for the sample of publicly listed firms.

Table 2: **Pre-crisis characteristics of cash-rich and cash-poor SMEs**

	Cash-rich		Cash-poor		
Variable	Mean	Variance	Mean	Variance	Normalized difference
Size (th)	543	989,478	966	2,088,079	-0.25
Young	0.47	0.25	0.38	0.24	0.13
Mature	0.25	0.19	0.31	0.21	-0.08
Old	0.27	0.20	0.31	0.21	-0.06
Group	0.05	0.05	0.13	0.11	-0.19
Leverage	0.48	0.10	0.72	0.15	-0.50
Profit	0.09	0.15	0.06	0.19	0.06
Investment	0.02	0.09	0.03	0.07	-0.02

Notes: This table presents means and variances of selected firm characteristics for SMEs with high and low cash holdings relative to their industry rivals for the subsample of SMEs with volatile cash holdings. Cash-rich firms are those in the top quartile of the relative cash distribution and cash-poor firms are in bottom quartile as measured in 2006. The last column reports the normalized difference, i.e., the difference between the average in the cash-rich and cash-poor groups divided by the square root of the sum of the variances. *Size* denotes the firms' total assets (in thousands). *Young* is a dummy that equals one if the firm is 10 years or younger. *Mature* is dummy that equals one if the firm is between 10 and 20 years old. *Old* is a dummy that equals one if the firm is over 20 years old. *Group* is a dummy that equals one if the firm is part of a group. *Leverage* denotes the share of total liabilities over total assets. *Profit* denotes the average profit growth between 2005 and 2006 and 2006 and 2007. *Investment* denotes the average of the log difference of the firm's fixed assets between 2005 and 2006 and between 2006 and 2007. All variables are measured in 2006 unless otherwise specified.

Table 3: **Cash holdings and planned investment**

	All SMEs		SMEs with volatile cash holdings		SMEs with persistent cash holdings	
Panel A: Expected growth capital expenditure (1 year ahead)						
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
Cash holdings	-0.085	-0.033	-0.407	-0.383	1.000**	1.023*
	(0.162)	(0.187)	(0.264)	(0.276)	(0.451)	(0.558)
Controls	no	yes	no	yes	no	yes
R-squared	0.00	0.01	0.01	0.03	0.04	0.23
No. Obs.	770	657	327	276	101	84
Panel B: Probability increase in capital expenditure (1 year ahead)						
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
Cash holdings	0.004	0.047	-0.091	-0.049	0.348*	0.325*
	(0.081)	(0.089)	(0.111)	(0.119)	(0.189)	(0.181)
Controls	no	yes	no	yes	no	yes
R-squared	0.00	0.01	0.00	0.02	0.03	0.31
No. Obs.	900	752	389	321	116	95
Panel C: Probability increase in capital expenditure (1 year ahead) > 50%						
	(1c)	(2c)	(3c)	(4c)	(5c)	(6c)
Cash holdings	0.061	0.103	-0.079	-0.060	0.546**	0.478**
	(0.106)	(0.109)	(0.128)	(0.133)	(0.220)	(0.198)
Controls	no	yes	no	yes	no	yes
R-squared	0.00	0.01	0.00	0.02	0.04	0.29
No. Obs.	900	752	389	321	116	95

Notes: This table presents the estimates of cash holdings on expected growth capital expenditure (Panel A), the probability that a firm assigns to increasing its capital expenditure (Panel B), and a dummy equal to one if the firm assigns a probability of at least 50 percent to increasing its capital expenditure (Panel C). The regressions in Columns 1 - 2 are based on the full set of SMEs, in Columns 3 - 4 on the sample of SMEs with volatile cash holdings and in Columns 5 - 6 on the sample of SMEs with persistent cash holdings. Regressions in uneven columns exclude control variables and in even columns includes as control variables leverage, size, age category, group, profit in addition to year fixed effects. Standard errors allow for correlation at the 2-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4: **Sensitivity of cash coefficients to unobservables**

All SMEs					
Horizon dependent variable	β_j	β_j^* $\delta = 1$; $R_{\max}$:1.3	β_j^* $\delta = 0.5$; $R_{\max}$:1.3	β_j^* $\delta = 1.5$; $R_{\max}$:1.3	β_j^* $\delta = 1$; $R_{\max}$:2
$t+1$	0.010	0.013	0.011	0.015	0.020
$t+2$	0.022	0.021	0.021	0.021	0.019
$t+3$	0.033	0.034	0.034	0.035	0.037
$t+4$	0.044	0.050	0.047	0.053	0.064
$t+5$	0.053	0.064	0.058	0.070	0.092
$t+6$	0.058	0.077	0.067	0.087	0.122
$t+7$	0.058	0.077	0.068	0.087	0.124

SMEs with volatile cash holdings					
Horizon dependent variable	β_j	β_j^* $\delta = 1$; $R_{\max}$:1.3	β_j^* $\delta = 0.5$; $R_{\max}$:1.3	β_j^* $\delta = 1.5$; $R_{\max}$:1.3	β_j^* $\delta = 1$; $R_{\max}$:2
$t+1$	0.002	0.002	0.002	0.003	0.003
$t+2$	0.011	0.010	0.010	0.009	0.008
$t+3$	0.019	0.018	0.018	0.018	0.017
$t+4$	0.030	0.034	0.032	0.035	0.037
$t+5$	0.035	0.043	0.039	0.047	0.051
$t+6$	0.039	0.050	0.045	0.055	0.060
$t+7$	0.035	0.048	0.041	0.054	0.060

Notes: This table presents our parameter estimate, β_j, and the Oster (2019) lower bound estimates of the cash effect, β_j^*. Estimates are shown for the different horizons and under alternative assumptions for δ and $R_{\max}$, where $R_{\max}$:1.3 and $R_{\max}$:2 indicate that $R_{\max}$ equals 1.3 and 2 times the R^2 of the full model, respectively. The bounds are computed by comparing our baseline model equation (1) to a model with only region and 4-digit industry fixed effects for all SMEs (top panel) and for the subsample of SMEs with volatile cash holdings (bottom panel).

Table 5: **Cross-firm relationship between cash and investment, 2007-2014**

	All SMEs			*SMEs with volatile cash holdings*		
Financial constraints criteria	Constrained	Unconstrained	Difference (p-value)	Constrained	Unconstrained	Difference (p-value)
Age	*Young*	*Old*		*Young*	*Old*	
	0.073***	0.030***	0.00***	0.051***	0.013	0.00***
	(0.005)	(0.007)		(0.009)	(0.010)	
	119,408	*46,228*		*25,254*	*18,910*	
Size	*Small*	*Large*		*Small*	*Large*	
	0.100***	0.060***	0.00***	0.069***	0.048***	0.29
	(0.009)	(0.007)		(0.014)	(0.011)	
	51,174	*51,071*		*11,313*	*19,641*	

Notes: This table presents the estimates of relative cash on fixed asset growth from 2007-2014 across different groups of SMEs. Firms are classified on the basis of proxies for financial constraints based on their age and size. Constrained firms in terms of age are firms that are 10 years or younger and unconstrained firms are firms older than 20 years. Constrained firms in terms of size are firms in the bottom quartile of the total asset distribution and unconstrained firms are those in the top quartile. Age and size are measured in 2006. The regressions on the left-hand side are based on the full set of SMEs and the regressions on the right-hand side on the sample of SMEs with volatile cash holdings. All regressions include the control variables as specified in model (1) and include 4-digit industry and region fixed effects. Standard errors allow for correlation at the 4-digit industry level. The last column presents the p-value associated with the F-tests that compare the coefficients between the constrained and unconstrained subgroups, which is derived from a pooled regression in which we interact all variables with a dummy that is one if the firm is old or large, respectively. The number of firms in each group is in italics. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6: **Cross-industry relationship between cash and investment, 2007-2014**

	All SMEs			*SMEs with volatile cash holdings*		
Industry criteria	Low	High	Difference (p-value)	Low	High	Difference (p-value)
			Panel A			
Age	0.069***	0.048***	0.09*	0.041***	0.068***	0.21
	(0.006)	(0.010)		(0.008)	(0.021)	
	91,604	*20,524*		*24,700*	*7,180*	
Size	0.072***	0.038***	0.02**	0.039***	0.041***	0.90
	(0.006)	(0.014)		(0.007)	(0.014)	
	96,973	*21,198*		*26,165*	*9,428*	
			Panel B			
Capital intensity	0.062***	0.073***	0.36	0.044***	0.068***	0.20
	(0.009)	(0.008)		(0.013)	(0.014)	
	51,353	*34,203*		*16,659*	*9,141*	
Concentration	0.051***	0.064***	0.34	0.025***	0.049***	0.25
	(0.007)	(0.012)		(0.008)	(0.018)	
	85,587	*29,985*		*25,122*	*8,463*	
Depth crisis	0.064***	0.053***	0.31	0.041***	0.031*	0.62
	(0.006)	(0.010)		(0.014)	(0.010)	
	61,592	*18,750*		*17,984*	*5,787*	

Notes: This table presents the estimates of relative cash on cumulative investment between 2007-2014 across different industries. The dependent variable is the log difference of fixed assets between 2007 and 2014. Industries are classified on the basis of different criteria. *Age* captures the industry mean firm age and *Size* the industry mean firm size. *Capital intensity* captures the industry mean firm ratio of fixed assets over total assets. *Concentration* equals the industry's Herfindahl index based on turnover. *Depth crisis* captures the mean firm growth in value added between 2007 and 2010. All measures are calculated at the 4-digit industry level. *Low* industries are those ranked in the bottom quartile of the respective distribution and *High* industries are those ranked in the top quartile of the same distribution, except for *Depth crisis* where *Low* captures the top quartile and *High* the bottom quartile. All industry characteristics, except depth crisis, are measured in 2006. The regressions on the left-hand side are based on the full set of SMEs and the regressions on the right-hand side on the sample of SMEs with volatile cash holdings. All regressions include the control variables as specified in model (1) and include 4-digit industry and region fixed effects. Standard errors allow for correlation at the 4-digit industry level. The last column presents the p-value associated with the F-tests that compare the coefficients between the high and low subgroups. The number of firms in each group is in italics. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 7: **Robustness tests**

	Excess cash		Cash holdings		Relative cash (2007)		Independent SMEs	
Horizon	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*
Panel A: All SMEs								
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Cash variable	0.107***	0.355***	0.080***	0.215***	0.031***	0.071***	0.023***	0.059***
	(0.013)	(0.029)	(0.008)	(0.017)	(0.002)	(0.004)	(0.002)	(0.004)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
No. Obs.	185,667	185,667	204,412	204,412	197,365	197,365	188,195	188,195
Panel B: SMEs with volatile cash holdings								
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Cash variable	0.025*	0.183***	0.039**	0.132***	0.025***	0.047***	0.012***	0.036***
	(0.015)	(0.035)	(0.011)	(0.022)	(0.003)	(0.006)	(0.003)	(0.006)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03
No. Obs.	57,143	57,143	60,976	60,976	59,430	59,430	54,407	54,407

Notes: This table presents the estimates of various robustness test. The dependent variable is the log difference of fixed assets between 2007 and 2009 in the uneven columns and between 2007 and 2014 in the even columns. In columns 1 to 6 three alternative cash measures are used. In columns 1 and 2 excess cash is used which is defined as the residual cash to total assets in 2006. In columns 3 and 4 cash holdings are used, which is defined as cash-to-total assets ratio in 2006. In columns 5 and 6 relative cash is measured in 2007 instead of 2006. In columns 7 and 8 only independent SMEs are included in the sample. The regressions in Panel A are based on the full set of SMEs and the regressions in Panel B on the sample of SMEs with volatile cash holdings. All regressions include the control variables as specified in model (1) and include 4-digit industry and region fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 8: **Competition channel**

Sample	All SMEs				SMEs with volatile cash holdings			
Sectors	All		Non-tradables		All		Non-tradables	
Horizon	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*
Panel A: Market share								
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Relative Cash	0.004**	0.007	0.003	0.031**	0.004	0.011**	0.008	0.042**
	(0.002)	(0.004)	(0.004)	(0.011)	(0.003)	(0.005)	(0.008)	(0.018)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	no	no	yes	yes	no	no
Area FE	no	no	yes	yes	no	no	yes	yes
R-squared	0.08	0.09	0.05	0.13	0.08	0.10	0.07	0.19
No. Obs.	195,561	195,561	25,670	25,670	58,674	58,674	6,834	6,834
Panel B: Profit								
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Relative Cash	0.041***	0.272***	0.023***	0.215***	0.036***	0.247***	0.024***	0.132***
	(0.003)	(0.020)	(0.004)	(0.025)	(0.004)	(0.025)	(0.008)	(0.035)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	no	no	yes	yes	no	no
Area FE	no	no	yes	yes	no	no	yes	yes
R-squared	0.67	0.40	0.77	0.50	0.69	0.42	0.78	0.55
No. Obs.	189,942	189,942	24,849	24,849	57,310	57,310	6,656	6,656
Panel C: ROA								
	(1c)	(2c)	(3c)	(4c)	(5c)	(6c)	(7c)	(8c)
Relative Cash	0.019***	0.031***	0.015***	0.027***	0.019***	0.030***	0.014***	0.018***
	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.004)	(0.005)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	no	no	yes	yes	no	no
Area FE	no	no	yes	yes	no	no	yes	yes
R-squared	0.75	0.56	0.80	0.58	0.77	0.59	0.81	0.62
No. Obs.	192,006	192,006	24,832	24,832	57,633	57,633	6,619	6,619

Notes: This table presents the estimates of relative cash on market share growth (Panel A), cumulative profit (Panel B), and average ROA (Panel C). Growth rates are measured between 2007 and 2009 in the uneven columns and between 2007 and 2014 in the even columns. Columns 1-2 and 5-6 include all sectors and Columns 3-4 and 7-8 non-tradable sectors only. Market share growth in the former is relative to total assets in the firm's 4-digit industry, in the latter relative the total assets in the same industry and postcode area. The regressions on the left-hand side are based on the full set of SMEs and on the right-hand side on the sample of SMEs with volatile cash holdings. All regressions include all control variables as specified in model (2), the first and second lag of the respective dependent variables and region/area and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 9: **Borrowing constraints channel**

Dependent variable	Total debt		Short-term debt		Long-term debt		Credit score	
Horizon	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*
Panel A: All SMEs								
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Relative Cash	0.076***	0.137***	0.042***	0.109***	0.064***	0.113***	0.578***	0.899***
	(0.011)	(0.016)	(0.010)	(0.014)	(0.009)	(0.016)	(0.053)	(0.057)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.11	0.12	0.11	0.12	0.10	0.11	0.01	0.08
No. Obs.	24,906	24,906	24,906	24,906	24,906	24,906	144,197	144,197
Panel B: SMEs with volatile cash holdings								
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Relative Cash	0.100***	0.164***	0.075***	0.139***	0.064***	0.131***	0.417***	0.753***
	(0.023)	(0.032)	(0.018)	(0.025)	(0.018)	(0.022)	(0.075)	(0.090)
Firm controls	yes	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.13	0.13	0.14	0.13	0.12	0.12	0.02	0.13
No. Obs.	7,242	7,242	7,242	7,242	7,242	7,242	41,666	41,666

Notes: This table presents the estimates of relative cash on debt and credit score growth. The dependent variable is cumulative growth in total debt (columns 1 and 2), in short-term debt (columns 3 and 4), in long-term debt (columns 5 and 6) and in credit scores (columns 7 and 8). Growth rates are measured between 2007 and 2009 in the uneven columns and between 2007 and 2014 in the even columns. The regressions in Panel A are based on the full set of SMEs and the regressions in Panel B on the sample of SMEs with volatile cash holdings. All regressions include all control variables as specified in model (2) plus the first and second lag of the respective dependent variables, except for the credit score regressions where the firm's credit score in 2006 is included. All regressions include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

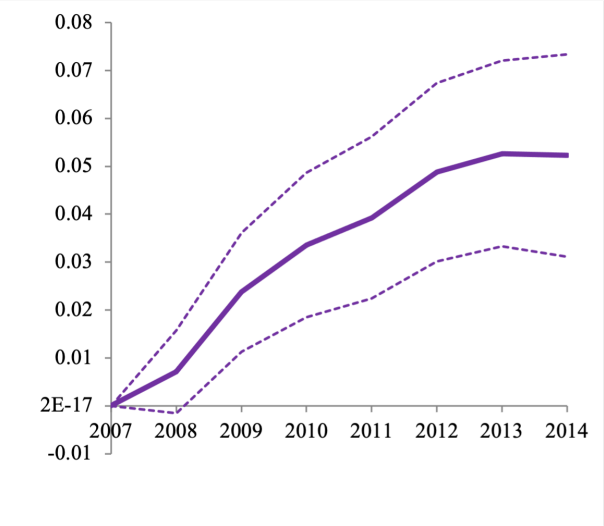
Table 10: **Cash balance adjustment channel**

Sample	All SMEs		SMEs with volatile cash	
Horizon	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*
	(1)	(2)	(3)	(4)
Relative cash	-0.164***	-0.343***	-0.177***	-0.366***
	(0.004)	(0.008)	(0.006)	(0.012)
Firm controls	yes	yes	yes	yes
Industry fixed effects	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes
R-squared	0.11	0.13	0.12	0.13
No. Obs.	178,608	178,608	53,613	53,613

Notes: This table presents the estimates of relative cash on growth in cash holdings. The dependent variable is cumulative growth in cash holdings between 2007 and 2009 in the uneven columns and between 2007 and 2014 in the even columns. Regressions in columns 1 and 2 are based on the full set of SMEs and in columns 3 and 4 on the sample of SMEs with volatile cash holdings. All regressions include all control variables as specified in model (2) plus the first and second lag of the dependent variable. All regressions include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

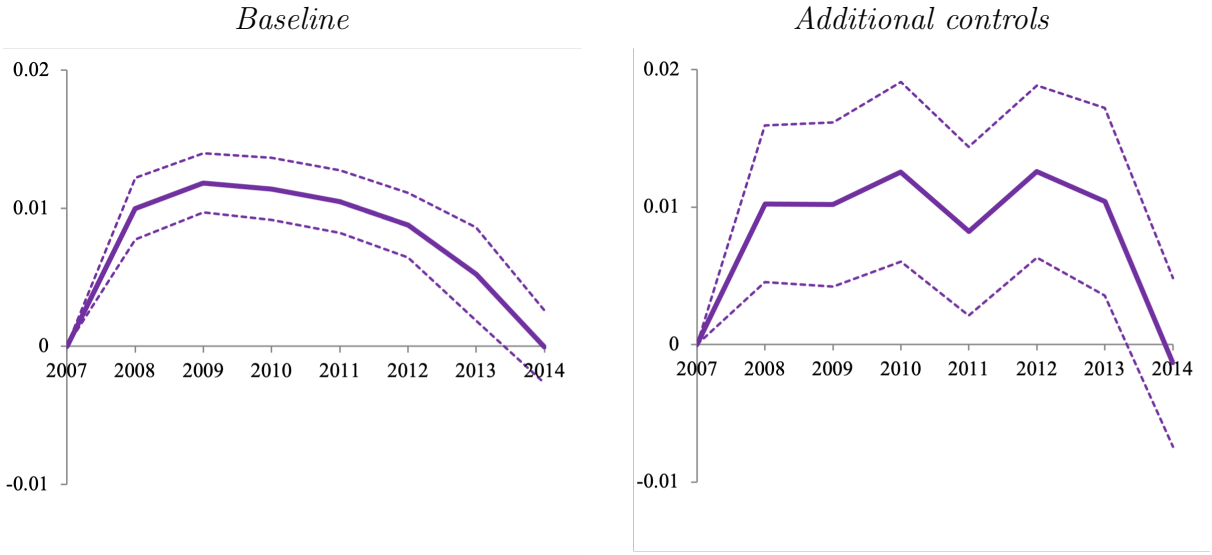
Online Appendix

Figure A.1: **Long-term relationship between cash and investment - robustness**



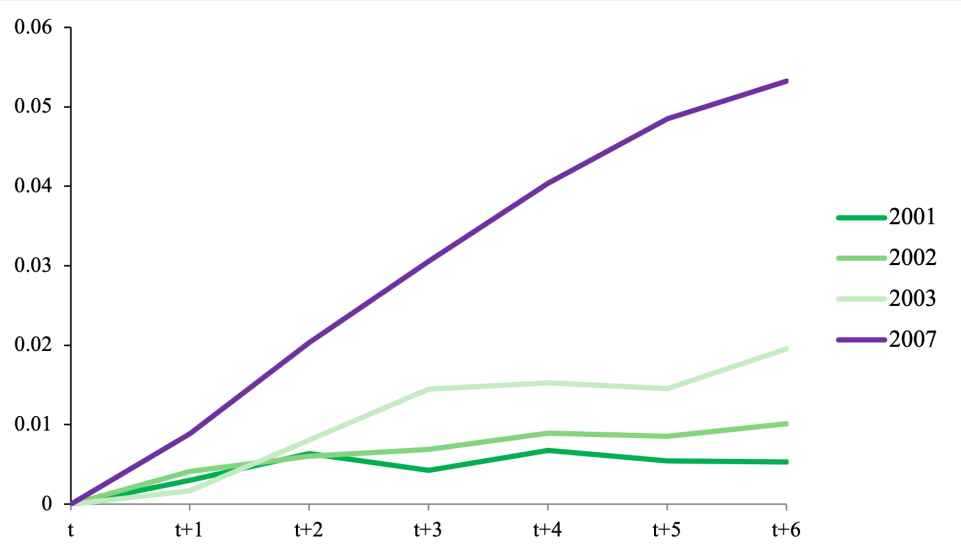
Notes: This figure plots the relationship between relative cash and investment over different horizons using local projections. The dependent variable is cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7. The model specification includes controls for leverage, size, age category, group, profit, investment, turnover growth and turnover volatility. All variables are measured in 2006, except investment, turnover growth and turnover volatility which are measured over 2005–2006 and 2006–2007. The specification includes region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* and the dashed lines show the 90 percent confidence intervals.

Figure A.2: **Long-term relationship between cash and annual investment rate**



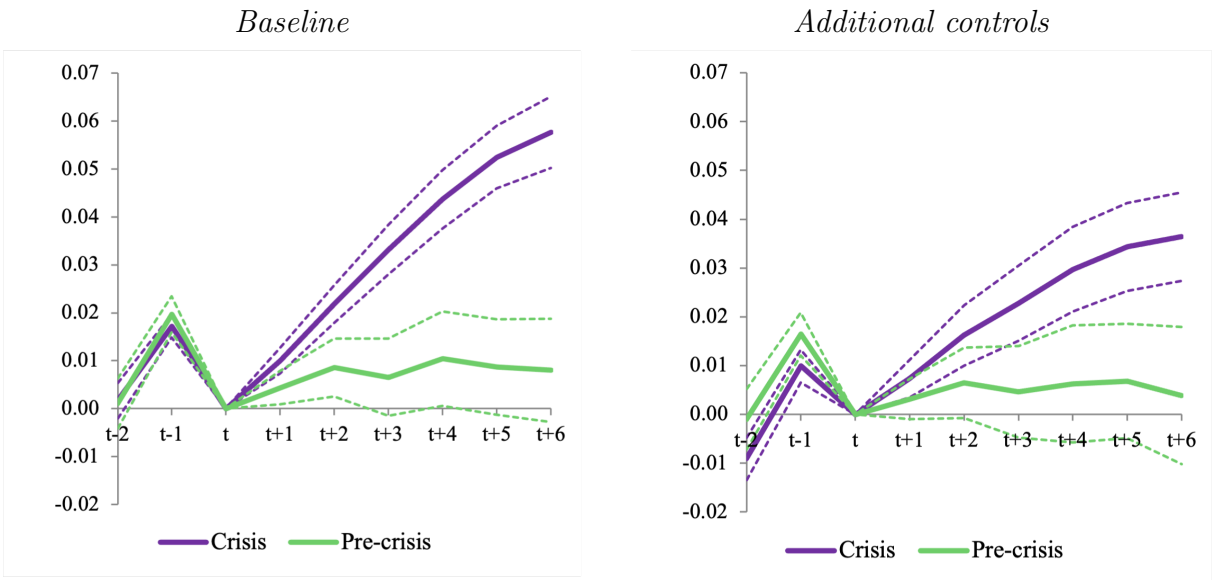
Notes: These figures plot the relationship between relative cash and the annual investment rate over different horizons using local projections. The dependent variable is the annual fixed asset growth in year 2007+j, where j ranges from 1 to 7. The model specification used in the left-hand panel includes controls for leverage, size, age category, group, profit and investment. The model specification used in the right-hand panel also includes controls for turnover growth. All variables are measured in 2006, except investment and turnover growth which are measured over 2005-2006 and 2006-2007. Both specifications include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* and the dashed lines show the 90 percent confidence intervals.

Figure A.3: **Long-term relationship between cash and investment - different tranquil periods**



Notes: This figure compares the relationship between relative cash and investment for different pre-crisis periods and the crisis period. It plots the relationship between relative cash and investment over different horizons using local projections. The dependent variable is the cumulative fixed asset growth between year t and year t+j, where j ranges from 1 to 6 and where t equals 2001, 2002, 2003 or 2007. *Relative cash* is measured in year t-1 for all regressions. All regressions include the standard control variables as specified in model (1) and region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* for the four periods.

Figure A.4: **Pre-trends and long-term relationship between cash and investment - crisis vs pre-crisis period**



Notes: These figures plot the relationship between relative cash and investment over different horizons using local projections for the crisis and pre-crisis periods. For the post-period the dependent variable is cumulative fixed asset growth between 2007 and 2007+j and between 2001 and 2001+j, where j ranges from 1 to 6. For the pre-period the dependent variable is fixed asset growth between 2007-j and 2007 and 2001-j and 2001, where j ranges from 1 to 2. The full sample includes all firms for which information is available. The fixed sample includes the subset of firms that are both present in the crisis and pre-crisis periods. All regressions include controls for leverage, size, age category, group and profits (measured at t-1), and region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. The lines correspond to the estimated parameter of *Relative cash* for the two periods and the dashed lines show the 90 percent confidence intervals.

Table A.1: **Representativeness of regression sample**

Region	ONS	Sample	Sector	ONS	Sample	Age	ONS	Sample
East Midlands	0.07	0.08	Services	0.42	0.34	Less than 2 years	0.17	0.04
East of England	0.10	0.11	Trade	0.22	0.22	2-3 years	0.15	0.23
London	0.16	0.14	Construction	0.12	0.16	4-9 years	0.26	0.32
North East	0.03	0.03	Manufacturing	0.12	0.17	10 or more years	0.42	0.41
North West	0.10	0.11	Hospitality	0.05	0.05			
Northern Ireland	0.03	0.02	Transport	0.04	0.04			
Scotland	0.07	0.06	Other	0.03	0.01			
South East	0.17	0.16						
South West	0.09	0.10						
Wales	0.04	0.04						
West Midlands	0.08	0.09						
Yorkshire and The Humber	0.07	0.08						

Notes: The table presents the share of SMEs across broad industries, regions and age groups in our main regression sample compared to the full SME population, based on data from *UK business: Activity, size and location* (2006) provided by the UK Office for National Statistics (ONS).

Table A.2: **Variable definitions and sources**

Variable Name	**Definition**	**Source**
ΔlnFA	Log difference of fixed assets between 2007 and year 2007+ j (crisis period) or between 2001 and 2001 + j (pre-crisis period)	FAME
Relative cash	Cash holdings of the firm minus the (4-digit) industry mean cash holdings, divided by the (4-digit) industry standard deviation. Cash holdings equal deposits divided by total assets.	FAME
Leverage	Total liabilities over total assets	FAME
Size	Log of total assets	FAME
Mature	Dummy equal to one if the firm is between 10 and 20 years old	FAME
Old	Dummy equal to one if the firm is older than 20 years	FAME
Group	Dummy equal to one if the firm has a parent or is part of a group, which we define as a firm that reports an ultimate owner in FAME	FAME
ROA	Profit over total assets	FAME
Pre-Investment	Log difference of fixed assets between 2005 and 2006 and between 2006 and 2007 (crisis period) or between 1999 and 2000 and between 2000 and 2001 (pre-crisis period)	FAME
Pre-Turnover growth	Log difference of turnover between 2005 and 2006 and between 2006 and 2007 (crisis period) or between 1999 and 2000 and between 2000 and 2001 (pre-crisis period)	FAME
Industry age	Average age of firms in a 4-digit industry	FAME
Industry size	Average size of firms in a 4-digit industry	FAME
Industry capital intensity	Average fixed assets over total assets of firms in a 4-digit industry	FAME
Industry HHI	Herfindahl-Hirschman Index (HHI) based on turnover for each 4-digit industry	ONS
Industry depth crisis	Average growth of value added by firms in a 4-digit industry	ONS
Excess cash	Difference between a firm's actual and predicted cash holdings	FAME
%ΔMShare	Growth rate of the firm's market share over the period 2007 to 2009/2014, where market share is defined as the ratio of the firm's assets over the total 4-digit industry assets.	FAME
%ΔLocal MShare	Growth rate of the firm's market share over the period 2007 to 2009/2014, where market share is defined as the ratio of the firm's assets over total assets of firms operating in the same postcode area and 4-digit non-tradable industry.	FAME
$\sum$ Profit	Cumulative profits over the period 2007 to 2009/2014 scaled by total assets in 2007	FAME
ROA	Average ROA (profit/ta) over the period 2007 to 2009/2014	FAME
ΔlnTotalDebt	Log difference of total debt (short-term loans and overdrafts + trade credit + long-term debt) over the period 2007 to 2009/2014	FAME
ΔlnSTDebt	Log difference of short-term debt (short-term loans and overdrafts + trade credit) over the period 2007 to 2009/2014	FAME
ΔlnLTDebt	Log difference of long-term debt over the period 2007 to 2009/2014	FAME
ΔCreditScore	Log difference of credit score (QuiScore) over the period 2007 to 2009/2014	FAME
ΔlnCash	Log difference of cash holdings over the period 2007 to 2009/2014	FAME

Table A.3: **Cash holdings and planned investment - robustness**

	All SMEs		SMEs with volatile cash holdings		SMEs with persistent cash holdings	
Panel A: Expected growth capital expenditure (2 years ahead)						
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
Cash holdings	-0.076	-0.085	-0.294	-0.289	0.714	0.851
	(0.184)	(0.271)	(0.310)	(0.324)	(0.517)	(0.559)
Controls	no	yes	no	yes	no	yes
R-squared	0.00	0.01	0.00	0.03	0.02	0.22
No. Obs.	770	657	327	276	101	84
Panel B: Expected growth capital expenditure (3 years ahead)						
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
Cash holdings	0.003	0.008	-0.164	-0.170	0.747	0.560
	(0.199)	(0.208)	(0.308)	(0.276)	(0.515)	(0.562)
Controls	no	yes	no	yes	no	yes
R-squared	0.00	0.01	0.00	0.03	0.02	0.32
No. Obs.	770	657	327	276	101	84

Notes: This table presents the estimates of cash holdings on expected growth capital expenditure 2 years ahead (Panel A) and 3 years ahead (Panel B). The regressions in Columns 1 – 2 are based on the full set of SMEs, in Columns 3 – 4 on the sample of SMEs with volatile cash holdings and in Columns 5 – 6 on the sample of SMEs with persistent cash holdings. Regressions in uneven columns exclude control variables and in even columns includes as control variables leverage, size, age category, group, profit in addition to year fixed effects. Standard errors allow for correlation at the 2-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A.4: **Long-term relationship between cash and investment**

Horizon	*2007-2008*	*2007-2009*	*2007-2010*	*2007-2011*	*2007-2012*	*2007-2013*	*2007-2014*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Relative Cash	0.010***	0.022***	0.033***	0.044***	0.053***	0.058***	0.058***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Leverage	-0.015**	-0.038***	-0.040***	-0.041***	-0.050***	-0.051***	-0.055***
	(0.006)	(0.011)	(0.014)	(0.016)	(0.018)	(0.021)	(0.020)
Size	0.006***	0.006***	0.009***	0.044***	0.053***	0.058***	0.058***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Mature	-0.012***	-0.018***	-0.025***	-0.029***	-0.028***	-0.028***	-0.033***
	(0.003)	(0.005)	(0.007)	(0.008)	(0.010)	(0.011)	(0.012)
Old	-0.010***	-0.015***	-0.026***	-0.034***	-0.034***	-0.037***	-0.044***
	(0.003)	(0.005)	(0.007)	(0.009)	(0.010)	(0.012)	(0.014)
Group	-0.003	-0.015***	-0.013*	-0.001	-0.007	-0.005	-0.002
	(0.003)	(0.005)	(0.007)	(0.008)	(0.009)	(0.010)	(0.010)
Profit	-0.012*	-0.024**	-0.024*	-0.025*	-0.034**	-0.037*	-0.038*
	(0.007)	(0.010)	(0.013)	(0.015)	(0.017)	(0.021)	(0.019)
Pre-Investment (1st lag)	-0.002	-0.026***	-0.060***	-0.073***	-0.074***	-0.068***	-0.068***
	(0.005)	(0.006)	(0.008)	(0.009)	(0.010)	(0.010)	(0.011)
Pre-Investment (2nd lag)	-0.000	-0.013***	-0.021***	-0.019***	-0.010	-0.007	-0.001
	(0.003)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)
R-squared	0.01	0.01	0.02	0.02	0.02	0.02	0.02
No. Obs.	204,412	204,412	204,412	204,412	204,412	204,412	204,412

Notes: This table presents the estimates of relative cash on investment over different horizons using local projections for the full sample of SMEs (left-hand side panel of Figure 4 in the main text).The dependent variable is cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7. All variables are measured in 2006, except investment which is measured over 2005-2006 and 2006-2007. All regressions include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A.5: **Long-term relationship between cash and investment - SMEs with volatile cash holdings**

Horizon	*2007-2008*	*2007-2009*	*2007-2010*	*2007-2011*	*2007-2012*	*2007-2013*	*2007-2014*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Relative Cash	0.002	0.011***	0.019***	0.030***	0.035***	0.039***	0.035***
	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)
Leverage	-0.015*	-0.041***	-0.039*	-0.028	-0.030	-0.025	-0.022
	(0.008)	(0.015)	(0.020)	(0.023)	(0.027)	(0.030)	(0.029)
Size	0.006***	0.009***	0.013***	0.019***	0.024***	0.032***	0.041***
	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
Mature	-0.010***	-0.012**	-0.025***	-0.030***	-0.030***	-0.042***	-0.053***
	(0.004)	(0.006)	(0.009)	(0.010)	(0.012)	(0.012)	(0.013)
Old	-0.014***	-0.022***	-0.038***	-0.048***	-0.056***	-0.070***	-0.088***
	(0.004)	(0.007)	(0.009)	(0.011)	(0.013)	(0.015)	(0.016)
Group	-0.006	-0.014*	-0.013	-0.004	0.009	0.008	0.002
	(0.005)	(0.008)	(0.010)	(0.011)	(0.013)	(0.014)	(0.014)
Profit	-0.003	-0.019	-0.012	-0.003	-0.005	-0.001	-0.005
	(0.010)	(0.017)	(0.022)	(0.022)	(0.023)	(0.027)	(0.025)
Pre-Investment (1st lag)	-0.004	-0.035***	-0.069***	-0.089***	-0.100***	-0.089***	-0.094***
	(0.006)	(0.007)	(0.009)	(0.010)	(0.011)	(0.012)	(0.013)
Pre-Investment (2nd lag)	-0.014***	-0.039***	-0.057***	-0.056***	-0.056***	-0.059***	-0.060***
	(0.005)	(0.007)	(0.009)	(0.009)	(0.011)	(0.011)	(0.013)
R-squared	0.01	0.02	0.02	0.02	0.02	0.02	0.03
No. Obs.	60,976	60,976	60,976	60,976	60,976	60,976	60,976

Notes: This table presents the estimates of relative cash on investment over different horizons using local projections for the sample of SMEs with volatile cash holdings (left-hand panel of Figure 6 in the main text). The dependent variable is cumulative fixed asset growth between 2007 and 2007+j, where j ranges from 1 to 7. All variables are measured in 2006, except investment which is measured over 2005-2006 and 2006-2007. All regressions include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A.6: **Long-term relationship between cash and investment - pre-crisis period**

Horizon	*2001-2002*	*2001-2003*	*2001-2004*	*2001-2005*	*2001-2006*	*2001-2007*
	(1)	(2)	(3)	(4)	(5)	(6)
Relative Cash	0.004**	0.009***	0.007	0.010**	0.009*	0.008
	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
Leverage	-0.014**	-0.003	0.005	-0.000	-0.003	0.014
	(0.006)	(0.012)	(0.013)	(0.017)	(0.019)	(0.022)
Size	0.001	0.000	0.000	0.006**	0.007***	0.012***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Mature	-0.035***	-0.071***	-0.094***	-0.116***	-0.136***	-0.150***
	(0.002)	(0.005)	(0.005)	(0.007)	(0.007)	(0.008)
Old	-0.037***	-0.070***	-0.100***	-0.114***	-0.132***	-0.141***
	(0.003)	(0.004)	(0.005)	(0.006)	(0.008)	(0.009)
Group	-0.014***	-0.043***	-0.046***	-0.054***	-0.058***	-0.060***
	(0.004)	(0.005)	(0.007)	(0.008)	(0.008)	(0.009)
Profit	-0.001	0.005	0.011	0.005	0.009	0.027
	(0.006)	(0.011)	(0.012)	(0.015)	(0.017)	(0.020)
Pre-Investment (1st lag)	-0.004	-0.029***	-0.054***	-0.063***	-0.059***	-0.060***
	(0.005)	(0.007)	(0.009)	(0.011)	(0.010)	(0.011)
Pre-Investment (2nd lag)	-0.012***	-0.030***	-0.040***	-0.033***	-0.031***	-0.026***
	(0.003)	(0.004)	(0.005)	(0.006)	(0.008)	(0.009)
R-squared	0.01	0.02	0.02	0.03	0.03	0.03
No. Obs.	135,617	135,617	135,617	135,617	135,617	135,617

Notes: This table presents the estimates of relative cash on investment over different horizons using local projections for the pre-crisis period for the full sample of firms (left-hand panel of Figure 7 in the main text). The dependent variable is cumulative fixed asset growth between 2001 and 2001+j, where j ranges from 1 to 6. All variables are measured in 2000, except investment which is measured over 1999-2000 and 2000-2001. All regressions include region and 4-digit industry fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A.7: **Borrowing constraints channel - robustness**

Dependent variable	Total debt		Short-term debt		Long-term debt	
Horizon	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*	*2007-2009*	*2007-2014*
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
Relative Cash	0.078***	0.128***	0.041***	0.094***	0.073***	0.126***
	(0.020)	(0.025)	(0.041)	(0.094)	(0.073)	(0.026)
Firm controls	yes	yes	yes	yes	yes	yes
Industry-location-size FE	yes	yes	yes	yes	yes	yes
R-squared	0.46	0.48	0.47	0.49	0.44	0.47
No. Obs.	8,976	8,976	8,976	8,976	8,976	8,976

Notes: This table presents the estimates of relative cash on debt growth for the full set of SMEs. The dependent variable is cumulative growth in total debt (columns 1 and 2), in short-term debt (columns 3 and 4), and in long-term debt (columns 5 and 6). Growth rates are measured between 2007 and 2009 in the uneven columns and between 2007 and 2014 in the even columns. All regressions include all control variables as specified in model (2) plus the first and second lag of the respective dependent variables. All regressions include industry-location-size fixed effects. Standard errors allow for correlation at the 4-digit industry level. Standard errors are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.