Financial Stability, Inventory Investment, and Profitability of SMEs

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Abstract

This paper examines the value effect of inventory investment on profitability for a large sample of UK SMEs over a ten-year period. Taking into account industry, firm and year effects, the results show that inventory investment is sensitive to SMEs access to finance. Inventory investment relationship to profitability is negative for both financially constrained and unconstrained SMEs. However, the negative effect of inventory investment on profitability is more severe in financially constrained SMEs. Specifically, financially unconstrained SMEs invest more in inventory and suffer less reduction in profitability from inventory investment than their constrained counterparts. Findings indicate that the speed of inventory investment adjustment is different for financially constrained and unconstrained SMEs. Indicatively, the negative impact of inventory investment on profitability is heightened during financial crisis, especially for financially constrained firms.

***JEL classification*:** G31; G32

Keywords: Financial Stability, Inventory Investment, Profitability, SMEs, Financial crisis

1. Introduction

At the end of 2015, United Kingdom (UK) small and medium enterprises (SMEs) had about £50.9 billion worth of inventory[1] on their balance sheet (ABFA, 2015). This amount indicates that investment in inventory is substantial for UK SMEs. Inventory investment, however, is subject to opportunity cost because of the cash tied-up. Firms cannot simply do away with inventory because it is a necessary evil (Hsieh and Kleiner 1992), as such firms have no choice but to finance investment in inventory. Therefore, access to finance plays an important role in inventory investment and its relationship with profitability. Gaur and Kesavan (2009) suggest that inventory is not only large in monetary value but also critical to the profitability of firms. According to Sack (2000), research by Standard and Poor found that inventory is the most important asset of firms. For example, research by Cupkun et al. (2009) found that inventory represents approximately 20% of sales revenue. According to Carter (2002), nearly 60% to 70% of total funds employed are tied up in current assets, of which inventory is the most significant component. The question of why firms hold inventory has attracted a number of researchers (see, for example, Carpenter et al., 1998; Guariglia, 1999; Bagliano and Sembenelli, 2004; Benito, 2005; Cunha and Paisana, 2011). However, the most notable features of these studies are the absence of reliable evidence on the influence of access to finance on the relationship between inventory investment and profitability and the lack of focus on SMEs.

This paper investigates the inventory investment effect on SMEs profitability vis-a-vis access to finance. Therefore, the objectives of this paper are: (1) to test the sensitivity of SMEs inventory investment to various financial measures; and (2) to examine the influence of access to finance on the relationship between inventory investment and SME profitability. Despite the importance of inventory investment to the profitability of all firms, the extant research has focused on larger firms (Gaur et al., 2005; Koumanakos, 2008; Mathuva, 2013). However, inventory investment

[1] By definition, inventory is made up of: raw materials, work-in-progress and finished goods.

decisions are very important to SMEs in particular (Mathuva, 2013) because of their lack of access to external finance (Fazzari and Petersen, 1993). SMEs are also known as high-risk firms and are therefore more likely to suffer from financial distress (Belghitar and Khan, 2013). Rajeev (2008) states that the effective and efficient management of inventory is very limited in SMEs due to lack of expertise and financing. The limited number of studies on the effect of access to finance on the relationship between inventory investment and SMEs profitability is surprising, given that SMEs are the stronghold of economic development in most countries around the world[2] (Beaver and Prince, 2004). Finally, the stringent credit conditions that came upon SMEs as a result of the recent financial crisis has made the study of access to finance effect on inventory investment and SME profitability far more important today than ever before.

This study seeks to make a number of contributions to the extant inventory management literature. First, this paper investigates the level of inventory investment of financially constrained and unconstrained SMEs by adjusting for industry-level effects. Research has shown that inventory investment is very much dependent on the industry belonging of a firm (Bento, 2005; Gaur et al., 2005; Koumanakos, 2008). For example, inventory investment policies of manufacturing firms are markedly different from service firms (Hill et al., 2010). Inventory can be a useful firm resource but needs financing, which means that firms with access to finance can take advantage of the benefits of inventory investment. Industry effects would ordinarily be captured by indicator variables; however, the use of fixed effects[3] estimation throughout this paper precludes such time-invariant variables.

Second, it reports the results of inventory investment effect on SME profitability. Evidence on the relationship between inventory investment and profitability is scant, with very little

[2] According to the Department for Business Innovation and Skills (2011), SMEs share of employment in the UK amounts to 58.8 percent and out of the 4.5 million businesses in the UK, 99.8 percent are SMEs, accounting for 50.1 percent of turnover.

[3] As stated in section 3.5, the Hausman's test indicates the use of fixed effect regression.

empirical literature on SMEs. The extant literature explains that inventory is more important to the profitability of SMEs (Carpenter et al., 1994) because of the generally high cost of inventory investment (Koumanakos, 2008) and SMEs lack of access to external finance in particular (Tauringana and Afrifa, 2013).

Third, the paper investigates the value effect of access to finance on the relationship between inventory investment and SMEs profitability by use of four different financial measures. Despite the few studies on the relationship between inventory investment and profitability (see, Koumanakos, 2008; Capkun, 2009), there is generally a lack of evidence on the possible impact that access to finance may have on this relationship[4]. Access to finance may improve SMEs profitability by reducing the transaction costs of raising funds (All-Nsjjar and Belghitar 2011), serve as a buffer against unexpected events (Opler et al., 1999) and avoid the likelihood of financial distress (Ferreira and Vilela 2004).

Fourth, the paper addresses the issue of optimum inventory investment policy. This paper examines whether there are differences in the speed of adjustment toward the target levels of inventory investment between financially constrained and unconstrained SMEs. The ability of a firm to speedily adjust to the optimum level of inventory depends more on the cost of adjustment. The evidence gathered is that SMEs with access to finance move faster to target inventory investment level than SMEs that lack access to finance. The costs of adjustment have been found to be the determinant of the speed of adjustment in other disciplines such as accounts receivable (Garcia-Teruel and Martinez-Solano, 2010) and net trade cycle (Banos-Caballero at al., 2010).

Fifth, this paper examines the relationship between access to finance effect on inventory investment; inventory management and profitability in times of financial crisis. Periods of financial

[4] Studies including: Carpenter et al. (1994); Carpenter et al. (1998); Guariglia (1999) and Guariglia and Mateut (2010) have addressed empirically the relationship between financing constraints and inventory investment. However, these studies do not consider profitability implications and none examines SMEs.

crisis are characterised by limited access to finance (Love et al., 2007), and, therefore, inventory investment is expected to decrease (Zhao, 2011). This is because in times of financial crisis, sales decline, and unsold goods stay on the balance sheet as inventory. The lack of sales growth during financial crisis suggests that any increase in inventory will lead to a decrease in a firm's profitability. Research by Kashyap et al. (1994) found a significant reduction in inventory investment of firms during the financial crisis.

The rest of the paper is structured as follows. Section 2 reviews the related literature and hypotheses development, followed by the study data and research methodology. The penultimate section discusses the empirical results, and the final section gives the summary and conclusion.

2. Literature Review and Hypotheses Development

2.2 Inventory investment and access to finance

Many studies have used access to finance measures including: cash reserve, firm size, asset tangibility, interest cover, cash flow, cost of external finance and the stock of liquidity to investigate the inventory investment patterns of firms (Carpenter et al., 1994; Kashyap et al., 1994; Fazzari et al., 1988; Guariglia, 2000; Guariglia and Mateut, 2006). These studies have all found a positive association between firm inventory investment and access to finance. Inventory investment is more sensitive to access to finance than other types of investments such as fixed investment or R&D (Carpenter et al., 1994) because of its high liquidity and low adjustment costs (Guariglia and Mateut, 2006). Research has documented that the main component of a firm's assets susceptible to financial instability is inventory (Carpenter et al., 1994; Guariglia, 1999; Bagliano and Sembenelli, 2004; Benito, 2005). Even though firms' activities are curtailed in response to financial shocks, much reduction happens in inventory (Carpenter et al., 1994; Sangalli, 2013). Research by Guariglia (1999) indicates that inventory investment is sensitive to the monetary policy changes. Carpenter et al. (1994) argue that access to finance is an important

determinant of inventory investment and that the presence of financial constraints induces a positive correlation between inventory investment and financial flows.

Access to finance tends to increase investment in inventory (Fazzari and Petersen, 1993; Carpenter et al., 1994), which is consistent with the theory of constraints (TOC)[5]. According to this theory, lack of access to finance may prevent a firm from profiting from inventory investment (Cunha and Paisana, 2011; Sangalli, 2013). Therefore, a significant difference in the level of inventory is expected between financially constrained and unconstrained SMEs. Carpenter et al. (1994) and Gertler and Gilchrist (1994) all posit that inventory investment of SMEs is more sensitive to access to finance. According to Sangalli (2013), financial constraints faced by SMEs are found to be one of the main determinants of downward alterations in inventory. That is, access to finance is expected to lead to higher inventory investment in SMEs. Based on the above arguments, the following hypotheses are developed:

Hypothesis 1a: A positive relationship exists between financial measures and inventory investment.

Hypothesis 1b: Financially unconstrained SMEs have a higher level of inventory investment than financially constrained SMEs.

2.2 Access to finance, Inventory investment and SMEs profitability

According to the cash conversion cycle (CCC) theory[6], firms can improve profitability by shortening the length of the time lag between the cash payment for inventory and the collection of cash from

[5] The TOC is largely the result of the work of Dr Eliyahu M. Goldratt in his 1984 book titled "The Goal". TOC is an overall management philosophy that recognizes constraint on any system which restricts the maximum performance level that the system can obtain in relation to its goal. For most firms the goal is to make a larger profit now and in the future; however, constraints on resources keep the firm from making a higher level of profit.

[6] The CCC was first introduced by Gitman (1974). The CCC is a measure of liquidity risk that captures the length of time it takes a firm to be deprived of cash if it increases investment in resources (e.g. inventories) in order to increase its sales level. Johnson and Soenen (2003) demonstrate the strength of using the CCC as a comprehensive working capital measure in predicting the success (or failure) of a firm. More

sales of the inventory (Deloof, 2003; Tauringana and Afrifa, 2013; Aktas et al., 2015). This theory is very important to firms because it shows how long it takes to recoup the amount invested in inventory, and that the faster the inventory investment turnover the better for firms' profitability (Deloof, 2003). This suggests a reduction in firms' inventory investment in order to increase profitability (Herer et al, 2002). Since inventory occupies space and is associated with many costs including warehouse storage cost, insurance, lighting and heating, theft and obsolesce (Deloof, 2003), the CCC argues that the reduction in inventory through the aggressive strategy may increase profitability. Without considering the impact of access to finance, Koumanakos (2008) postulated a negative relationship between inventory investment and firm profitability. Capkun et al. (2009) also found a negative association between inventory investment and profitability of manufacturing firms and, therefore, indicated that firms that decrease inventory relative to sales increase both gross profit and operating profit. However, one shortcoming of the CCC theory is that it does not take into consideration the value effect of access to finance. Access to finance may allow a firm to finance the needed inventory investment in order to meet sales demand, prevent production interruptions and stock out situations (Tauringana and Afrifa, 2016). The high cost of inventory investment means that internal cash flow and cost of capital will lead to improvements in the profitability of financially unconstrained firms (Carpenter et al., 1998). This logic leads to the following hypotheses:

Hypothesis 2a: Access to finance reduces the negative relationship between inventory investment and SMEs profitability.

Hypothesis 2b: The negative relationship between inventory investment and SMEs profitability is higher for financially constrained than unconstrained SMEs.

specifically, the CCC is expected to be influenced by internal resources in a firm, the level of investment in fixed resources, firm sustainability, the level of external borrowing and economic conditions.

2.3 Optimal inventory investment and speed of adjustment

Rumyantsev and Netessine (2007) argue that the overarching aim of inventory management is to find the optimal level. The way to achieve this is to balance the marginal benefits of inventory investment against its marginal costs (Mathuva, 2013). However, since inventory investment depends on access to finance (Guariglia and Mateut, 2006), it is therefore argued here that the speed with which firms can adjust their inventory investment level to the optimum depends on the costs of adjustment (Lovell, 1961; Guariglia and Mateut, 2010) and therefore, firms with access to finance are expected to have lower adjustment costs; and hence adjust towards their optimum inventory investment level faster than those without access to finance. This is because the former can adjust any increase in inventory by selling to customers on credit (Ferrando and Mulier, 2013) and also procure inventory in case of shortages[7].

In sum, the above argument suggests that SMEs with access to finance will have a faster speed of adjustment. SMEs without access to finance may be slower in adjusting a downward deviation from the optimum inventory investment level because of lack of access to make new purchases. Moreover, lack of access to finance may also prevent an SME from making a faster speed of adjustment to an upward deviation from the optimum because such firms cannot afford to sell on credit to customers[8] (Love et al., 2007). The extant research suggests that firms in financial difficulties reduce their level of credit extended to customers (Hill et al., 2010). Overall, the above argument leads to the following hypotheses:

Hypothesis 3: SMEs with access to finance adjust toward target inventory investment level more quickly than financially constrained SMEs.

[7] It is assumed that firms without immediate cash will not be able to procure inventory immediately since they will have to take time and negotiate a credit facility.

[8] The extant literature suggests that one quick way to reduce excess inventory levels is to sell to customers on credit (Ng et al., 1999; Afrifa, 2015).

2.4 The effect of financial crisis on inventory investment of SMEs

Inventory is the component of firms' assets that is most likely to be affected by financial pressure and adverse macroeconomic conditions (Bagliano and Sembenelli, 2004). Boom periods are characterised by easy access to finance, which allows firms to increase their investment in inventory. In booming periods, the marginal cost of inventory investment is expected to be less than the marginal benefit because of the corresponding increase in sales growth (Cunhan and Paisana, 2011). However, in times of financial crisis, sales generally decline and as such the benefits of inventory investment are expected to be less due to the restriction on access to finance (Guariglia, 1999). For example, Blanchard and Fischer (1989) reported that reduction in inventory accounts for 50% of output decline during the financial crisis. Guariglia (1999) argues that firms reduce their economic activities during financial crisis through a decline in inventory. Sangalli (2013) found a negative response of inventory investment to financial crisis periods.

In terms of economic conditions on different sizes of firms, Carpenter et al. (1994) found that the restriction of access to finance is greater for SMEs during the financial crisis period. Therefore, SMEs inventory investment is expected to be largely affected in financial crisis periods because they rely more on bank loans (Oliner and Rudebusch, 1996). Banks and other financial institutions tend to favour high-quality borrowers in times of tight monetary policy. Gertler and Gilchrist (1994) reported sales and inventory as the main areas of SMEs operations that are heavily affected by adverse macroeconomic conditions. Therefore, the general trend of inventory investment of SMEs is expected to fall during financial deepenings, such as the financial crisis that started as a sub-prime crisis in 2007 but unfolded into the Great recession in 2009. However, Cunha and Paisana (2011) found in their empirical studies that access to finance improves inventory investment in the financial crisis period. Based on the above arguments the following hypotheses are developed:

Hypothesis 4a: The level of inventory investment in both financially constrained and unconstrained SMEs is reduced during financial crisis periods.

Hypothesis 4b: The level of inventory investment reduction during financial crisis periods is more pronounced in financially constrained SMEs than unconstrained ones.

2.5 The effect of financial crisis on inventory investment and SMEs profitability

Given the severe scarcity of funds (both internal and external) in financial crisis periods for SMEs, the relationship between inventory investment and profitability is expected to be high and inversely related. The downward trend in sales during financial crisis periods means that any increase in inventory investment will not be complemented by a corresponding increase in sales (Bagliano and Sembenelli, 2004). Also, the lack of funds to finance investment in inventory during financial crisis periods means that the cost of inventory investment will be more than the benefit, leading to a highly negative relationship with profitability. However, the effect of access to finance is expected to mitigate the highly negative relationship between inventory and profitability during financial crisis periods (Cunha and Paisana, 2011). Therefore, access to finance in times of financial crisis periods is expected to improve the inventory and profitability relationship[9]. In sum, the arguments lead to the following final hypotheses:

Hypothesis 5a: The negative relationship between inventory investment and SMEs profitability increases during the financial crisis period.

Hypothesis 5a: The negative relationship between inventory investment and profitability during financial crisis period is more pronounced in financially constrained than unconstrained SMEs.

[9] Access to finance during financial crisis is only expected to reduce the negative effect but not to turn it to positive.

3. Data, Variables, and Methodology

3.1 Sample selection and data

The data used in this study was obtained from the AMADEUS database. The sample for the study is drawn from SMEs in the UK for the period from 2005 to 2014. Financial firms such as banks and insurance were excluded because they have different accounting requirements (e.g. Deloof, 2003; Hill et al., 2010). Moreover, firm-years with anomalies in their accounts such as negative values in assets, sales, current assets, fixed assets were removed (see, Hill et al., 2010). Also, firms missing a substantial amount of information were excluded. Finally, all variables were winsorized at the 1% in order to mitigate the influence of outliers (see, Garcia-Teruel and Martinez-Solano, 2007; Hill et al., 2010). The final sample of SMEs, which is based on the requirements established by the European Commission's recommendation 2003/361/CE of 6rd May 2003, on the definition of SMEs, therefore, consists of an unbalanced panel of 16,236 firms. By allowing for both entry and exit, the use of an unbalanced panel partially mitigates potential selection and survivor bias. It represents 129,888 firm-year observations. Specifically, the following criteria are used for the selection of SMEs[10]:

- Number of employees of up to 250
- Turnover less than €50 million; and
- Possession of less than €43 million of total assets.

3.2 Dependent and independent variables

The dependent variable to be analysed is the return on assets (ROA) which has been used extensively in the literature to measure firm profitability (Tauringana and Afrifa, 2013; Aktas et al., 2015). ROA is measured as the ratio of operating income before depreciation divided by total

[10] The average exchange rate per each year from 2015-2014 was used to convert the total assets and turnover values from British Pounds Sterling to Euro.

assets (see, Aktas et al., 2015). ROA is used as the main performance measure because approximately 97% of the companies used in this study are not listed on a stock exchange, which makes the use of market-based performance somewhat difficult. Also, ROA is an indicator of the performance of management with regard to the given resources, and because it can remove size effects, it allows for inter-industry comparison (Lev and Sunder, 1979).

To determine whether inventory investment is sensitive to financial measures, inventory investment is used as the dependent variable. Then, inventory investment is employed as an independent variable to examine its relationship with SMEs profitability. Industry adjusted inventory investment is derived by subtracting the industry-level mean of $\frac{Inventory}{Total\ assets - inventory}$ from the annual means for each SME per each year (see, Hill et al., 2010; Aktas et al., 2015).

3.3 Partitioning criteria

To test the effect of access to finance on inventory investment; and the effect on the relationship between inventory investment and SMEs profitability, firms are partitioned on the basis of the likelihood that they have constrained access to finance or not. As argued by Banos-Caballero et al. (2014), there are several proxies used in previous studies to partition firms according to whether they are constrained or not (see, Carpenter et al., 1994; Guariglia and Mateut, 2006); however, it is still a matter of debate as to which proxy is the best. Thus, firms in the sample are classified according to the following proxies to determine the existence of financial constraint.

Size – This variable has been used extensively in the literature to measure firms' access to institutional credit (Schwartz, 1974). Firms with more assets are considered to be more creditworthy and, therefore, have easy access to funds in the capital markets than firms with limited assets (Banos-Caballero et al., 2010). Atanasova (2012) argues that smaller firms are limited in terms of their access to external finance as a result of their high failure rate. Therefore,

firms are separated according to their size, measured by the total assets of firms. An SME is considered to be financially constrained if its total assets value is below its industry's median.

Cash reserve – Following Aktas et al. (2015) cash reserve is defined as the ratio of cash and cash equivalent to total assets. Unlike Carpenter et al. (1994), the cash reserve is preferred to cash flow in order to avoid multicollinearity issues[11]. Mikkelson and Pertch (2003) used cash reserve as a measure of firm financial constraint and found that cash reserve is accompanied by greater investment, particularly in inventory. An SME with cash reserve below the sample median of its industry is assumed to be more likely to face financing constraints.

Collateral – This is defined as the ratio of tangible fixed assets to total assets and it is a good indication of access to institutional finance (Braun and Larrain, 2005). This is because tangible fixed assets can easily be recaptured if the borrower default (Almeida and Campello, 2004). As argued by Guariglia and Mateut (2006), firms that are more collateralised are less likely to face financial constraints. Thus, SMEs with collateral below its industry median are more financially constrained than those with collateral above the industry median.

Interest coverage – According to Banos-Caballero et al. (2014), the interest coverage is a common measure of a firm's bankruptcy and financial constraints; and the greater this ratio, the easier it is for a firm to repay its debt. Following Molina and Preve (2009), interest coverage is calculated as operating income before depreciation scaled by interest expense. Here, an SME is considered to be facing difficulties in covering interest expenses if its interest coverage is below its industry's median.

Next, a dummy variable (D) is developed, which is equal to one if an SME i is financially constrained in year t, and zero otherwise. Therefore, (D) is used to measure the extent to which

[11] The definitions of both return on assets and cash flow have operating income and total assets as numerator and denominator, respectively

inventory investment and its effect on profitability differ between financially constrained and unconstrained SMEs. This procedure allows firms to move across classes[12].

3.4 Control variables

Following past studies (Capkun et al., 2009; Hill et al., 2012; Mathuva, 2013) control variables, firm age, intangible assets, annual sales growth, R&D and net trade credit are included to avoid any spurious association between firm performance and inventory investment. The literature suggests that these variables can affect the firms' performance (see, Tauringana and Afrifa, 2013; Aktas et al., 2015). Firm age is measured as the number of years between incorporation and the calendar year end of each firm; intangible assets is proxied by the ratio of intangible assets to total assets; annual sales growth is measured by the percentage of changes in sales over the previous year, R&D is defined as research and development expenditure to total assets; net trade credit is defined as trade receivables minus trade payables, scaled by total assets.

3.5 Methodology

The variation in inventory across firms may be a result of firm-specific unobservable factors, which can cause pooled OLS regression results to be affected by heterogeneity bias. Therefore, a Breusch and Pagan (1980) Lagrange multiplier test was performed but which rejected the use of pooled OLS with a single intercept[13]. Hence, the Hausman's test was carried out to decide whether to employ the Fixed Effects (FE) model or Random Effect (RE) model by first determining whether there is a correlation between the unobservable heterogeneity (μ_i) of each firm and the explanatory variables of the model. The Hausman's test rejected the null hypothesis that the unobserved heterogeneity is uncorrelated with the regressors in all models. This finding means

[12] Therefore, the empirical analysis will focus on firm-year observations. Similar procedure was adopted by Guariglia and Mateut (2006).
[13] The results are available upon request.

that the RE is significantly different from the FE, and therefore, the FE is the more consistent and efficient method to use. Therefore, the FE specification is used in all models for this paper. Also, it is important to note that in addition to the control of firm and year fixed effects, industry fixed effects are indirectly controlled for through the use of industry-adjusted inventory investment measure.

3.6 Regression model specification

To examine the sensitivity of SMEs inventory investment to financial measures (*Hypothesis 1a*), the following model is estimated:

$$\boldsymbol{IndAdjINV_{it} = \alpha_t + \eta_i + \beta_1 SIZE_{i,t-1} + \beta_2 CRESERVE_{i,t-1} + \beta_3 COLLATERAL_{i,t-1} + \beta_4 INTCOV_{i,t-1} + \beta_5 Controls_{i,t-1} + \varepsilon_{i,t}} \quad \textbf{(1)}$$

To gauge the extent to which the effects of access to finance on inventory investment differ between financially constrained and unconstrained SMEs (*Hypothesis 1b*), the following model is estimated.

$$\boldsymbol{IndAdjINV_{it} = \alpha_t + \eta_i + \beta_1 Finance_{i,t-1} + \beta_2 Finance_{i,t-1} X\ D + \beta_3 Controls_{i,t-1} + \varepsilon_{i,t}} \quad \textbf{(2)}$$

To examine the effect of financial measures on the relationship between inventory investment and SME profitability (Hypothesis *2a*), the following equation is estimated:

$$\boldsymbol{ROA_{it} = \alpha_t + \eta_i + \beta_1 IndAdjINV_{i,t-1} + \beta_2 IndAdjINV_{i,t-1} X\ Finance + \beta_3 Finance_{i,t-1} + \beta_4 Controls_{i,t-1} + \varepsilon_{i,t}} \quad \textbf{(3)}$$

To examine the extent to which the effect of inventory investment on SMEs profitability differ between financially constrained and unconstrained firms (*Hypothesis 2b)*, the following equation is estimated:

$$\boldsymbol{ROA_{it} = \alpha_t + \eta_i + \beta_1 IndAdjINV_{i,t-1} + \beta_2 IndAdjINV_{i.t-1} X\ Finance_{i,t-1} XD + Finance_{i,t-1} XD + \beta_6 Controls_{i,t-1} + \varepsilon_{i,t}} \quad \textbf{(4)}$$

Next, to test (*Hypotheses 3*), a comparison of how quickly financially constrained and unconstrained SMEs adjust towards their target inventory investment levels is examined. This is achieved by estimating the following partial adjustment model for financially constrained and unconstrained SMEs separately:

$$\Delta \boldsymbol{INV_{it}} = \boldsymbol{\beta_0} + \boldsymbol{\delta}(\boldsymbol{INV^{*}_{it}} - \boldsymbol{INV_{i,t-1}}) + \boldsymbol{\varepsilon_{i,t}} \quad \textbf{(5)}$$

In equation (5), the dependent variable ΔINV_{it} is the change in inventory investment from year t – 1 to t. INV_{it-1} is the lagged value of inventory investment. INV_{it}* is the target inventory ratio, which is estimated from a regression of inventory investment on the control variables listed above, separately for financially constrained and unconstrained firms, as follows:

$$\boldsymbol{INV_{it}} = \boldsymbol{\beta_0} + \boldsymbol{\gamma X_{it}} + \boldsymbol{\varepsilon_{it}} \quad \textbf{(6)}$$

This approach allows for the possibility that financially constrained and unconstrained firms may maintain heterogeneous inventory investment targets, which concur with the argument made above that these firms have different inventory investment levels. The coefficient of interest δ measures the speed of adjustment toward the target level of inventory investment, which takes the value of zero to one. An SME that adjusts its inventory investment level immediately will have a speed of adjustment equal to one. On the other hand, a firm that is slower in adjusting its inventory investment level will have a speed of adjustment equal to zero. As argued above, unconstrained SMEs are expected to have lower costs of adjustment and, therefore, adjust more quickly; and vice versa for constrained SMEs. The Chow test is used to compare the speed of adjustment between financially constrained and unconstrained SMEs by testing whether the difference in the estimates of δ is statically significant.

Next, to examine the inventory investment levels of financially constrained and unconstrained SMEs; and profitability during the financial crisis period (Hypotheses 4a, 4b, 5a, and 5b), the following models are estimated:

$$IndAdjINV_{it} = \alpha_t + \eta_i + \beta_1 Finance_{i,t-1} + \beta_2 Finance_{i,t-1} \times Crisis_{i,t-1} + \beta_3 Crisis_{i,t-1} + \beta_4 Controls_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

$$ROA_{it} = \alpha_t + \eta_i + \beta_1 Crisis_{t,t-1} + \beta_2 IndAdjINV_{i,t-1} + \beta_3 IndAdjINV_{i,t-1} X\ Finance_{i,t-1} XD + \beta_4 IndAdjINV_{i,t-1} \times Finance_{i,t-1} X\ D\ X\ Crisis_{i,t-1} + \beta_5 Finance_{i,t-1} XD + \beta_6 Controls_{i,t-1} + \varepsilon_{i,t} \quad (8)$$

Models (7) and (8) extend models (2) and (4) in that they include a dummy variable to account for the adverse economic conditions, which is proxied by the recent financial crisis of 2007 – 2009. *CRISIS* is a dummy variable that takes the value of 1 in the years 2007 – 2009, and 0 otherwise. The inventory investment of both the financially constrained and unconstrained firms during financial crisis periods is expected to severely reduce. Also, the inventory investment during financial crisis periods is expected to severely impact on SMEs profitability of both financially constrained and unconstrained firms.

All variables are defined in Appendix A. The subscript *i* denotes the nth company (i = 1,... 16,236), and the subscript *t* denotes the n^{th} year (t=1,...10). α_t and η_i represent year and firm fixed effects, respectively.

4 Empirical evidence

4.1 Description of sample

Table 1 contains the descriptive statistics. The mean ROA is approximately 7%. The average inventory investment and its industry adjusted are approximately 12% and −0.0003%, respectively[14]. Thus, approximately £0.12 of each dollar in sales revenue is tied up in inventory

[14] The non-zero mean industry adjusted inventory investment is mainly due to the winsorization of the variable at the 1st and 99th percentiles.

equating to just over £1.6 million[15], a nontrivial amount given its effect on firms' free cash flow. The summary statistics for the remaining variables are similar to prior studies. In terms of the access to finance measures, the total asset of the average SME in the sample is £10.4 million. The collateral base of the average SME in the sample is approximately 30%. The average cash reserve for all SMEs in the sample is approximately 25%. The average interest cover ratio of the sample is approximately 14.

For the control variables, the average firm age is approximately 20 years with a median of 13 years. The average firm has approximately 4% of its assets in the form of intangible assets. The average annual sales growth is 7%; the average R&D to total assets is 2% and net trade credit is on average 3%.

[Insert Table 1 here]

Table 2 provides the distribution of ROA, inventory investment, firm size, collateral, cash reserve and interest cover across time (2005-2014). The results show a decrease in all the variables being considered here during the financial crisis period from 2007 to 2009, with the exception of firm size and collateral. These are consistent with existing literature that firms reduce investment in inventory (Carpenter et al., 1994; Kashyap et al., 1994); cash reserves of firms reduces (Love et al., 2007) and the profitability of firms generally declines (Danso and Adomako, 2014) during financial crisis.

[Insert Table 2 here]

Table 3 provides the distribution of ROA, inventory investment, firm size, collateral, cash reserve and interest cover by industry affiliation using the NACE revenue 2 industry classification system[16] (see, (Andrew, José María García, Teresa López-García Usach, & Sánchez, 2013; Hyytinen,

[15] The mean sales revenue is £13.560 million.

[16] The industrial codes are based on NACE revenue 2 which is a statistical classification system of economic activities the European Community. See Table 3 for the full list. By construction, the financial and insurance activities (K) have been omitted from this analysis.

Pajarinen, & Rouvinen, 2015; Tykvová & Borell, 2012). From the onset, it is evident that the variations of these variables are widespread across industries. The substantial variation in inventory investment across industries echoes the findings by (Bento, 2005; Gaur et al., 2005; Koumanakos, 2008), which suggest that inventory investment behaviour is industry specific. The most and least profitable industries are construction (F) and real estate activities (L) with a ROA of 11% and 4%, respectively. The industry with the maximum inventory investment is wholesale and retail trade (G) with 25%, and others has the smallest mean inventory investment of 5%. In terms of the financial measures, real estate activities (L) have the highest total assets of approximately £17 million and professional, scientific and technical activities (M) with the lowest of £7 million. The industries with the highest and lowest collateral base are agriculture, forestry and fishing (A) and activities of households as employers; undifferentiated goods (T) with approximately 44% and 24%, respectively. Electricity, gas, steam and air conditioning supply industry (D) has the highest cash reserve of 32%; and the industry with the lowest cash reserve is administrative and support service activities (N) with 18%. The two industries with the highest and lowest interest cover are electricity, gas, steam and air conditioning supply industry (D) and activities of households as employers; undifferentiated goods (T) with approximately 21 and 9, respectively.

[Insert Table 3 here]

The results of the Pearson correlation coefficients of the independent variables are presented in Table 4. All the four financial measures including firm size, cash reserve, collateral and interest cover have a positive correlation with industry adjusted inventory investment at the 1% significance level. The correlation coefficients of firm age, intangible assets and R&D are negative and significantly related to industry adjusted inventory investment at the 10% level or better; annual sales growth and net trade credit are positively related to industry adjusted inventory investment at the 1% level. With regards to the financial measures, the correlation coefficients between them are all positive and significantly related at the 1% level. Also, the

correlation coefficients are below the threshold prescribed by Field (2005) to suggest no problems of multicollinearity.

[Insert Table 4 here]

However, Myers (1990) argues that a certain degree of multicollinearity can still exist even when none of the correlation coefficients are very large. Therefore, the variance inflation factors (VIFs) were examined in all models to further test for multicollinearity and all were well below the threshold value of 10[17] suggested by Field (2005) indicating that multicollinearity does not pose a problem in the regressions.

4.2 Multivariate Regression Results

This section first examines the sensitivity of inventory investment to SMEs' access to finance and the inventory investment of constrained and unconstrained firms. Then, the effect of access to finance on the relationship between inventory investment and profitability; and the profitability of inventory investment of financially constrained and unconstrained SMEs are examined. Next, a comparison of how quickly financially constrained and unconstrained SMEs adjust toward their target inventory levels is examined. Finally, the relationship between inventory investment and its relationship with the profitability of SMEs during financial crisis periods are also explored.

4.2.1 Inventory investment and access to finance

Table 5 presents the inventory investment regressions. Panel A reports the regression results of running regression model (1), which examines the sensitivity of inventory investment to financial measures. Columns 1−4 of panel A have each of the four access to finance ratios listed above as the explanatory variable; with industry adjusted inventory investment as the dependent variable. All the independent variables are lagged by one year period with respect to the dependent

[17] The VIFs result is not provided because of limited space but is available upon request.

variable. Also, all specifications include firm and year fixed effects. In all columns, the results show that inventory investment is positively associated with financial measures of the previous period at the 1% level of significance. These findings strongly support (*Hypothesis 1a)* that access to finance leads to higher level of inventory investment. This indicates that the increase in access to finance across time leads on average to increasing inventory investment in the subsequent period. These findings echo those of Fazzari and Petersen (1993), Carpenter et al. (1994) and Guariglia and Mateut (2006). The coefficient estimates of the financial measures are positive and statistically significant in all columns with values of 0.0482 (*p*−value = 0.000), 0.0952 (*p*−value = 0.000), 0.1312 (*p*−value = 0.000) and 0.0701 (*p*−value = 0.000), respectively. The corresponding economic effects are substantial: a one standard deviation increase in total assets, collateral, cash reserve and interest cover across time are associated with an increase of approximately 1%, 2%, 4%, and 1%, respectively, in inventory investment.

After having established that the increase in financial measures across time is associated with higher investment in inventory, the next step is to gauge the extent to which the effect of these financial measures on inventory investment differ for financially constrained and unconstrained SMEs. This procedure helps in examining the marginal effects of access to finance on inventory investment. Columns 5−8 in panel B of Table 5 have each of the access to finance ratios as the explanatory variable; with industry adjusted inventory investment as the dependent variable. All the independent variables are lagged by one year period with respect to the dependent variable. Also, all specifications include firm and year fixed effects. To test this conjecture, panel B of Table 5 reports the regression results using model (2). The regression specification includes an interactive variable (*Finance X D)*, which interacts each of the four access to finance ratios with a dummy variable identifying SMEs that are considered financially constrained.

The coefficient estimates of the interaction term (*Finance X D*) are statistically highly significant with values of −0.0390 (*p*−value =0.000), −0.0238 (*p*−value =0.000), −0.0367 (*p*−value =0.000), and −0.0256 (*p*−value =0.000) for all four access to finance ratios, respectively. The results indicate that SMEs with access to finance ratios below the industry median in a particular year reduce investment in inventory. Specifically, financially constrained firms investment in inventory on average is about approximately 79% less in column (5), 25% less in column (6), 27% less in column (7), and 32% in column (8). These findings strongly support (*Hypothesis 1b*) that financially unconstrained SMEs have a higher investment in inventory than constrained SMEs.

Concerning the control variables, in all specifications in Table 5, the coefficients of firm age, intangible assets, sales growth and net trade credit are statistically significant at conventional levels. Consistent with the literature, inventory increases with firm age; decreases with intangible assets, sales growth, and net trade credit. The coefficient of R&D is not statistically different from zero in all eight columns.

[Insert Table 5 here]

4.2.2 Inventory investment, access to finance and SMEs profitability

The fixed effects estimation results of Equation (3) are reported in panel A of Table 6, which presents the effect of access to finance on the association between inventory investment and SMEs profitability. Columns 1−4 have each of the access to finance ratios as the explanatory variable. The dependent variable in columns 1−4 is the ROA. $Finance_{i,t-1}$ identifies the financial situation of a firm. All the independent variables are lagged by one year period with respect to the dependent variable. Also, all specifications include firm and year fixed effects. The same asymmetric model with the same set of control variables as in Table 5 is used. In this section, the main variable of interest is (*IndAdj*INV *X Finance*), which measures the incremental impact of access to finance on the relationship between inventory investment and SMEs profitability.

The results show that the ROA is negatively associated with inventory investment in all four columns. However, with the introduction of access to finance (IndAdjINV X *Finance*), the relationship between inventory investment and SMEs profitability becomes significantly highly positive in all four columns. The coefficient estimate of interaction variable (*IndAdj*INV X *Finance*) is positive and statistically significant in all columns with values of 0.0309 (*p*−value = 0.000), 0.0105 (*p*−value = 0.000), 0.0077 (*p*−value = 0.000) and 0.0213 (*p*−value = 0.000), respectively. Specifically, with access to finance, an additional pound in inventory improves ROA by approximately 65% in column (1), 27% in column (2), 25% in column (3), and 59% in column (4). For example, in column (1), the loss on inventory investment of the average firm is −0.0474, but reduces to −0.0165 [−0.0474 + (0.0309)] when access to finance is introduced. These findings strongly support (*Hypothesis 2a*) that access to finance reduces the negative impact of inventory investment on ROA. The letter (ϒ) is used to denote the coefficient estimate of the corresponding variable. The sum of (Υ_1) and (Υ_2) is statistically significant.

After having established that access to finance positively moderates the association between inventory investment and profitability, next, the extent to which the effect of inventory investment on profitability differs for financially constrained and unconstrained SMEs is determined. To test this conjecture, panel B of Table 6 reports the regression results for the model (4). The regression specification includes an interaction variable (*IndAdj*INV *X* (*Finance X D)*), which interacts the (*IndAdj*INV) with SMEs that are considered financially constrained. Here, the main variable of interest is (IndAdjINV *X Finance* X D), which measures the incremental impact of constrained access to finance on the relationship between inventory investment and SMEs profitability. The results in Panel B of Table 6 indicate that financially constrained SMEs inventory investment increases the negative impact on profitability, which strongly support (*Hypothesis 2b*).

The coefficient estimates of the interaction term (IndAdjINV *X Finance* X D) are statistically highly significant with values of −0.0053 (*p*−value =0.007), −0.0130 (*p*−value =0.000), −0.0122

(*p*−value =0.000) and −0.0110 (*p*−value =0.000) for all four access to finance ratios, respectively. Specifically, the results show that in comparison with unconstrained SMEs, constrained SMEs receive approximately 11% less in ROA in column (5), 39% less in ROA in column (6), 32% less in ROA in column (7), and 29% in ROA in column (8). For example, in column (1), the loss on inventory investment of a firm with access to finance is −0.0466, but increases to −0.0519 [−0.0466 + (−0.0053)] for a firm that is financially constrained. The coefficients of the control variables are consistent with those displayed in Table 5. The sum of (Υ_1) and (Υ_2) is statistically significant.

[Insert Table 6 here]

4.2.3 Optimal inventory investment and speed of adjustment

This section examines whether financially constrained and unconstrained SMEs adjust toward their inventory investment level and whether they do so with different speeds. To start with, the target level of inventory investment is estimated separately for financially constrained and unconstrained SMEs. The adopted approach accounts for a difference in the target inventory investment level between financially constrained and unconstrained SMEs. The results displayed in Table 7 show evidence of significantly different coefficients of the determinants of those target levels[18].

The regression results for the partial adjustment model of inventory investment on the full sample are presented in panel A of Table 7. Because of space constraint, a dummy variable (*DV*) denotes whether the firm-year observation is constrained for at least two[19], of the aforementioned access to finance criteria. The results show that both financially constrained and

[18] The same results of adjustment speeds are quantitatively obtained when the approach by Gao et al. (2013) is followed by assuming that constrained and unconstrained firms have the same target inventory investment level.

[19] Unreported descriptive statistics results show that many firms that are classified as constrained under one criterion is likely to be constrained by the other criteria (see, Hill et al., 2012 for similar approach).

unconstrained SMEs adjust towards their inventory investment level but at significantly differently speeds, with unconstrained SMEs adjusting toward their optimal inventory investment level quicker than constrained SMEs. These findings support the extant literature that firms have optimal inventory investment level and that they adjust towards this target (Mathuva, 2013). Importantly, the results indicate that constrained SMEs adjust at a rate of 59%, which is much slower than the adjustment speed of 77% for unconstrained SMEs. Also, the Chow test in column 4 of Table 7 indicates a significant difference in the adjustment speeds between the financially constrained and unconstrained SMEs. Thus, (*Hypothesis 3*) is supported. The finding that constrained SMEs adjust their inventory investment level slower than their unconstrained counterparts supports the assertion that firms with financial problems struggle to adjust towards their target inventory investment level because of the costs of adjustment (Guariglia and Mateut, 2006).

Panels (B) and (C) investigate whether the difference in the speed of adjustment between financially constrained and unconstrained SMEs is dependent on the deviation from target inventory investment level. The results displayed in panel B show that unconstrained SMEs again have a faster speed of 73% higher than that of constrained SMEs of 63% for deviation below the target inventory investment level. Moreover, the results contained in panel C indicate that unconstrained SMEs have faster adjustment speed of 81% higher than 58% of constrained SMEs when the deviation is above the target inventory investment level. These results suggest that unconstrained SMEs are able to easily adjust their below optimal inventory investment in order to stimulate sales (Deloof, 2003), avert production and trading interruptions (Garcia−Teruel and Martinez−Solano 2007) and also reduce the risk of stock out (Deloof, 2003). Similarly, unconstrained SMEs can adjust their above optimal inventory investment by offering generous credit to customers because such firms can finance investment in customers.

[Insert Table 7 here]

4.2.4 Inventory investment during financial crisis period

In this section, the differential impact of financial crisis on the inventory investment level of financially constrained and unconstrained SMEs is examined. Table 8 presents the results of the fixed effect regressions. To capture this differential effect, the recent financial crisis of 2007−2009[20] is used. *CRISIS* is an indicator variable which identifies the crisis period and takes the value one for years 2007−2009, and zero otherwise. The same asymmetric model with the same set of control variables as in panel B of Table 5 is used. All the independent variables are lagged by one period with respect to the dependent variable. Also, all specifications include firm and year fixed effects.

In panel A, the dependent variable is inventory investment. Columns 1-4 have each of the access to finance ratios as the explanatory variable. Here, the main variable of interest is (*Finance X Crisis*), which corresponds to the marginal effect of access to finance on inventory investment during the financial crisis period. Consistent with the results in panel A of Table 5, inventory investment is positively related to all four financial measures. During the crisis period, however, inventory investment is negatively related to all four financial measures. These findings suggest that access to finance does not lead to an increase in inventory investment. This result is expected because during such period, other sources of finance are dried up and as such firms will hold on to their extra financial resources in order to meet short-to-medium term obligations as and when they fall due. The coefficient estimate of (*Finance X Crisis*) is −0.0118 (*p*−value =0.000) in column (1), −0.0114 (*p*−value =0.000) in column (2), −0.0136 (*p*−value =0.000) in column (3), and −0.0153 (*p*−value =0.000) in column (4). Specifically, SMEs investment in inventory during financial crisis is reduced by approximately 25%, 16%, 10% and 29% in columns (1 to 4), respectively. These findings

[20] Similar results are quantitatively obtained when the financial crisis period of 2007-2008 is used.

strongly support (Hypothesis 4a) that the level of inventory investment in SMEs is reduced during financial crisis periods. The sum of (Υ_1) and (Υ_2) is statistically significant.

Now that it has been established that investment in SMEs' inventory reduces during financial crisis periods, next, the marginal effect of the financial crisis on inventory investment of financially constrained and unconstrained SMEs is examined. The results contained in Panel B of Table 8 show that the inventory investment reduction during financial crisis of financially constrained firms is more severe than financially unconstrained firms. Specifically, financially constrained firms inventory investment reduction during financial crisis is much higher than unconstrained firms by approximately 18% in column (5), 9% in column (6), 4% in column (7), and 4% in column (8). These findings strongly support (Hypothesis 4b) that the inventory investment reduction during financial crisis period is more pronounced in financially constrained SMEs than unconstrained ones. The sum of (Υ_1) and (Υ_2) is statistically significant.

[Insert Table 8 here]

4.4.5 Inventory investment and SMEs profitability during financial crisis period

Here, the effect of financial measures on the association between inventory investment and SMEs profitability during financial crisis period is examined. In panel A of Table 9, the dependent variable is ROA. Columns 1-4 have each of the access to finance ratios as the explanatory variable. Once again *CRISIS* is an indicator variable which identifies the crisis period and takes the value one for years 2007−2009, and zero otherwise. The main variable of interest is (IndAdjINV X Finance X CRISIS), which corresponds to the marginal effect of financial measures on the relationship between inventory investment and SMEs profitability during the financial crisis. The results show the loss of inventory investment of SMEs is increased during financial crisis period. Specifically, the negative effect of inventory investment on SMEs profitability during financial crisis period is approximately 33% more in column (1), 42% more in column (2), 52% more in column (3), and 22%

more in column (4). These findings strongly support (Hypothesis 5a) that the inventory investment reduction of SMEs profitability is further increased during financial crisis period. The sum of (Υ_1) and (Υ_2) as well as the sum of (Υ_2) and (Υ_3) are statistically significant.

Consistent with the results in Table 5, the results in panel B of Table 9 indicate that SMEs profitability is negatively related to inventory investment over the pre-crisis period. Furthermore, the results show that financially constrained SMEs loss on inventory investment further increases during financial crisis period. In terms of the economic magnitude of the impact of financial crisis on SMEs inventory investment relationship to profitability, the findings indicate that financially constrained SMEs loss increases by approximately 40% in column (5), 14% in column (6), 22% in column (7), and 3% in column (8). These findings strongly support (Hypothesis 5b) that the loss of inventory investment during financial crisis period is more pronounced in financially constrained SMEs. The results of the control variables generally echo those displayed in the Tables above. The sum of (Υ_1) and (Υ_2) as well as the sum of (Υ_2) and (Υ_3) are statistically significant.

[Insert Table 9 here]

6 Conclusions

This paper provides comprehensive evidence of a relationship between inventory investment and SMEs profitability by taken access to finance into consideration. The study was based on an unbalanced panel data regression analysis of 16,236 SMEs over a ten-year period (2005-2014). In particular, the results show that inventory investment is sensitive to financial measures and that firms with access to finance make a higher investment in inventory. Even more importantly, the results show that inventory investment relationship to profitability is negative for both financially constrained and unconstrained SMEs. The results demonstrate that SMEs should strive to reduce the investment in inventory, but more so for financially constrained SMEs.

Further analyses show that financially unconstrained SMEs have a faster speed of adjustment to the optimum inventory investment level than constrained ones. In terms of

inventory investment performance during the financial crisis, the findings indicate that both financially constrained and unconstrained SMEs reduce their inventory investment levels. However, the reduction is more severe in the former than the latter. Also, the findings demonstrate that the negative effect of inventory investment on profitability is worsened in both financially constrained and unconstrained SMEs during financial crisis; the former having a severe effect than the latter.

Ultimately, this study has contributed to knowledge of how access to finance influences the profitability of inventory investment. The results also have important corporate policy implications. Given the magnitude of inventory as a proportion of firm assets and sales, corporate managers should put particular importance in exploiting its value for the benefit of shareholders. In particular, the findings suggest that corporate managers of both financially constrained and unconstrained SMEs to avoid having too much inventory; and target an optimum level of inventory investment.

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Appendix A: Summary of Variables Calculations and Definitions

Dependent variable	Acronym	Description
Return on total assets	ROA	Operating income before depreciation scaled by total assets.
Inventory investment	INV	Total inventory as a percentage of total assets minus inventory.
Industry–Adjusted INV	IndAdjINV	The annual INV for each firm minus industry average INV for the respective year.
Firm size	SIZE	Value of firms total assets in British pounds sterling
Cash reserve	CRESERVE	Cash and cash equivalent scaled by total assets.
Collateral base	COLL	Fixed assets as a percentage of total assets
Interest coverage	INTCOV	Operating income before depreciation scaled by interest expense.
Finance	Finance	Represents four financial measures including firms size, cash reserve, collateral and interest coverage
Firm age	AGE	A number of years between incorporation and the calendar year end of each firm.
Intangible assets	INTANG	Intangible assets scaled by total assets
Annual sales growth	GROWTH	Percentage change in sales revenue over the previous year.
Research & Development	R & D	Research and development expenditure to total assets
Net trade credit	NTC	Trade receivables minus trade payables, scaled by total assets

Table 1: Summary Descriptive Statistics

The table provides the summary statistics of 129,888 firm–years across 16,236 UK SMEs over the period 2005–2014. Variable definitions are provided in Appendix A. N denotes the sample size.

Variable	Mean	Std. Dev	Q1	Median	Q3	N
Return on assets (%)	7.0465	18.7522	–6.9990	5.3080	25.0340	129,888
Inventory (%)	11.9857	17.7565	0.3116	2.6152	36.4987	129,888
IndAdj inventory (%)	–0.0003	13.7567	–9.2404	–0.6903	27.1684	129,888
Size (£million)	10.4180	7.7200	2.6661	8.1700	24.9880	129,888
Cash Reserve (%)	25.1210	16.0915	–4.1125	10.6586	49.7424	129,888
Collateral (%)	29.8481	27.6350	0.4155	22.5350	73.8700	129,888
Interest cover (ratio)	14.2239	31.8163	6.2149	16.7811	58.3398	129,888
Age (years)	19.8295	21.1840	8.5777	13.0051	45.2763	129,698
Intangibles (%)	4.3215	12.4595	0.0000	4.0666	13.0166	117,706
Sales Growth (%)	7.1621	13.8255	–1.9068	5.1448	49.5848	109,391
R & D (%)	2.2378	2.8336	0.4547	3.1209	9.5305	115,815
Net trade credit (%)	2.4704	14.1247	–5.3683	0.0000	0.0000	129,526

Table 2. Time distribution of sample

The table provides the mean distribution of sample across time for 129,888 firm–years across 16,236 UK SMEs over the period 2005–2014. Variable definitions are provided in Appendix A. The mean value of IndAdjINV is not reported since it approximates zero by construction.

YEAR	**ROA** (%)	**INV** (%)	**SIZE** (£M)	**CRESERVE** (%)	**COLL** (%)	**INTCOV**(ratio)
2005	6.9682	12.8806	9.835	24.1677	29.4146	15.4456
2006	6.7280	12.0757	9.698	24.4027	29.4862	15.1041
2007	5.7656	12.0757	9.909	24.5117	28.9401	13.9627
2008	6.1280	10.9412	10.469	23.9425	28.8447	10.8773
2009	6.0928	11.0337	10.793	24.0344	29.0309	10.3970
2010	6.3068	11.0834	10.120	23.8736	30.3769	9.6922
2011	7.0475	11.0355	10.478	24.9318	30.6601	14.4363
2012	7.5550	12.9332	10.771	26.7470	30.4369	15.9235
2013	8.6451	12.9632	10.967	27.4354	30.4542	18.0634
2014	9.2423	13.0387	11.137	27.1775	30.8507	18.3509

Table 3. Industry distribution of sample

The table provides the mean distribution of sample across industries for 129,888 firm–years across 16,236 UK SMEs over the period 2005–2014. Variable definitions are provided in Appendix A. NACE Rev. 2 refers to the statistical classification system of economic activities (industries) in the European Community. The mean value of IndAdjINV is not reported since it approximates zero by construction.

Industry Focus	**Nace Rev. 2**	**ROA** (%)	**INV** (%)	**SIZE** (£M)	**CRESERVE** (%)	**COLL** (%)	**INTCOV**(ratio)
Agriculture, forestry and fishing	A	7.0641	17.9867	10223	28.1138	43.9656	13.6964
Mining and quarrying	B	10.2138	14.0751	12519	23.0814	36.9636	18.9219
Manufacturing	C	7.0249	21.7788	13328	28.1814	27.0835	12.2777
Electricity, gas, steam and air conditioning supply	D	4.6622	8.9899	14594	31.9161	38.8739	21.527
Water supply; sewerage, waste management and remediation activities	E	8.6263	6.681	10638	31.1175	36.691	11.9547
Construction	F	11.4747	17.5607	10178	23.8357	25.8691	17.0954
Wholesale and retail trade; repair of motor vehicles and motorcycles	G	6.5463	24.8717	10765	25.2832	24.8749	15.413
Transportation and storage	H	7.7213	6.9893	9425	23.2215	31.6897	14.3226
Accommodation and food service activities	I	5.7303	10.9753	11036	25.6121	34.0553	15.0736
Information and communication	J	7.0788	13.26	10008	24.5074	24.0781	13.8952
Real estate activities	L	3.9742	8.0687	16786	23.457	34.7238	10.8316
Professional, scientific and technical activities	M	8.7359	14.0452	7005	26.2612	24.8351	12.5526
Administrative and support service activities	N	7.737	11.3729	9060	18.2373	28.9199	9.4804
Public administration and defence; compulsory social security	O	8.6773	8.9755	7761	27.2433	25.0598	11.2626
Education	P	5.9451	12.8825	9430	24.3854	32.8755	14.2834
Human health and social work activities	Q	6.4028	9.7877	10015	23.3888	30.0125	18.7844
Arts, entertainment and recreation	R	4.7123	9.4891	8214	24.0998	20.9178	16.5217
Other service activities	S	7.8547	7.9886	10092	20.6953	28.6381	15.1451
Activities of households as employers; undifferentiated goods–	T	5.5453	11.0693	10724	27.2231	23.6315	9.0756
Activities of extraterritorial organisations and bodies	U	6.4375	9.8211	9409	25.2023	27.0204	10.9839
Others	Others	5.8421	5.0606	7570	22.5072	26.0597	16.6334

Table 4. Pearson correlation coefficients

This table presents Pearson correlation coefficients for the 129,888 firm–years across 16,236 UK SMEs over the period 2005–2014. Variables definitions are provided in Appendix A.

	IndAdjINV	SIZE	CRESERVE	COLL	INTCOV	AGE	INTANG	SGROWTH	R & D	NTC
IndAdjINV $_{t-1}$ (%)	1									
SIZE $_{t-1}$ (log)	0.0137	1								
	0.0000									
CRESERVE $_{t-1}$ (%)	0.0014	0.0294	1							
	0.0000	0.0000								
COLL $_{t-1}$ (%)	0.2612	0.2989	0.0022	1						
	0.0000	0.0000	0.0000							
INTCOV $_{t-1}$ (ratio)	0.0025	0.0115	0.0146	0.016	1					
	0.0000	0.0000	0.0000	0.0000						
AGE $_{t-1}$ (log)	0.0081	0.0179	–0.0021	–0.0082	–0.004	1				
	0.0000	0.0000	0.3388	0.0000	0.1098					
INTANG $_{t-1}$ (%)	–0.0832	0.0229	0.0009	0.1813	–0.0049	0.0056	1			
	0.0000	0.0000	0.6659	0.0000	0.0364	0.0037				
SGROWTH $_{t-1}$ (%)	–0.0059	0.0191	–0.0003	0.0153	–0.0007	–0.0025	0.0084	1		
	0.0066	0.0000	0.0914	0.0000	0.8098	0.2640	0.0002			
R & D $_{t-1}$ (%)	–0.0018	–0.0183	–0.0182	–0.0032	–0.0097	–0.0016	0.0019	0.0008	1	
	0.3815	0.0000	0.0000	0.1202	0.0002	0.4656	0.0000	0.7438		
NTC	–0.0011	0.0006	–0.0001	0.0031	0.0000	–0.0024	–0.0006	–0.0001	0.0000	1
	0.0075	0.0094	0.0074	0.0705	0.0089	0.1847	0.7366	0.9578	0.9918	

Table 5. Inventory investment and access to finance

This table reports the fixed effects inventory investment regressions for the 129,888 firm−years across 16,236 UK SMEs over the period 2005−2014, with *p-values* (reported in parentheses). The dependent variable is the industry adjusted inventory investment in columns 1 to 8. Variable definitions are provided in Appendix A. The independent variables are lagged by one year period with respect to the dependent variable. Panel A reports the estimation of the financial measures, and Panel B the estimation of the financial constraint faced by SMEs [see Equation (2)]. In panels A, Finance measures the level of access to finance based on the four criteria listed above. In Panel B, Finance X D is a dummy variable taking value one if the corresponding firm-year observation is financially constrained and 0 otherwise.

Variables	Panel A Access to finance ratios				Panel B. Access to finance ratios			
	(1) SIZE (log)	(2) CRESERVE (%)	(3) COLL (%)	(4) INTCOV (ratio)	(6) SIZE (log)	(6) CRESERVE (%)	(7) COLL (%)	(8) INTCOV (ratio)
$Finance_{t-1}$	0.0482***	0.0953***	0.1312***	0.0701***	0.0493***	0.0948***	0.1342***	0.0793***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Finance_{t-1}$ X D					–0.0390***	–0.0238***	–0.0367***	–0.0256***
					(0.000)	(0.000)	(0.000)	(0.000)
$Firm\ age_{t-1}$	0.0212***	0.0184***	0.0143***	0.0144***	0.0209***	0.0190***	0.0134***	0.0148***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Intangible\ assets(\%)_{t-1}$	–0.1520***	–0.1710***	–0.0574***	–0.1950***	–0.1501***	–0.1682***	–0.0659***	–0.204***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Sales\ growth(\%)_{t-1}$	–0.0006*	–0.0004*	–0.0745***	–0.0046***	–0.0110***	–0.0108***	–0.0639***	–0.0926***
	(0.073)	(0.075)	(0.000)	(0.006)	(0.003)	(0.004)	(0.000)	(0.000)
$R\ \&\ D(\%)_{t-1}$	–0.0001	–0.0001	–0.0001	–0.0001	–0.0001	–0.0001	–0.0001	–0.0001
	(0.142)	(0.143)	(0.147)	(0.142)	(0.155)	(0.154)	(0.156)	(0.153)
$Net\ trade\ credit_{t-1}$	–0.0427***	–0.0374***	–0.0525***	–0.0421***	–0.0400***	–0.0338***	–0.0513***	–0.0393***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm−and year−fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R−square	0.0252	0.1081	0.0283	0.0300	0.0248	0.0336	0.1127	0.0533
N	92,663	92,663	92,663	92,663	92,663	92,663	92,663	92,663

Table 6. Inventory investment, access to finance and SMEs profitability

This table reports the fixed effects return on assets regressions for the 129,888 firm−years across 16,236 UK SMEs over the period 2005−2014, with *p-values* (reported in parentheses). The dependent variable is the return on assets in columns 1 to 8. Variable definitions are provided in Appendix A. The independent variables are lagged by one year period with respect to the dependent variables. Panel A reports the estimation of the financial measures, and Panel B the estimation of the financial constraint faced by SMEs [see Equation (2)]. In panels A, Finance measures the level of access to finance based on the four criteria listed above. In Panel B, Finance X D is a dummy variable taking value one if the corresponding firm-year observation is financially constrained and 0 otherwise. Control variables in Panels A and B are the same as in Table 5. Υ refers to the coefficient estimate of the corresponding variable. Intercepts are omitted because of space constraints.

Variables	Panel A. Access to finance				Panel B. Access to finance			
	(1) SIZE (log)	(2) CRESERVE (%)	(3) COLL (%)$_t$	(5) INTCOV (ratio)	(6) SIZE (log)	(7) CRESERVE (%)	(8) COLL (%)	(10) INTCOV (ratio)
IndAdjINV $_{t-1}$, Υ_1	–0.0474***	–0.0393***	–0.0312***	–0.0362***	–0.0466***	–0.0336***	–0.0383***	–0.0382***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IndAdjINV $_{t-1}$ X Finance $_{t-1}$, Υ_2	0.0309***	0.0105***	0.0077***	0.0213***				
	(0.000)	(0.000)	(0.000)	(0.000)				
Finance $_{t-1}$,	0.0937***	0.0382***	0.0871***	0.0154***				
	(0.000)	(0.000)	(0.000)	(0.000)				
IndAdjINV(%)$_{t-1}$ X Finance $_{t-1}$ X D, Υ_2					–0.0053***	–0.0130***	–0.0122***	–0.0110***
					(0.007)	(0.000)	(0.000)	(0.000)
Finance $_{t-1}$ X D					–0.0341***	–0.0676***	–0.0912***	–0.0388***
					(0.000)	(0.000)	(0.000)	(0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm−and year−fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R−square	0.0548	0.0529	0.0550	0.0314	0.0658	0.0231	0.0478	0.0474
N	92,663	92,663	92,663	92,663	92,663	92,663	92,663	92,663
$\Upsilon_1 + \Upsilon_2$	7.84***	5.71***	9.95***	8.21***	27.91***	45.53***	27.71***	88.34***

Table 7. Speed of Adjustment to Target Inventory

This table presents the regression results for the partial adjustment model of inventory holding for the 129,888 firm-years across 16,236 UK SMEs over the period 2005−2014. It reports the estimated speed of adjustment, showing how fact financially constrained and unconstrained firms adjust toward their respective target level of inventory holding. Panel A presents the results for the full sample of constrained and unconstrained firms. Panel B provides the results for the subsample with below-target inventory. Panel C reports the results for the subsample with above-target inventory. The dependent variable, ΔINV_{it}, is the change in inventory. The independent variable, $INV_{it}^* - INV_{i,t-1}$, is the deviation from target inventory, where INV_{it}^* is the estimated target inventory. *p*-value of Chow test of differences in the adjustment speed estimates are reported in brackets. *p*–values are in parentheses below coefficients.

Panel A: Full Sample

	Constrained firms ΔINV (%)	Unconstrained firms ΔINV (%)	F−stat Chow test [p−value]
$INV_{it}^* - INV_{it-1}$	0.5881***	0.7722***	61.7265
	(0.000)	(0.000)	[0.000]
_cons	0.0713***	0.1740***	
	(0.000)	(0.000)	
Adjusted R^2	0.6436	0.8132	
N	50,138	68,059	

Panel B: Firms with Below-target Inventory

	Constrained firms ΔINV (%)	Unconstrained firms ΔINV (%)	F−stat Chow test [p−value]
$INV_{it}^* - INV_{it-1}$	0.6312***	0.7325***	66.1756
	(0.000)	(0.000)	[0.000]
_cons	0.0843***	0.0910***	
	(0.000)	(0.000)	
Adjusted R^2	0.7143	0.7432	
N	28,671	42,698	

Panel C: Firms with Above-target Inventory

	Constrained firms ΔINV (%)	Unconstrained firms ΔINV (%)	F−stat Chow test [p−value]
$INV_{it}^* - INV_{it-1}$	0.5764***	0.8112***	72.5476
	(0.000)	(0.000)	[0.000]
_cons	0.0610***	0.1012***	
	(0.000)	(0.000)	
Adjusted R^2	0.6531	0.8712	
N	21,467	25,361	

Table 8. Inventory investment during financial crisis

This table reports the fixed effects inventory investment regressions for the 129,888 firm−years across 16,236 UK SMEs over the period 2005−2014, with *p-values* (reported in parentheses). The dependent variable is the inventory investment in columns 1 to 8. Variable definitions are provided in Appendix A. The independent variables are lagged by one period with respect to the dependent variables. In panels A, Finance measures the level of access to finance based on the four criteria listed above. In Panel B, Finance X D is a dummy variable taking value one if the corresponding firm-year observation is financially constrained and 0 otherwise. Control variables in Panels A and B are the same as in Table 5. ϒ refers to the coefficient estimate of the corresponding variable. Intercepts are omitted because of space constraints.

Variables	Panel A. Access to finance				Panel B. Access to finance			
	(1) SIZE (log)	(2) CRESERVE (%)	(3) COLL (%)	(4) INTCOV (ratio)	(5) SIZE (log)	(6) CRESERVE (%)	(7) COLL (%)	(8) INTCOV (ratio)
Finance $_{t-1}$, Υ_1	0.0463***	0.0735***	0.1402***	0.0591***	0.0419***	0.0731***	0.1461***	0.0526***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Finance $_{t-1}$ X Crisis $_{t-1}$, Υ_2	–0.0118***	–0.0114***	–0.0136**	–0.0153***				
	(0.000)	(0.000)	(0.000)	(0.000)				
Crisis $_{t-1}$	–0.0521***	–0.0123***	–0.0876**	–0.0477***	–0.0591***	–0.0143***	–0.0853***	–0.0474***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Finance $_{t-1}$ X D X Crisis $_{t-1}$, Υ_2					–0.0075***	–0.0069***	–0.0054***	–0.0020***
					(0.005)	(0.006)	(0.007)	(0.010)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm− and year− fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R−square	0.0495	0.0472	0.0499	0.0853	0.0619	0.0535	0.0734	0.0730
N	92,663	92,663	92,663	92,663	92,663	92,663	92,663	92,663
$\Upsilon_3 + \Upsilon_5$	4.43**	3.69**	7.77***	6.48***	22.20***	45.45***	24.80***	79.78***

Table 9. Inventory investment, access to finance and SMEs profitability during financial crisis

This table reports the fixed effects inventory investment regressions for the 129,888 firm−years across 16,236 UK SMEs over the period 2005−2014, with *p-values* (reported in parentheses). The dependent variable is the inventory investment in columns 1 to 8. Variable definitions are provided in Appendix A. The independent variables are lagged by one period with respect to the dependent variables. In panels A, Finance measures the level of access to finance based on the four criteria listed above. In Panel B, Finance X D is a dummy variable taking value one if the corresponding firm–year observation is financially constrained and 0 otherwise. Control variables in Panels A and B are the same as in Table 5. Υ refers to the coefficient estimate of the corresponding variable. Intercepts are omitted because of space constraints.

Variables	Panel A. Access to finance				Panel B. Access to finance			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SIZE (log)	CRESERVE (%)	COLL (%)	INTCOV (ratio)	SIZE (log)	CRESERVE (%)	COLL (%)	INTCOV (ratio)
Crisis	–0.0019**	–0.0062***	–0.0096***	–0.0017**	–0.0096***	–0.0090***	–0.0172***	–0.0062***
	(0.011)	(0.008)	(0.000)	(0.012)	(0.000)	(0.000)	(0.000)	(0.006)
IndAdjINV $_{t-1}$, Υ_1	–0.0423***	–0.0376***	–0.0383***	–0.0312***	–0.0403***	–0.0383***	–0.0325***	–0.0342***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IndAdjINV $_{t-1}$(%) X Finance, Υ_2	0.0318***	0.0117***	0.0063***	0.0221***				
	(0.000)	(0.000)	(0.000)	(0.000)				
IndAdjINV $_{t-1}$(%) X Finance, X Crisis, Υ_3	–0.0104***	–0.0049***	–0.0033***	–0.0048***				
	(0.000)	(0.008)	(0.009)	(0.008)				
Finance $_{t-1}$	0.0943***	0.0318***	0.0892***	0.0172***				
	(0.000)	(0.000)	(0.000)	(0.000)				
IndAdjINV $_{t-1}$(%) X (Finance X D), Υ_2					–0.0101***	–0.0035***	–0.0032***	–0.0098***
					(0.000)	(0.009)	(0.009)	(0.000)
IndAdjINV $_{t-1}$(%) X (Finance X D) X Crisis, Υ_3					–0.0040***	–0.0005**	–0.0007**	–0.0003**
					(0.008)	(0.025)	(0.027)	(0.029)
Finance $_{t-1}$ X D					–0.0354***	–0.0619***	–0.0943***	–0.0367***
					(0.000)	(0.000)	(0.000)	(0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm− and year− fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R−square	0.0740	0.0761	0.0741	0.0329	0.0235	0.0584	0.0624	0.0513
N	92,663	92,663	92,663	92,663	92,663	92,663	92,663	92,663
$\Upsilon_1 + \Upsilon_2$	5.12***	7.01***	4.75**	5.27***	29.03***	46.45***	19.12***	17.19***
$\Upsilon_2 + \Upsilon_3$	4.55**	4.81**	8.93***	7.78***	27.44***	18.02***	16.74***	13.31***