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Financial constraints on investment: Effects of firm size and the financial crisis

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ABSTRACT

We estimate the effect of external financial constraints on fixed investment intentions for UK manufacturing by size of firm distinguishing between normal effects and those since the financial crisis began in the UK in 2007. Our financial constraints data are constructed to reflect only supply-side influences *i.e.* they are independent of cyclical conditions that may affect the demand for credit. Using consistent quarterly long run survey data with IV estimation, we find that only for the crisis period are financial constraints important for large firms and then only for periods of falling business optimism. By contrast, small firms experienced continuous constraint but with no additional supply side effects during the crisis. A policy implication for the UK is that the key to resumed lending may lie not so much with bank behaviour as with the demand conditions that firms face, in particular the sustainability and certainty of demand.

1. Introduction

The financial crisis that affected the UK from 2007-8 involved a shock, not only to credit supply but also to credit demand. The changed conditions represent an opportunity to study the long-debated question about the availability of credit to small and large enterprises and in particular the controversy over whether small firms face particular difficulties in accessing finance for expansion both in normal times and under conditions of general credit constraints that characterise a financial crisis. The latter issue is important for forward-looking assessment of financial indicators such as firm-level Beta in periods when there is an expectation that general credit conditions may worsen. It is also important for policy-makers seeking to understand whether constraints on capital investment should be attributed to credit availability or to other influences.

During the Financial Crisis, UK capital investment fell sharply with a fall of more than a quarter between the end of 2007 – when the failure of Northern Rock initiated the first leg of the UK crisis - and 2009. The recovery was slow by historical standards and by comparison with the US and Germany; six years after the onset of the crisis investment was still more than 12% below pre-crisis levels (Oxford Economics, 2013, p.31). Many commentators have attributed the slow recovery to the banks' reluctance to provide finance, especially to small and medium firms (SMEs). Other accounts, however, see investment as more constrained by real economy issues such as firm-level uncertainty or corporate governance influences (Salaheen et al 2017; Driver and Guedes, 2017).

Financial constraints are often seen as generated by asymmetric information held by banks, one result of which is to disrupt the normal market mechanism of pricing loans by risk. An adverse selection effect operates whereby the weight of the most risky borrowers may increase with interest rates, thus rendering allocation by rationing more effective (Stiglitz and Weiss, 1981). The counter narrative of the Keynesian literature sees the possibility of financial constraints even in a world of symmetric information

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with rationing due to the endogenous creation of money by commercial banks and the need to curtail credit when lending booms end (McLeay et al., 2014). While the asymmetric story tends to focus attention on small firms for whom it may be uneconomic to monitor intensively, the financial crisis showed that financial constraints operated more broadly and were felt by firms large enough to support bond ratings and to be amenable to low cost monitoring. The cross-country study of Beck et al (2005) finds support for both these narratives in the period up to 1999; in that study, finance constraints – which are found to affect small firms most - reflect both relational variables (paper work, special connections, persuasive collateral) as well as macroeconomic drivers such as interest rates and a lack of supply capacity in the banking system.

The pattern of financial constraints may differ from normal in a financial crisis. Small firms will normally have "constrained access to lines of credit" especially when the banking system is concentrated as in the UK (Han et al., 2015, p.3.). It is unclear whether this effect is intensified in a crisis period. The UK Financial Conduct Authority has investigated one large bank and found there to be systemically poor treatment of small business customers in the recovery period following the crisis. But there seems only anecdotal evidence that, in general, SME credit constraints "…became acute after the financial crisis in 2008″ (Mayer, 2013 p.134). There is some hard evidence of immediate lower credit provision for SMEs in the early part of the crisis but it remains unclear whether this was particularly sharp for SMEs or indeed to what extent it reflected demand, or supply, influences. Nevertheless, the policy response by public agencies was sympathetic to a supply-constrained interpretation and, in the 2014 UK Budget, a consultative review was set up to address concerns that the top four banks - accounting for 80% of lending to SMEs - were not facilitating enough credit (HM Treasury, 2014). This report focused on the difficulty of switching between financial providers, while remaining (as so many previous studies) agnostic as to whether banks actively discriminate against SME's (Cosh et al., 2009; Breedon, 2012).[1]

In this article we investigate how financial constraints have affected the investment behaviour of groups of large and of small firms in UK manufacturing, contrasting the period from the onset of the financial crisis with a longer sample. We focus in particular on the constraining role of *external* finance and its differential effect on groups of small and large firms. In particular we find that credit constraints for large and small firms diverged during the financial crisis in a way that disadvantaged large firms more. Nevertheless, this is in a context of pre-crisis constraints on the small-firm group not observed for the large-firm group. Our study also addresses the question of whether any perceived constraint experienced by either small or large firm groups can be attributed to demand side or supply-side influences.

We use a single consistent survey data set to explore these questions. While survey data is often distrusted due to the lack of incentives for truthful answers, the particular data set that we use here has been subjected to considerable scrutiny by statistical bodies over many years and we report evidence of its robustness later in the paper. The remainder of the paper is organised in sections 2–7 detailing: (2) previous literature findings; (3) the hypotheses to be tested; (4) data sources and testing strategy; (5) specification; (6) results and discussion and (7) conclusions.

2. Previous literature: a selective review

The literature, on the whole, supports the finding that small firms find it more difficult to access finance. This has been established both in survey-based literature for the EU (Canton et al., 2012) and in many econometric studies in macroeconomics and finance. The econometric approach has mostly consisted in measuring the response to cash flow of fixed capital spending, inventory investment, or R&D on the assumption that the response coefficient captures information on financial constraints (Carpenter and Petersen, 2002; Bond et al., 2003). The underlying theory is that this coefficient will lose significance when good access to capital markets allows firms to seamlessly substitute external funding for internal funding. The coefficient on cash flow for US investment has declined over time and is now insignificant, reflecting a greater provision of equity finance. However, for small firms the coefficient still appears to be positive and significant (Brown and Petersen, 2009).[2]

Some authors view the pattern and severity of financial constraints as reflecting institutional differences such as the extent of bank-based lending, with SME bank finance less constrained in normal times but more so when banks themselves are distressed (Baum et al., 2011). Others differentiate between types of banks with those labelled relationship banks better able to support SMEs in crisis times, but not necessarily more supportive in normal times (Beck et al., 2018).

2.1. EU studies pre-crisis

For the EU area, most econometric work finds that small firms' investment, at least in some countries, is affected by credit constraints or the cost of credit. Nevertheless, comparisons are difficult due to different definitions of size categories (Butzen et al., 2003; Chatelain et al., 2003; Mizon and Vermeulen, 2005). For Germany, it has been argued that financial constraints apply most to

[1] The observation of supply constraints for small firms after the crisis may also reflect that if anything SME funding may have been too *easy* in boom periods in the UK (Hughes, 1997). On this account the policy challenge is to smooth this cycle through better intermediation and scrutiny *e.g.* via co-operative or mutual guarantee schemes and plural sources of finance such as equity, aggregated bond facilities, and peer to peer lending (Hutton and Peasnell, 2011; Breedon, 2012).

[2] In the remainder of this section we focus mostly on the EU and UK. Time series evidence on other countries including The US and Japan is presented in OECD (2015).We do not engage here with the complex debates over the interpretation of the cash flow coefficient following the initial contribution by Fazzari et al (1988). For an overview and critique see Lewellen and Lewellen (2011); D'Espallier and Guariglia (2015); Farre-Mensa and Ljungqvist (2015). Alternative indirect metrics of financial constraint categorising firms by variables such as leverage, cash holdings and dividends have also be argued to be uninformative (Hadlock and Pierce, 2010).

medium sized businesses as small firms benefit from competitive savings banks, while large firms tend not to be dependent on bank credit (Audretsch and Elston, 2002). For the EU area generally, Canton et al (2012) report on direct perceptions of firms, investigating perceived constraints on access to bank credit before 2008. Noting that asymmetry is associated with smaller firms due to lower transparency, lower collateral, less reputation, and higher unit monitoring costs, these authors establish that self- perceived constraints are indeed higher for smaller firms within the general class of SMEs.

2.2. UK studies pre-crisis

Specific work for the UK suggests that small firms *increased* their access to finance during the 1990s (Lund and Wright, 1999). This is confirmed in Angelopoulou and Gibson (2009) who nevertheless find continuing supply-side constraints, especially for small firms. The continued existence of financial constraints is also noted in Guariglia (1999) who modified the approach of Gertler and Gilchrist (1994) to establish that financially constrained and unconstrained samples exhibited distinct inventory investment behaviour. Size also seems to matter in determining firms' choice of capital intensity in times of financial constraint (Spaliara, 2011). Other work (using the same data source as this paper) finds a correspondence between capacity constraints - indicating a lack of investment - and directly reported financial constraints (Kalckreuth, 2006). The author finds that small firms' periods of capacity shortage are prolonged by financial constraints – a result that is less significant for larger firms. However, the findings here are sometimes subtle: small firms tend to exit from capacity constraints faster than larger firms, apparently reflecting the type of sector that they populate.

2.3. Financial constraints since the crisis

Since the financial crisis of 2007/8 there has been a raft of further work on whether investment constraints reflect demand side influences, a bank credit squeeze, or difficulty in raising finance generally (Duchin et al., 2010; Bo et al., 2014). In the US case it has been noted that net equity issued by small firms after the crisis has also been unusually low, while company cash holdings have actually increased, suggesting that demand for finance is the major issue. Furthermore, firms that were more dependent on bank credit before the crisis were not those that reduced their capital investment disproportionately (Kahle and Stulz, 2011). The implication is that demand side issues such as risk attitude were more important and that credit was available at least for firms with strong balance sheets. Other authors, employing a global CFO study did find that constrained firms reduced investment plans significantly more than unconstrained ones; however, no differential effects of credit constraints were identified between firms with employment size above and below 500 (Campello et al., 2010).

For countries in the Eurozone, Vermoesen et al (2013) identified a credit supply constraint for Belgian SMEs during the crisis (in 2009). Within that sample of SMEs, those firms with long term debt that needed to be rolled over in the near-term had lower capital investment when they were assigned to categories likely to be financially constrained. The authors interpret this evidence as a negative credit supply shock to certain types of SMEs in the financial crisis. However, these authors also report survey evidence from the European Central Bank to the effect that credit was tightened more for *large firms* than for small firms in the crisis period, perhaps reflecting banks' own restricted funding and capital requirements. They conclude that *"it cannot be ruled out that the impact of the crisis on the availability of external finance was smaller for SMEs than for large firms."* (p. 5). A similar finding was obtained for private firms in Norway at the outset of the crisis, where it was shown that capital investment fell more for firms that were previously unconstrained financially (Hetland and Mjos, 2012). It seems that the pattern of how financial constraints operate in Europe is complex and diverse. Furthermore there is no consensus over whether perceived constraints reflect company fundamentals or are due to stress in the banking system (Bremus, 2015).

For the UK, a number of investigations have been undertaken without producing consensus. One study, using a crisis dummy variable with interactions identified a restriction on trade credit but not on debt levels during the crisis (Akbar et al., 2017). In another study, credit supply shocks were estimated to account for only one sixth of the output fall in the early crisis period (Finlay and Jääskelä, 2014). Some UK studies have attempted to use a double differencing approach to establish whether demand or supply influences are dominant determinants of change in the crisis period. Contrasting matched lending behaviour of constrained banks and non-constrained banks, a more conservative lending strategy after the crisis was observed for the former group (effectively those that had been rescued). Borrowers were assumed to be unable to switch credit supplier so that any observed effect can be viewed as a supply constraint. A post crisis differential fall in loans was observed for constrained bank clients. However, it is not clear whether that effect simply reflected the differential quality of pre-crisis loans. Subsequent productivity or capital intensity differences between clients of the different lender sets were not found to be significant, so no negative effects were directly demonstrated (Riley et al., 2014a). A similar approach is followed by Franklin et al (2015) using differential Credit Default Swap premia for different banks as an indicator of post-crisis lending capacity. The authors find that total debt and productivity grew less rapidly for firms banking with weaker banks. Nevertheless the finding, as with the case of Riley et al (2014a) do not control for the quality of pre-crisis loans made by the banks that cut back lending most in the post crisis period.

The UK evidence is therefore not entirely clear on the extent to which changes in bank lending can be attributed to credit supply shocks. Nevertheless the tenor of much of the policy discussion is exemplified in assessments such as that in the Breedon report (2012) that *"on balance the evidence would indicate some constraint in the supply of bank credit"* (p.13). This supply constraint arises both from business decisions by the banks themselves to strengthen balance sheets or exogenous influences such as new regulatory requirements.

2.4. Differential effect on small and large firms for the UK

Several UK studies have also investigated *differential* access to credit for small and large firms in the crisis period. Supply and demand indicators for bank and non-bank credit to non-financial firms have been published by size group in the Bank of England Credit Conditions Survey since 2009. Since this survey is aimed at credit providers it cannot identify effects such as discouraged borrowing - when expected rejection curtails loan applications (Kon and Storey, 2003; Freel et al., 2012). Discouraged borrowers are likely to be younger and smaller firms (Chakravarty and Xiang, 2013) but they may also be "self rationing" high-risk borrowers (Han et al., 2009). Survey data from 2012 suggests that three quarters of SME firms seeking external funds obtained them but that this is down from 90% before the credit crisis (BIS, 2012). It is possible therefore that the crisis created a discouraged borrower effect and it has been estimated to account for 2% of the 15% fall in term loans for 2008/9 compared with the previous five-year average (Fraser, 2013).

The Bank of England credit conditions data show that both large and small firms experienced falling applications *and* approvals of loans from 2009 but that there was more variability on the demand side. This is confirmed in Cowling et al. (2012) using the UK official Small Firm Barometer data. Perhaps surprisingly, the Bank's data show that is only for the large firm sample – in the years 2009/10 – that we observe any lengthy period of tightening of supply along with a rising demand for credit. Other data show a greater improvement in availability and approval of loans for small firms than for large firms between 2009 and 2012 (Oxford Economics, 2013).

The cost of finance for small firms, as represented by credit spreads is sometimes argued to help identify supply and demand influences. This spread has grown both absolutely and relatively to other firms from 2009, suggesting some tightening of credit conditions for small firms. It is possible, however, that this can be explained by variation in default risk and a lower value of collateral. Arguably the lower rates on offer for large firms are again a feature of competition in the market for loans where large firms do not feel any urgent need to access finance, given that their holdings of liquid assets have risen in recent years as they have held back from investment and acquisitions (Oxford Economics, 2013). In general, data on credit spreads are of limited use because the character and risk attributes of loans may be changing over time. Thus spreads may simply reflect variation in the quality of the units seeking and being offered credit. Because of these limitations, the UK credit conditions survey do not fully identify the reasons for lending variation. Furthermore, as the data sample is post-crisis, these Bank of England indicators are unhelpful in establishing what changes the crisis itself has brought about in the effects of credit conditions.

3. Investment and financial constraints in UK manufacturing: hypotheses

A priori, we would expect, for the UK case, that size would be an important discriminator of access to credit since small firms tend to lack credit ratings or good access to equity markets (Bougheas et al., 2006). To be sure, our small firm sample will contain some high growth firms (accounting for some 2% by number) that are thought to rely on equity, but it has been shown that such firms only turn to equity markets when debt capacity is limited (Vanacker and Manigart, 2010). Thus, we expect:

Hypothesis 1. Only small firms have a continuous financial constraint over the whole sample period.

The debt burden that banks consider tolerable depends on the value of collateral that falls in recessions and thus financial constraints may be aggravated at such times, an effect known as the financial accelerator first identified in US research (Gertler and Gilchrist, 1994; Bernanke et al., 1996).[3] It is usually assumed that the brunt of the effect is felt by those firms already financially constrained but in a context of a credit crunch rather than a cyclical downturn, the effect may be more general (Hetland and Mjos, 2012). Accordingly we propose:

Hypothesis 2. The financial crisis aggravated any existing financial constraints.

Where restricted funding arises largely through bank credit, the incidence of financial constraint may be affected by size. While large firms were, at the onset of the crisis, able to substitute both bond and equity finance for bank credit this was not the case for small firms in our sample (Bank of England, 2010). This suggests that the financial crisis may have manifested itself primarily through an increased credit constraint on small firms. However, as noted earlier, some survey evidence tends not to support this. We formulate:

Hypothesis 3A. The financial crisis negatively affected small firms' access to finance but not that of large firms.

Evidence reviewed earlier suggests that banks choose to ration on the basis of debt capacity rather than size alone. Given that banks will have allowed large and well collateralised firms to have the highest leverage, small firms may not have suffered any *additional* constraints, conditional on the cycle, in the crisis period. This leads to:

Hypothesis 3B. The financial crisis negatively affected large firms' access to finance but not that of small firms.

[3] Debt may also independently lower the demand for investment (Hernando and Martínez-Carrascal, 2008).

4. Data sources, specification and testing strategy

4.1. Data sample

Our data comes from the Industrial Trends Survey (ITS), a long-run quarterly database for UK manufacturing firms, disaggregated by size category and maintained by the main UK employers' organisation, the Confederation of British Industry (CBI), since its inception in 1958. It is a component part of the Eurostat harmonised surveys on business climate, detailed further in Driver et al (2005).[4] Questionnaires are targeted at chief executives, managing directors and finance directors and are "… generally replied to by a board member" (Lui et al., 2011, p.329). The sampling frame consists of a regular panel of 2200 firms and a different group of respondents (1000) contacted each quarter. The sample is stratified in a representative way by size. Sampling and processing procedures are detailed in CBI (2015) including an explanation of the weighting of the responses. The raw survey data are qualitative (usually coded –1, 0, +1) at firm level and are aggregated by the CBI survey unit into groups (including the size categories that we use here), by adding up the responses, weighted by percentage of the responding firm in sales volume (Mitchell et al., 2005). We inspected the data series for outliers checking for data points outside the interquartile range (IQR). All but a few data points in each case were within +/- 1 IQR and exceptions were all explainable as reflecting the period of the financial crisis for which an interactive dummy variable is employed (see Section 5). Accordingly there was no need for winsorization.

The data sample is for 101 quarters from 1987 Q2 to 2012 Q2.[5] The CBI Industrial Trends Survey questions used in this work are:

Question 1: Are you more, or less, optimistic than you were three months ago about the general business situation in your industry? (Possible choices: *more* or *same* or *less* or *n/a*).

Question 3b: Do you expect to authorise more or less capital expenditure in the next twelve months than you authorised in the past twelve months on: plant and machinery? (Possible choices: *more* or *same* or *less* or *n/a*).

Question 4: Is your present level of output below capacity (*i.e.*, are you working below a satisfactory full rate of operation)? (Possible choices: *yes* or *no* or *n/a*).

Question 8: Excluding seasonal variations, what has been the trend over the PAST THREE MONTHS, and what are the expected trends for the NEXT THREE MONTHS, with regard to: volume of output? (Possible choices: *up* or *same* or *down* or *n/a*).

Question 16c: What factors are likely to limit your capital expenditure authorisations over the next twelve months? (Possible choices: inadequate net return; internal finance shortage; inability to raise external finance; cost of finance; uncertainty about demand; labour shortage; other)

A large literature has considered the best transformation to convert these series to quantitative indicators (European Commission, 1997; see also Lamont, 2000). For the directional responses, the balance of the aggregated data (*up* minus *down*) may be interpreted as an index of the growth rate of the underlying variable which are generally stationary (Smith and McAleer, 1995; Driver and Urga, 2004). We use the following transformations:

CAPEX: Balance of *more* over *less* for Question 3b.

OPT: Balance of *more* over *less* for Question 1.

OUTNEXT: Balance of *up* over *down* for Question 8 NEXT

OUTPAST: Balance of *up* over *down* for Question 8 PAST

CAPUTIL: Logit transformation of the count variable (percentage) responding "*no*" to Question 4

FINCAP: Percentage of respondents responding "*Inability to raise external finance*" *to* Question 16c

The survey data source used in this paper has been extensively used in academic research (Mitchell et al., 2005; Kalckreuth, 2006 Lui et al., 2011). What makes it particularly useful for the purposes of this paper is that it also provides matched data on capital investment intentions, indicators of business optimism, and financial constraints. A natural concern with survey data is the representativeness of the sample and also the accuracy of the replies, absent incentives for respondents to reply truthfully. Nevertheless, survey expectations have often been shown to be internally consistent (Dominitz and Manski, 1997; Dominitz, 1998) and are often characterised by a close correspondence between expectations and outcomes (European Commission, DG2 1997). Many macro variables in common use are survey-based (Thaler, 2015).

In our study, access to the micro data was not possible due to confidentiality. Our estimation is based on variables obtained by aggregating the micro data from the survey into small and large size classes. However historical micro data has previously been made available to the Director of the National Institute of Economic Research (UK) to assess the accuracy and predictive performance of these survey data, an important issue, given their use in several macroeconomic models. This research found that the retrospective qualitative data from the CBI survey responses "plainly related" to the responses that the same firms gave for survey questions underlying official production statistics and that "confidence can be placed in the responses to questions that have no counterpart in official enquiries" (Lui et al., 2011, p.346). In keeping with other previous work, this research concluded that the CBI data "offers valid indicators of the business environment." (p.346).

Our data are aggregated up into size classes by the CBI. This will have some disadvantages. In particular, the distribution of shocks across individual micro units are not captured and such variation is known to generate time-varying elasticities (Haltiwanger, 1997).

[4] For information on how the data is used by the EC see: http://ec.europa.eu/economy_finance/db_indicators/surveys/index_en.htm.

[5] Prior to this starting date the format of some of the survey questions was different. The end date in 2012 is justified by the extended period over which financial constraints lasted. "The cost of new [Bank] borrowing relative to Bank Rate peaked in around early 2009 and has since declined, albeit with a further rise in 2011 and 2012 in response to the effects of the Euro Area crisis on UK banks." (Riley et al., 2014b).

However to fully resolve this would require access to establishment data whereas the CBI micro-data corresponds to enterprises and groups. Use of micro-data may also introduce measurement error which can cancel out under aggregation (Bound et al., 2001 p.3830) so that it remains unclear in principle which level of aggregation is best. Using standard predictability tests it has been found that disaggregate forecasts outperform aggregate ones for manufacturing output growth on an in-sample basis. Out-of-sample the evidence is mixed "…with only the non-parametric disaggregate indicator providing more accurate forecasts than those of the aggregate indicators."(Mitchell et al., 2005 p. 496). We can reasonably assume therefore that our aggregated size categories contain information useful for the present study.

4.2. Testing strategy

We use the transformed variables described above to estimate investment authorisation equations with business optimism as the main conditioning variable. This may be regarded as a type of accelerator equation with the forcing variable a composite indicator of factors such as sales and financing costs which are well captured by the optimism variable, as shown in Driver (2007). This specification for an investment equation follows the arguments in Chirinko (1993) that direct forward looking expectations are a good alternative to implicit models such as those based on the Euler equation or Q models using stock market data.

We included in the specification a variable on financial constraints constructed from directly reported responses in the CBI survey but transformed so as to be independent of the economic cycle. This procedure avoids conflating the supply-side financial constraint with cyclical factors such as demand influences that are captured by the business optimism variable. Specifically we obtained the residual ($\hat{FINCAP}$) from a regression of the financial constraint data (FINCAP, detailed above) on two own lags and the survey-recorded data of capacity utilisation (CAPUTIL).[6] The latter is expressed as a logit to remove skewness, given that it is constructed as a count variable. Our testing strategy is not to focus on the financial accelerator effect but to identify whether, independently of the demand cycle, the credit stance of banks and other intermediaries, reflecting their own lending strategies and capacities to lend, has affected the investment of manufacturing firms, both large and small. To establish whether the coefficient on this financial constraint variable changed for either of the size groups after the financial crisis, we interact variables with a step dummy for the UK financial crisis (post Q3 2007).

The additional variables required for the financial constraints are detailed below

FINCAP: Residual from an auto-regression, order 2, of FINCAP augmented by CAPUTIL

iFINCAP: interaction of ***FINCAP*** variable with a step dummy for the UK financial crisis (post 2007Q3)

We also utilise a double interaction detailed below:

i ***FINCAP*** *up*: interaction of ***FINCAP*** variable with a step dummy for the UK financial crisis (post 2007Q3) and a dummy equal to one when $OPT \geq 0$

i ***FINCAP*** *dw*: interaction of ***FINCAP*** variable with a step dummy for the UK financial crisis (post 2007Q3) and a dummy equal to one when $OPT < 0$

The use of directly reported financial constraints may call for some discussion. A hard financial constraint may be defined as the case where a firm is unable to raise capital at any price when it tries to do so (Farre-Mensa and Ljungqvist, 2015). These authors cast doubt on some existing proxies for financial constraints, finding that: "supposedly constrained firms have no difficulty obtaining credit when their demand for debt increases exogenously as a result of a tax increase" (p.1). Such proxies include credit ratings, text-based metrics from analysing company accounts or reports; and indices based on a set of financial variables such as market-to-book ratios and leverage. Whatever the merit of this criticism, it does not directly apply to our data which captures the reply to the question of whether the firm is financially constrained in the sense of "inability to raise external finance". To be clear the questionnaire contains alternative replies allowing the respondent to record a constraint arising from a cost of finance or a shortage of internal finance. Our proxy therefore relies on much more specific information than that criticised in Farre-Mensa and Ljungqvist (2015).

5. Econometric specification

Our specification is derived from Blanchard and Fischer (1989, pp. 299–300). Maximising the value of the firm with capital as the only fixed factor subject to a production function with exogenous demand yields a closed form solution if the implied cost penalty being minimised is the discounted sum of out-of-equilibrium and capital adjustment costs. Under some plausible restrictions this reduces to a linear relationship between our survey measures of investment intentions (*CAPEX*) and profit expectations or business optimism (*OPT*) (Driver et al., 2005). We augment this relationship with a term in external finance constraint ($\hat{FINCAP}$), defined earlier as a cyclically adjusted version of the survey response on financial constraints. The specification is completed by adding interaction terms for the period after the onset of the UK financial crisis (Q3 2007), indicated by a lower case *i* before the variable, *e.g.* *i* $\hat{FINCAP}$ represents the interaction of the $\hat{FINCAP}$ variable with the post 2007 dummy. The same specification is used for each of the

[6] Given that the $\hat{FINCAP}$ measures are generated variables, constructed as a residual from a regression, there may be a concern that the standard errors are underestimated (Pagan, 1984; Murphy and Topel, 1985). Much of the literature on this deals with methods to correct it for large samples where asymptotic properties are assumed. Re-estimation of a small sample in Barro (1977) by Murphy and Topel (1985) shows that the three terms representing the generated variable have t-values in the main regression that are on average 20% less than the corrected t-values. Were a similar correction to be applied to our case, it would not substantially change the conclusions drawn from the results tables.

Table 1
Time Series Descriptive Statistics Quarterly observations, data sample from 1987 Q2 to 2012 Q2.

Variable	Small Firm Group				Large Firm Group				Mean difference test small *vs.* large firms
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	
CAPEX	−8.030	15.221	−45	21	−5.079	21.187	−75	33	−2.951**
OPT	−11.040	22.496	−64	36	−10.911	22.827	−71	29	−0.129
OUTNEXT	3.178	15.356	−43	37	6.386	17.351	−61	40	−3.208**
OUTPAST	−3.248	17.712	−51	33	1.287	19.548	−58	38	−4.535***
CAPUTIL	−0.482	0.410	−1.276	0.532	−0.371	0.587	−3.178	0.847	−0.111***
$\hat{FINCAP}$	0.010	1.383	−4.251	5.401	−0.003	3.158	−5.520	15.044	0.013

The number of observations is 101. ***CAPEX***: Balance of *more* over *less* for Question 3b CBI Industrial Trends Survey. ***OPT***: Balance of *more* over *less* for Question 1. ***OUTNEXT***: Balance of *up* over *down* for Question 8 NEXT. ***OUTPAST***: Balance of *up* over *down* for Question 8 PAST. ***CAPUTIL***: Logit transformation of the count variable (percentage) responding *no* to Question 4. ***FINCAP***: Balance of answers Inability to raise external finance Question 16c. $\hat{\boldsymbol{FINCAP}}$: Residual from an autoregression, order 2, of **FINCAP** augmented by CAPUTIL. $\boldsymbol{i}\,\hat{\boldsymbol{FINCAP}}$: interaction of $\hat{\boldsymbol{FINCAP}}$ variable with a step dummy for the UK financial crisis (post 2007Q3). Mean difference test between small and large firms, with*** mean difference significant at 1%, ** significant at 5% and * significant at 10%.

two size groups.[7]

Estimation by OLS will lead to endogeneity bias as the optimism variable is likely to co-vary with the investment decision, so that there is a need to find suitable instruments for the recorded optimism. Fortunately there are at least two previous contributions that suggests a choice of instruments. An early special survey by the CBI itself found that optimism primarily reflected future demand, with interest rates being a second concern - this was a period of high real rates - while domestic politics and exchange rates were mentioned as minority concerns (Junankar, 1989). A later paper published by the Institute for Fiscal Studies reported estimation of the optimism variable disaggregated by size with OLS and SURE. This confirmed that past and future demand indicators were the main drivers for all size groups with weak significance for the real interest rate (Driver, 2007). In the light of this evidence we instrumented optimism by the first lag of the survey-based indicator of reported past output growth ($OUTPAST_{t-1}$) and the contemporaneous indicator of output growth expectations ($OUTNEXT_t$). The financial constraint variables ($\hat{FINCAP}$) are not instrumented as they are constructed as a residual from a regression on a capacity utilisation index and two lags of the dependent variable. The IV equations system is thus specified for each of the two size groups as:

$$CAPEX_t = \beta_0 + \beta_1 CAPEX_{t-1} + \beta_2 iCAPEX_{t-1} + \beta_3 OPT_t + \beta_4 \hat{FINCAP}_t + \beta_5 \hat{FINCAP}_{t-1} + \beta_6 i\hat{FINCAP}_t + \beta_7 i\hat{FINCAP}_{t-1} + \varepsilon_t$$

$$OPT_t = \alpha_0 + \alpha_1 OUTNEXT_t + \alpha_2 OUTPAST_{t-1} + e_t$$

Descriptive statistics for each time series of the size groups are given in Table 1. This shows that for the optimism variable there are similar statistics (mean and SD) for both large and small firms with a consistent bias towards pessimism. There are differences between large and small firms in the balance of up- over - down expectations for the past and the future volume of output. The small firms' group report half the expected trend of output compared to large firms. Moreover, the mean balance of the past 3 months is negative for small firms reflecting the fact that sharp falls in output for extreme cases are not smoothed by aggregation as they would be for larger units. In general, differences in means between the two samples are statistically significant except for the optimism variable.

Table 2 contains the correlation matrices for the full period and the period up to the financial crisis. It may be seen that the correlations for the small firms' variables are higher than those for the large firms' variables (in absolute terms) with the exception of $\hat{FINCAP}$.

6. Results and discussion

Table 3 reports IV investment equations. For both sets of firms, Table 3 shows a high F-statistic for *OPT (significant at the 0.1% level)*, obtained in the first stage regression. This indicates no weak instruments and we therefore focus on the IV results, with the OLS results reported in Appendix A, Table A1 for reference. The need for robust estimators is indicated by the Breusch-Pagan/Godfrey statistics test which fails to reject heteroscedasticity in the IV equations. Accordingly, robust standard errors are reported throughout. The Hansen-Sargan test (consistent in the presence of heteroscedasticity) rejects correlation between the error term and the instruments.

Comparing the results across the two size samples, the adjustment speed, indicated by the lagged dependent variable is slightly

[7] The small firms group corresponds to the firm size category 1 to 200 employees. However, the CBI data source underrepresents very small firms (< 10 employees) and start-ups. Given the upper size limit, they may also contain what would be regarded in other work as medium-sized firms. The large firms correspond to the size category 500-5000 employees. We omit the largest firm category because there are few such firms and the intermediate size is not reported as the results are uninformative and interpretable as a mixture of the small and large results.

Table 2
Correlation Matrixes.

Small Firm Group

Data sample from 1987 Q2 to 2012 Q2							Data sample from 1987 Q2 to 2007 Q2					
	CAPEX	OPT	OUTNEXT	OUTPAST	CAPUTIL	$\widehat{FINCAP}$	CAPEX	OPT	OUTNEXT	OUTPAST	CAPUTIL	$\widehat{FINCAP}$
CAPEX	1						1					
OPT	0.780***	1					0.787***	1				
OUTNEXT	0.913***	0.841***	1				0.908***	0.857***	1			
OUTPAST	0.890***	0.678***	0.834***	1			0.910***	0.60***	0.850***	1		
CAPUTIL	0.713***	0.442***	0.634***	0.795***	1		0.738***	0.365***	0.645***	0.799***	1	
$\widehat{FINCAP}$	0.030	0.049	0.006	0.030	0.006	1	0.190*	0.258**	0.168	0.155	0.087	1

* Correlation significant at 1%, ** significant at 5% and *** significant at 10%

Large Firm Group

Data sample from 1987 Q2 to 2012 Q2							Data sample from 1987 Q2 to 2007 Q2					
	CAPEX	OPT	OUTNEXT	OUTPAST	CAPUTIL	$\widehat{FINCAP}$	CAPEX	OPT	OUTNEXT	OUTPAST	CAPUTIL	$\widehat{FINCAP}$
CAPEX	1						1					
OPT	0.523***	1					0.569***	1				
OUTNEXT	0.680***	0.648***	1				0.509***	0.776***	1			
OUTPAST	0.671***	0.547***	0.702***	1			0.598***	0.577***	0.681***	1		
CAPUTIL	0.462***	0.351***	0.421***	0.546***	1		0.463***	0.155	0.398***	0.575***	1	
$\widehat{FINCAP}$	−0.262***	−0.258***	−0.326***	−0.187*	−0.001	1	−0.078	−0.201*	−0.031	−0.029	0.162	1

The number of observations is 101 for the full sample from 1987 Q2 to 2012 Q2 and 81 observations for the sample 1987 Q2 to 2007 Q2. *** Correlation significant at 1%, ** significant at 5% and * significant at 10%. ***CAPEX***: Balance of *more* over *less* for Question 3b CBI Industrial Trends Survey. ***OPT***: Balance of *more* over *less* for Question 1. ***OUTNEXT***: Balance of *up* over *down* for Question 8 NEXT. ***OUTPAST***: Balance of *up* over *down* for Question 8 PAST. ***CAPUTIL***: Logit transformation of the count variable (percentage) responding *no* to Question 4. ***FINCAP***: Balance of answers Inability to raise external finance Question 16c. $\widehat{\boldsymbol{FINCAP}}$: Residual from an autoregression, order 2, of ***FINCAP*** augmented by CAPUTIL. $\boldsymbol{i}$ $\widehat{\boldsymbol{FINCAP}}$: interaction of $\widehat{\boldsymbol{FINCAP}}$ variable with a step dummy for the UK financial crisis (post 2007Q3).

Table 3
Investment Equation (IV). $CAPEX_t = \beta_0 + \beta_1 CAPEX_{t-1} + \beta_2 iCAPEX_{t-1} + \beta_3 OPT_t + \beta_4 \hat{FINCAP}_t + \beta_5 \hat{FINCAP}_{t-1} + \beta_6 i\hat{FINCAP}_t + \beta_7 i\hat{FINCAP}_{t-1} + \varepsilon_t OPT_t$
$= \alpha_0 + \alpha_1 OUTNEXT_t + \alpha_2 OUTPAST_{t-1} + e_t$

	Small Firm Group			Large Firm Group		
Constant	0.48	0.56	0.47	2.39	3.52	2.39
CAPEX(-1)	0.55***	0.50***	0.55***	0.46***	0.39***	0.46***
iCAPEX(-1)	−0.59***	−0.50***	−0.58***	−0.10	−0.09	−0.10
OPT	0.49***	0.52***	0.49***	0.41***	0.57**	0.41***
$\hat{FINCAP}$	−1.01***	−0.97**	−1.06**	0.15		
$\hat{FINCAP}$(-1)	−1.53***		−1.61***	−0.02	0.11	
i$\hat{FINCAP}$	−0.16	0.08		−1.81		−1.66*
i$\hat{FINCAP}$(-1)	−0.25			−2.42**	−2.75*	−2.45**
Disturbance is homoscedastic Breusch-Pagan/Godfrey statistic	22.90***	21.68***	18.54***	16.77**	19.04***	16.64**
Hansen J-statistic	3.17*	3.17*	2.55	0.62	0.04	0.55
First-stage regressions of OPT F-test	40.52***	37.25***	44.33***	17.93***	16.82***	15.59***
Tests of endogeneity of *OPT* Durbin-Wu-Hausman	35.65***	38.38***	34.28***	3.88**	10.00***	3.73*
CAPEX(-1) + iCAPEX(-1) = 0	0.07	0.00	0.05	3.54*	1.33	3.49*
$\hat{FINCAP} = \hat{FINCAP}(-1) = 0$	16.55***		11.87***	0.04		
$i\hat{FINCAP} = i\hat{FINCAP}(-1) = 0$	0.04			5.92*		7.96**
$\hat{FINCAP} = \hat{FINCAP}(-1) = i\hat{FINCAP} = i\hat{FINCAP}(-1) = 0$	18.90***			7.99*		
Obs	101	101	101	101	101	101

Statistical significance is calculated using robust standard errors; *** significant at 1%, ** significant at 5% and * significant at 10%. The *Breusch-Pagan/Godfrey test* is used to test for the presence of heteroscedasticity. Under the null of no heteroscedasticity the error of the regression is normally distributed. Similar results were found with the *White/Koenker tests*, not included in the table. The *Hansen-Sargan* or *J-Test* for overidentying restrictions has a joint null hypothesis to test if the instruments are valid instruments - uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation- A rejection of the null questions the validity of the instruments. ***CAPEX***: Balance of *more* over *less* for Question 3b CBI Industrial Trends Survey. ***OPT***: Balance of *more* over *less* for Question 1. ***OUTNEXT***: Balance of *up* over *down* for Question 8 NEXT. ***OUTPAST***: Balance of *up* over *down* for Question 8 PAST. ***CAPUTIL***: Logit transformation of the count variable (percentage) responding *no* to Question 4. ***FINCAP***: Balance of answers Inability to raise external finance Question 16c. ***$\hat{FINCAP}$*** : Residual from an auto-regression, order 2, of ***FINCAP*** augmented by CAPUTIL. ***i $\hat{FINCAP}$*** : interaction of ***$\hat{FINCAP}$*** variable with a step dummy for the UK financial crisis (post 2007Q3).
The data sample is from 1987 Q2 to 2012 Q2. The interactive dummy is equal to 1 from 2007 Q3.

higher for small firms, as expected. However, in the crisis period, for small firms, this coefficient is reduced to zero with the test for equality between *CAPEX* and *–iCAPEX* comfortably accepted. This seems to indicate that firms were not using past investment as a guide in this period, which probably reflects a shock to uncertainty. By contrast, there was no significance for such an interaction term for large firms where adjustment is dampened by heterogeneity over business lines.

The optimism coefficient is clearly confirmed as endogenous by the Hausman test for the small firm group; for the large firms, the p-statistic of about 5% for this test is marginal at conventional levels. The optimism coefficients are broadly similar across the two size categories at about 0.5. Previous literature has shown that survey responses of the type used here can be interpreted as approximate rates of change and thus a coefficient of 0.5 would indicate an impact response elasticity of about a half and, at least for the large firm group a long-run elasticity of about unity.

6.1. Results for financial constraints

The remaining coefficients relate to financial constraints that are the focus of this paper. Each of the columns in Table 3 differs according to whether a lag is included and whether an interaction is included for the financial crisis. For small firms the interaction is never significant and the financial constraint appears to operate contemporaneously and with a lag. Thus there appears to be no *differential* financial constraint associated with the crisis for this group. For large firms, *only* the interaction coefficients are significant and negative indicating that financial constraints bite only in the period of the crisis. The lagged interaction term *i $\hat{FINCAP}$ (-1)* is significant with p-values between 0.02 and 0.06 and with some indication of significance for the contemporaneous interaction as well. There is thus considerable difference between the pattern of financial constraints observed for the small and large firm groups, both generally and for the crisis period.

We now comment on the hypotheses outlined in Section 3. *Hypothesis 1* is confirmed by the finding in Table 3 that, only for the

small firm group, is there a significant coefficient on the financial constraint variable outside of the financial crisis. For both $\hat{FINCAP}$ and its lag, significance at the 1% level or less for the small group contrasts with the clear rejection of the hypothesis for the large group. *Hypothesis 2* is not confirmed. Only in the case of large firms is there an increased financial constraint in the crisis period with the lagged interaction term significantly negative in the first and last columns. In fact the crisis period is the only time in which the large firm group suffers from financial constraint, as confirmed by the joint test on $\hat{FINCAP}$ and its lag, as contrasted with the tests on i $\hat{FINCAP}$ and its lag in the final rows of the table. These findings are relevant to *Hypotheses 3 A* and *3B* since we have already noted that the small firm group's constraint, cyclically adjusted, does not diminish during the financial crisis, whereas this period is when the large firm group experiences a constraint for the first time. We thus reject 3 A in favour of 3B.

Table 4 shows results for exactly the same specification as Table 3 but with the variables now expressed as standardised variables. The variables in Table 4 are demeaned, and divided by the sample period standard deviation so that they are expressed in units of standard deviation from the mean. The interaction terms are then formed as before. We can interpret the coefficients, as the effect of one standard deviation change in the independent variables in terms of the number of standard deviation changes in the intention to invest. However, as noted earlier since the main survey variables such as investment and optimism are already approximations to rates of change we do not expect there to be great differences between the tables for the coefficients on these variables. The similarity is confirmed by comparing the coefficients for the two size categories across Tables 3 and 4. These are of roughly similar magnitude though the optimism effect for small firms seems slightly stronger in the standardised coefficients in Table 4 both absolutely and in comparison with large firms.

There are substantial differences between the standardized and the unstandardized results in respect of the financial constraint coefficients. As these variables and interactions are constructed as residuals we do not expect the coefficients to be invariant between the two tables and here it may be preferable to use Table 4 in understanding the relative magnitude of the effects. The economic significance of these distinct patterns between the two size groups is two-fold. For normal periods, the results confirm that only small firms face financial constraints. Nevertheless this effect is fairly substantial with a one standard deviation change in the constraint variable resulting in an approximate 0.2 standard deviation fall in investment summed over two quarters for which the impact is recorded. The long-term effect is greater, given the coefficient on the lagged dependent variable, and is approximately double the impact effect. For the financial crisis period, these constraints also operate but there is no differential additional effect, conditional on the other regressors, for the small firms group. However, for the large firm group, the effect of financial constraints in the financial crisis is substantial. It is two to three times bigger than the effect for small firms observed over the full sample period when measured in terms of the ratios of standard deviations of investment to that of financial constraints.

Table 5 provides a closer focus on the crisis period. The interaction variable ($i\ \hat{FINCAP}$) is now differentiated by whether business optimism is rising ($i\ \hat{FINCAP}\ up$) or falling ($i\ \hat{FINCAP}\ dw$). The general pattern of the results is stable as compared with those in Table 3. The change in specification makes very little difference for the small firm group where the interaction terms for $\hat{FINCAP}$ are all insignificant. However, for the large firm group, it is notable that the financial interaction effects are only significant when optimism is falling ($i\ \hat{FINCAP}\ dw$ and $i\ \hat{FINCAP}\ dw(-1)$). Similar results were found with a step dummy based on Lehman Brothers collapse (post Q3 2008) as shown in Table 5 in the right-most column of each of the two groups, though this date is not the most appropriate for the UK economy. A final robustness check was made by repeating the Table 5 analysis on the pooled sample with an intercept dummy and interactive slope dummies: see Appendix A, Table A2. Pooling might offer an advantage of extra degrees of freedom were homogeneity of error variances across groups to be a valid assumption. However this approach is less suitable where error variances are unequal (Schepers et al., 2016; Holgersson and Öner, 2016). In our case we found a significant difference when comparing the two groups residual standard deviations ($p = 0.0000$), suggesting that caution is warranted in the use of the dummy variable approach. Nevertheless the pooled results confirmed the same pattern of results as in the separate regressions with $\tilde{FINCAP}$ being negative and highly significant for the base (small) group but the large group interaction only significant for the crisis period when business optimism was falling, as observed already for the single equations in Table 5.[8]

6.2. Conclusions on financial constraints

The UK experience is thus one of continuous financial constraint for small firms but no additional *unexpected* (demand conditioned) handicap for them in the crisis period. This does not of course mean that small firms in the crisis period did not experience a

[8] Although the testing across equations is not a prime issue in this paper, we can also carry out a direct test, as a first approximation, by ignoring the covariance between the estimated coefficients as might be justified in our case for the financial constraint where the pattern of results between the two groups seems substantially different. We performed this test for the financial coefficients in Table 3. Calculated in this way, the t-ratios for these coefficient differences confirm significance in difference at up to 0.01%.

Table 4

Standardised Variables Investment Equation (IV). $CAPEX_t = \beta_0 + \beta_1 CAPEX_{t-1} + \beta_2 iCAPEX_{t-1} + \beta_3 OPT_t + \beta_4 \hat{FINCAP}_t + \beta_5 \hat{FINCAP}_{t-1} + \beta_6 i\hat{FINCAP}_t + \beta_7 i\hat{FINCAP}_{t-1} + \varepsilon_t OPT_t$

$= \alpha_0 + \alpha_1 OUTNEXT_t + \alpha_2 OUTPAST_{t-1} + e_t$

	Small Firm Group			Large Firm Group		
Constant	−0.03	−0.02	−0.02	0.04	0.03	0.04
CAPEX(-1)	0.54***	0.53***	0.54***	0.44***	0.36**	0.44***
iCAPEX(-1)	−0.50***	−0.47***	−0.51***	−0.04	−0.01	−0.04
OPT	0.69***	0.68***	0.68***	0.44***	0.61**	0.45***
$\hat{FINCAP}$	−0.08**		−0.06	0.02		
$\hat{FINCAP}$(-1)	−0.13***	−0.12***	−0.12**	−0.01	0.01	
i$\hat{FINCAP}$	0.04			−0.26		−0.24*
i$\hat{FINCAP}$(-1)	0.04	0.03		−0.34*	−0.39*	−0.35**
Disturbance is homoscedastic Breusch-Pagan/Godfrey statistic	22.80***	10.63	19.61***	19.07**	23.29***	19.02***
Hansen J-statistic	4.05**	3.37*	3.28*	0.66	0.06	0.59
First-stage regressions of ***OPT*** F-test	42.70***	42.72***	50.65***	18.17***	17.18***	15.83***
Tests of endogeneity of ***OPT*** Durbin-Wu-Hausman	34.76***	34.72***	32.14***	3.96**	10.00***	3.82*
CAPEX(-1) + iCAPEX(-1) = 0	0.06	0.15	0.05	3.77*	1.58	3.72*
$\hat{FINCAP} = \hat{FINCAP}$(-1) = 0	13.53***		5.95*	0.04		
$i\hat{FINCAP} = i\hat{FINCAP}$(-1) = 0	0.13			5.12*		6.81**
$\hat{FINCAP} = \hat{FINCAP}$(-1) = $i\hat{FINCAP} = i\hat{FINCAP}$(-1) = 0	14.28**			6.86		
Obs	101	101	101	101	101	101

All variables are standardised as the original data subtracted by the mean and divided by the sample period standard deviation so that they are expressed in units of standard deviation. Statistical significance is calculated using robust standard errors; *** significant at 1%, ** significant at 5% and * significant at 10%. The *Breusch-Pagan/Godfrey test* is used to test for the presence of heteroscedasticity. Under the null of no heteroscedasticity the error of the regression is normally distributed. Similar results were found with the *White/Koenker tests*, not included in the table. The *Hansen-Sargan* or *J-Test* for overidentying restrictions has a joint null hypothesis to test if the instruments are valid instruments - uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation- A rejection of the null questions the validity of the instruments. ***CAPEX***: Balance of *more* over *less* for Question 3b CBI Industrial Trends Survey. ***OPT***: Balance of *more* over *less* for Question 1. ***OUTNEXT***: Balance of *up* over *down* for Question 8 NEXT. ***OUTPAST***: Balance of *up* over *down* for Question 8 PAST. ***CAPUTIL***: Logit transformation of the count variable (percentage) responding *no* to Question 4. ***FINCAP***: Balance of answers Inability to raise external finance Question 16c. $\hat{\textbf{FINCAP}}$: Residual from an autoregression, order 2, of ***FINCAP*** augmented by CAPUTIL. $i\hat{\textbf{FINCAP}}$: interaction of $\hat{\textbf{FINCAP}}$ variable with a step dummy for the UK financial crisis (post 2007Q3).

The data sample is from 1987 Q2 to 2012 Q2. The interactive dummy is equal to 1 from 2007 Q3. Variable names are in **bold** to differentiate from Table 3.

Table 5

Modified Investment Specification (IV). $CAPEX_t = \beta_0 + \beta_1 CAPEX_{t-1} + \beta_2 iCAPEX_{t-1} + \beta_3 OPT_t + \beta_4 \hat{FINCAP}_t + \beta_5 \hat{FINCAP}_{t-1} + \beta_6 iFINCAPup_t + \beta_7 iFINCAPdw_t + \beta_8 iFINCAPup_{t-1} + \beta_9 iFINCAPdw_{t-1} + \varepsilon_t OPT_t = \alpha_0 + \alpha_1 OUTNEXT_t + \alpha_2 OUTPAST_{t-1} + e_t$

	Small Firm Group				Large Firm Group			
	Interactive dummy from 2007 Q3			Dummy from 2008 Q3	Interactive dummy from 2007 Q3			Dummy from 2008 Q3
Constant	0.49	0.51	0.48	0.47	2.50	2.51	2.54	2.57
CAPEX(-1)	0.55***	0.51***	0.55***	0.55***	0.48***	0.48***	0.48***	0.49***
iCAPEX(-1)	−0.57***	−0.52***	−0.57***	−0.58***	−0.15	−0.15	−0.13	−0.16
OPT	0.49***	0.49***	0.49***	0.49***	0.37***	0.38***	0.38***	0.38***
$\hat{FINCAP}$	−1.13***		−1.15***	−1.13***	0.10		0.13	0.10
$\hat{FINCAP}$ (-1)	−1.59***		−1.58***	−1.58***	−0.04		−0.26	−0.04
i$\hat{FINCAP}$up	−0.30	−1.16		−0.74	0.04	0.14		−0.01
i$\hat{FINCAP}$dw	0.35	−0.71	0.36	0.37	−2.19*	−2.09***	−2.10**	−2.19*
i$\hat{FINCAP}$up(-1)	−0.02	−1.53		−0.52	−1.09	−1.13		−1.16
i$\hat{FINCAP}$dw(-1)	−0.03	−1.62	−0.07	−0.06	−3.56***	−3.60***	−3.26***	−3.56***
Disturbance is homoscedastic Breusch-Pagan/Godfrey statistic	26.27***	19.20**	25.70***	26.87***	24.59***	24.41***	24.44***	23.69***
Hansen J-statistic	3.05*	3.069*	3.067*	3.19*	0.86	0.77	0.89	0.86
First-stage regressions of OPT F-test	41.81***	42.22***	41.27***	41.92***	27.27***	22.53***	21.21***	27.68***
Tests of endogeneity of OPT Durbin-Wu-Hausman	39.99***	36.92***	34.19***	36.86***	2.92*	2.79*	3.09*	2.91*
CAPEX(-1) + iCAPEX(-1) = 0	0.02	0.01	0.02	0.03	2.83*	2.78*	2.95*	2.50
$\hat{FINCAP} = \hat{FINCAP}$-1 = 0	19.52***		19.49***	19.49***	0.02		0.28	0.02
i$\hat{FINCAP}$dw = i$\hat{FINCAP}$dw(-1) = 0	0.03	1.03	0.04	0.04	8.80**	11.80***	8.81**	8.94**
i$\hat{FINCAP}$up = i$\hat{FINCAP}$up(-1) = 0	0.02	0.79		0.10	0.71	0.92		0.75
i$\hat{FINCAP}$up = i$\hat{FINCAP}$dw = 0	0.05	0.31		0.12	3.99	6.70**		3.90
i$\hat{FINCAP}$up(-1) = i$\hat{FINCAP}$dw(-1) = 0	0.00	1.64		0.09	10.57***	12.53***		10.69***
Obs	101	101	101	101	101	101	101	101

Statistical significance is calculated using robust standard errors; *** significant at 1%, ** significant at 5% and * significant at 10%. The *Breusch-Pagan/Godfrey test* is used to test for the presence of heteroscedasticity. Under the null of no heteroscedasticity the error of the regression is normally distributed. Similar results were found with the *White/Koenker tests*, not included in the table. The *Hansen-Sargan* or *J-Test* for overidentying restrictions has a joint null hypothesis to test if the instruments are valid instruments - uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation- A rejection of the null questions the validity of the instruments. ***i $\hat{FINCAP}$ up***: interaction of ***$\hat{FINCAP}$*** variable with a step dummy for the UK financial crisis (post 2007Q3) and a dummy equal to one when $OPT \geq 0$. ***i $\hat{FINCAP}$ dw***: interaction of ***$\hat{FINCAP}$*** variable with a step dummy for the UK financial crisis (post 2007Q3) and a dummy equal to one when $OPT < 0$. The far right column for each firm size group present results using an interactive dummy from the Lehman Brothers collapse (post 2008Q3).
The data sample is from 1987 Q2 to 2012 Q2.

reduction in bank lending. However there is no firm evidence that this was mainly supply led. Nor does it suggest that a recovery was stymied by changed behaviour of credit providers to small firms particularly. If anything the crisis lesson for financial constraint was how abruptly the *large firm group* encountered difficulty and, as noted in Table 4, how substantial the financial constraint coefficient is for the large firm group in the crisis period. For completeness, it should also be recognised that any large firm effect may have impinged indirectly on SMEs who may depend on the financial health of large firms to obtain trade credit when other forms of finance are unavailable (McGuinness and Hogan, 2016; Akbar et al., 2017).

Our findings are based on a source that has consistent information on small and large firms over a long period that includes the financial crisis. This comprehensive data is unusual and makes our results difficult to compare fully with other work. Differences in definition or sample also makes for difficulties in comparison; for example our sample is not representative of very small or micro firms (with 1–9 employees) that constitute a large fraction of some other academic studies of financial constraints (Cowling et al., 2012; Lee et al., 2015). Nevertheless some comparisons with previous results may be drawn. Our findings echo those of other researchers who report a particular increase in constraints for large firms during the crisis period (Hetland and Mjos, 2012). Our results concerning different patterns of finance constraints for small and large firms are consistent with Riley et al (2014b) who find that bank credit constraints for large firms ended several years after the onset of the crisis while small firms experienced continuing constraints. Our findings on SMEs are somewhat at odds with Armstrong et al. (2013), who found that rejection rates for SME firms' loans of low and average risk were significantly higher in the period from 2008–9 onwards, compared with the period since 2001 even controlling for some risk factors. We cannot be sure however whether this is the result of different propensities to apply for such loans (which would be reflected in rejection rates) or omitted risk factors such as debt.

6.3. Policy issues

A common view of the UK economy in the financial crisis is that small firms were most severely affected by credit constraints and this prevented an early recovery in capital investment. We have shown that this story lacks robust evidence. Although small firms were credit rationed, this was no more severe on a cyclically adjusted basis that would have been expected historically. Rather it is large firms that were unusually affected. This correction to general perceptions matters for policy. It would be a mistake for policymakers to focus exclusively on the supply of credit to firms when the underlying problem may be more that firms' appetite to invest has been reduced for non-financial reasons.[9] As we noted from Table 5 the crisis-specific financial constraints (for large firms) are only observed for periods of falling optimism. It seems unlikely therefore that financial constraints can fully explain the continued caution of such firms in relation to capital investment, even as general business confidence recovered over the crisis period (Oxford Economic Forecasting, 2013). More recent survey evidence from the Bank of England has shown that UK firms have continued to under-invest. One third of firms recognised themselves as investing less than appropriate compared with only 2% that were overinvesting. Firms also believed the return on investment to be significantly higher than their cost of capital. Eighty percent of those perceived to be underinvesting responded "yes" to whether financial market pressures for short term returns were an obstacle to investment. However, external finance features only in third place as constraining investment for a given level of internal funds (Saleheen et al., 2017). The lesson that can be drawn from this, in conjunction with our own results, is that while financial constraints can matter for all firms for some periods - and for small firms perennially - such constraints on capital investment may be overshadowed by non-financial ones including the role of investor preference for cash now over return later. Certainly we have not been able to establish that cyclically adjusted financial constraints became more severe for our small firm sample in the financial crisis.[10]

7. Overall conclusions

There is a time pattern to the coefficients for financial constraints with respect to capital investment that is distinct between the group of small firms and the group of large firms. Large firms' sensitivity to financial constraints emerged only during the crisis period. For small firms, on the other hand, the effect is perennial and does not seem to have been increased in the crisis, once other determinants of investment are taken into account. These results are important findings, given that the literature reviewed earlier has not demonstrated consensus about the effects of the crisis. Furthermore our approach allows us to interpret the results as relating to supply-side financial constraints, separate from cyclical influences that influence firms requests for credit *i.e.* demand-side influences.

[9] Discussion of non-financial factors affecting investment, including corporate governance, may be found in Williamson et al (ed., 2014), Driver and Temple (2014), and Driver and Thompson (eds, 2018).

[10] These findings may be specific to the UK context where firms are served by large inter-connected banks with little relational banking provision. Clearly the institutional features of the banking system in different countries will have affected the pattern of lending both in the run up to the crisis and afterwards (Bayoumi, 2017).

A further finding of this paper is that the financial constraint experienced in the crisis by the large firms group operates only for worsening business optimism; there is no evidence for such an effect when optimism is rising. This last result suggests that the failure of investment to recover substantially even in the face of rising optimism cannot be attributed primarily to financial constraints, a finding that has recently been reinforced by survey evidence from the Bank of England. Policies to stimulate investment in the upturn may require a shift from monetary policy to fiscal policy (Sawyer, 2012) aimed at reducing uncertainty in regard to the output path, and implementing measures to encourage a long-term focus for investors. Industrial Strategy and Corporate Governance are key elements of this approach.

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Appendix A

Table A1
Investment Equation (OLS).$GI_t = \beta_0 + \beta_1 GI_{t-1} + \beta_2 iGI_{t-1} + \beta_3 OPT_t + \beta_4 FXR_t + \beta_5 FXR_{t-1} + \beta_6 iFXR_t + \beta_7 iFXR_{t-1} + \varepsilon_t$

	Small Firm Group		Large Firm Group	
Constant	−0.02	−0.05	0.78	0.92
CAPEX(-1)	0.67***	0.67***	0.55***	0.54***
iCAPEX(-1)	−0.47***	−0.44***	−0.08	−0.08
OPT	0.32***	0.32***	0.23***	0.24***
$\hat{FINCAP}$	−0.49	−0.77	−0.20	
$\hat{FINCAP}$(-1)	−1.44***	−1.61***	−0.18	
i$\hat{FINCAP}$	−0.85		−1.70	−1.90*
i$\hat{FINCAP}$(-1)	−0.59		−1.99*	−2.19**
CAPEX(-1) + iCAPEX(-1) = 0	2.17	3.91*	6.74**	6.81**
Observations	101	101	101	101

Statistical significance is calculated using robust standard errors; *** significant at 1%, ** significant at 5% and * significant at 10%. ***CAPEX***: Balance of *more* over *less* for Question 3b CBI Industrial Trends Survey. ***OPT***: Balance of *more* over *less* for Question 1. ***OUTNEXT***: Balance of *up* over *down* for Question 8 NEXT. ***OUTPAST***: Balance of *up* over *down* for Question 8 PAST. ***CAPUTIL***: Logit transformation of the count variable (percentage) responding *no* to Question 4. ***FINCAP***: Balance of answers Inability to raise external finance Question 16c. $\hat{\textbf{\textit{FINCAP}}}$: Residual from an autoregression, order 2, of ***FINCAP*** augmented by CAPUTIL. ***i*** $\hat{\textbf{\textit{FINCAP}}}$: interaction of $\hat{\textbf{\textit{FINCAP}}}$ variable with a step dummy for the UK financial crisis (post 2007Q3).
The data sample is from 1987 Q2 to 2012 Q2. The interactive dummy is equal to 1 from 2007 Q3.

Table A2
Modified Investment Specification (IV) pooled regression. $CAPEX_t = \beta_0 + \beta_1 CAPEX_{t-1} + \beta_2 iCAPEX_{t-1} + \beta_3 OPT_t + \beta_4 FIN\hat{C}AP_t + \beta_5 FIN\hat{C}AP_{t-1} + \beta_6 iFIN\hat{C}APup_t + \beta_7 iFIN\hat{C}APdw_t + \beta_8 iFIN\hat{C}APup_{t-1} + \beta_9 iFIN\hat{C}APdw_{t-1} + \varepsilon_t OPT_t = \alpha_0 + \alpha_1 OUTNEXT_t + \alpha_2 OUTPAST_{t-1} + e_t$

	Pooled regression Small and Large Firm Groups		
	Interactive dummy from 2007 Q3		
Constant	0.22	0.34	0.24
CAPEX(-1)	0.52***	0.51***	0.52***
iCAPEX(-1)	−0.28*	−0.26*	−0.25*
OPT	0.43***	0.43***	0.43***
$FIN\hat{C}AP$	−0.80**		−0.90**
$FIN\hat{C}AP$ (-1)	−1.32***		−1.29***
i$FIN\hat{C}AP$up	−1.59	−2.14	
i$FIN\hat{C}AP$dw	0.90	0.13	1.20
i$FIN\hat{C}AP$up(-1)	−0.70	−1.95	
i$FIN\hat{C}AP$dw(-1)	0.44	−0.92	0.41
large	2.99*	2.78*	2.96*
large * $FIN\hat{C}AP$	0.99		1.14
large * $FIN\hat{C}AP$ (-1)	1.36**		1.02
large *i$FIN\hat{C}AP$up	1.71	2.44	
large *i$FIN\hat{C}AP$dw	−3.23	−2.25	−3.42
large *i$FIN\hat{C}AP$up(-1)	−0.82	0.48	
large *i$FIN\hat{C}AP$dw(-1)	−4.37**	−2.96*	−3.93**
Disturbance is homoscedastic Breusch-Pagan/Godfrey statistic	89.46***	84.54***	87.81***
Hansen J-statistic	2.24	1.91	2.22
First-stage regressions of OPT F-test	67.13***	61.18***	56.39***
Tests of endogeneity of OPT Durbin-Wu-Hausman	15.31***	15.41***	15.48***
Obs	202	202	202

Statistical significance is calculated using robust standard errors; *** significant at 1%, ** significant at 5% and * significant at 10%. The *Breusch-Pagan/Godfrey test* is used to test for the presence of heteroscedasticity. Under the null of no heteroscedasticity the error of the regression is normally distributed. Similar results were found with the *White/Koenker tests*, not included in the table. The *Hansen-Sargan* or *J-Test* for overidentying restrictions has a joint null hypothesis to test if the instruments are valid instruments - uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation- A rejection of the null questions the validity of the instruments. ***i $\hat{FINCAP}$ up***: interaction of ***$\hat{FINCAP}$*** variable with a step dummy for the UK financial crisis (post 2007Q3) and a dummy equal to one when $OPT \geq 0$. ***i $\hat{FINCAP}$ dw***: interaction of ***$\hat{FINCAP}$*** variable with a step dummy for the UK financial crisis (post 2007Q3) and a dummy equal to one when $OPT < 0$. The prefix *large* denotes the interactive term for the large firm group.
The data sample is from 1987 Q2 to 2012 Q2.

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