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TRADE CREDIT IN THE UK CONSTRUCTION INDUSTRY: An Empirical Analysis of Construction Contractor Financial Positioning and Performance

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UCL

Authors: Graham Ive and Alex Murray, Bartlett School of Construction and Project Management, UCL.

Department for Business, Innovation and Skills

1 Victoria Street

London SW1H 0ET

www.gov.uk/bis

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Executive summary

The consultants were requested to undertake a study of the availability of trade credit to UK construction firms and their reliance upon such trade credit to support their operations and deliver construction output.

Particular questions we were asked to address were:

- How do companies in the construction sector finance their work? What is the balance between assets, bank borrowing and trade credit? How important is the role of trade credit for construction companies?
- How do finance structures within the construction sector compare to those of the economy as a whole? Do construction companies make more use of trade credit than other sectors?
- How does the way construction companies fund themselves differ between main contractors and subcontractors? How does this vary by firm size?
- What implications do these findings have for companies in the construction sector?
- Since the financial and banking crisis, has the structure of construction industry finance significantly altered?

Chapter 1 introduces the study and contains an outline of the structure and contents of each chapter. It also contains an explanation of why construction contractors' balance sheets show the characteristics that they do.

Chapter 2 lists propositions or ideas for analysis derived from a review of the trade credit literature.

Chapter 3 describes the methods adopted to explore these questions and propositions. The methods use data taken from the company accounts of over a thousand construction contractor firms.

Chapter 4 is the bulk of the report, where the results of the analyses are described. There are three types of comparison: between construction and the rest of the economy; between main construction contractors (Tier 1) and construction subcontractors (Tier 2); and between SMEs and larger construction firms. For each of these comparisons, there are six kinds of comparison: size of firms; financial performance of firms; relative importance of trade credit to firms; relative importance of bank credit to firms; total balance sheet structure; and need for working capital. Most of the analyses are for the whole period 2005-11 but there are also some analyses of year-by-year change within that period, both to look at trends and also to examine the impact of the financial crisis.

Chapter 5 presents conclusions and recommendations and also outlines limitations of the research.

Scope of the study: to what type and size of firms do the findings refer?

This study did not investigate 'micro' firms, and has only limited information on firms below the size at which they are required to file full accounts at Companies House. In construction such micro and small firms are numerous and in aggregate account for a substantial proportion of output.

The findings refer specifically and only to construction contractors.

How do finance structures in the construction sector compare to those of the economy as a whole?

Construction firms are relatively undercapitalised, compared with firms across the rest of the UK economy. That is, the weighted mean shares of their combined balance sheets contributed by both capital employed (45%) and equity (25%) are much lower than in the rest of the economy (60% and 34% respectively). This is most especially the case for Tier 1 contractors (capital 41% and equity 22%) and for large contractors (capital 41% and equity 24%).

The key difference in the structure of financing of assets in construction is the higher proportion of trade creditors and accruals compared to the rest of the economy; between two and three times as much depending on the measure used.

Greater use of trade credit allows each £ of capital employed by construction firms to support firstly a larger value of total assets and secondly to support a larger value of output or sales (£3.7 compared with £1.5 in the economy as a whole).

Do construction companies make more use of trade credit than other sectors?

Taken as a whole, construction firms take much more trade credit from their suppliers (two to three times as much, depending on the measure used) as a proportion of their balance sheet than do firms in the rest of the economy. They also give much more credit to their customers as a proportion of their balance sheet. The respective weighted mean shares in total assets are: trade creditors + accruals = 32% for construction, 11% for Rest of the Economy; trade debtors = 20% for construction, 8% for Rest of Economy. (Tables 1C and 1E).

Giving and taking trade credit: what are the net balances in the Rest of Economy, All Construction and Construction tiers 1 and 2?

Figures 5.1 – 5.3 (Conclusions) summarise what we were able to observe in this regard, and the inferences we were able to draw from those observations.

For the construction industry as a whole, accounts payable are equal to and sufficient to finance accounts receivable. In the rest of the economy firms as a whole are (relatively minor) net providers of trade finance to (customers in) the non-corporate sectors.

Total trade credit received by construction firms is broken into two components: trade credit offered by suppliers to supply-and-fix specialist contractors; and trade credit offered by supply-and-fix specialist contractors (Tier 2) and other suppliers to main contractors (Tier 1).

Tier 1 firms were found to be net receivers of trade credit whereas Tier 2 firms were found to be large net providers of trade credit. The trade credit flow from Tier 2 to Tier 1 contractors substantially exceeds in size the trade credit flow from suppliers outside the construction industry to Tier 2 contractors. Figure 5.3 (Conclusions) explains why we think we know this is so.

How reliant are UK construction firms on trade credit to deliver output and growth?

Reading the ratios 'backwards', each £ of growth of construction sales requires a 62 pence increase in total assets, and that in turn requires a 20 pence increase in trade credit; whereas in the corporate economy at large, each £ of growth of sales requires £1.16 increase in total assets, and that in turn requires a 16 pence increase in trade credit.

In any growth of construction output, the Tier 2 contractors will require additional trade credit from outside the industry, so that they can extend extra trade credit to Tier 1 contractors, so that the latter can extend extra trade credit to the construction industry's customers.

The role of trade credit in financing UK construction activity has been shown to be cascade-like. An initial flow of trade credit coming from supplier firms outside the industry plays a dominant and critical part in financing the industry's specialist contractors. This initial flow, widened by injections of equity and long-term debt capital by the specialist contractors, allows and finances a second somewhat larger flow of trade credit, from specialist contractors to main contractors; that in turn finances a third and somewhat smaller flow of trade credit, from main contractors to their clients.

The strength of the balance sheets and (trade) credit-worthiness of the UK's specialist contractors is therefore shown to be of system-wide importance.

Are the providers of construction trade credit able to 'price' that credit? What is the impact of providing trade credit upon profitability?

Though the Tier 2 firms were large providers of trade credit to the Tier 1 firms, the price they obtained for this in terms of higher margins (higher selling prices) appears to fully offset the cost in terms of lower turnover per pound of capital employed. This is reflected in the higher weighted mean ROCEs of the Tier 2 than of the Tier 1 contractors.

How does financing structure and use of trade credit vary by firm size?

The larger contractors appear to obtain relatively more trade credit, particularly accruals. Construction SMEs face some limits in the amount of trade credit their suppliers are willing to afford them, specifically in the form of accruals (for definition and discussion of 'accruals' see Chapter 1, Accounting Distinctions)

Whether a firm is Tier 1 or Tier 2 has more impact on its financing structure, and receipt of trade credit, than does its size alone.

The study findings tend to contradict the idea that, in construction, medium sized firms as a whole receive less finance from banks (relative to their balance sheet totals) than do larger construction contractors.

For construction companies, what is the balance between bank borrowing and receipt of trade credit?

In construction, trade credit is the first, by far the most important, continuous, and most widespread source of finance for operations; whereas short-term bank finance is an expedient used by some firms some of the time.

Since the financial and banking crisis, has the structure of construction industry finance significantly altered?

Profitability (ROCE) of construction contractors fell from its peak in 2006 by one third of its peak level to 2011. All this fall in ROCE is accounted for by fall in profit margins. Capital-turnover ratios (and hence need for capital to finance turnover) have been stable.

The period since 2008 shows bank credit falling in relative importance and trade credit rising in relative importance in construction.

What other sources of finance are important for construction firms?

HMRC acts as a kind of lender to its corporate tax-collecting agents. This is at least as important as short-term bank credit as a source of finance for all but very large firms.

This source of finance is particularly important for construction firms as they tend to be labour-intensive and most tax balances are payroll taxes.

Policy implications of findings

1. BIS and Bank of England monitoring:

In this particular industry, it is clearly important to have continuous monitoring of the trade credit situation, either by regular survey or by establishment of statistics covering such credit, because trade credit is the most important source of finance for the whole construction industry – and as crucial for industry output, capacity and competition as the resources covered by existing construction statistics. Such surveys should include a focus on monitoring changes in the trade-credit worthiness and access to trade credit of tier 2 and tier 3 firms, because they stand at the head of the cascade of trade credit on which tier 1 contractors and construction customers rely. It should also perhaps include monitoring indicators of the risk of potential bad trade debt flowing up the cascade from developers and tier 1 contactors.

2. Procurement and form-of-payment policy:

The undercapitalisation of tier 1 contractors and their reliance on business models generating negative need for working capital may in practice be as decisive as industry attitudes to risk and business models of risk transfer in determining whether intended changes to procurement and forms of payment (milestone payments; performance-based contracting) will be taken up by the industry, and with what effect on competition.

3. Tax liability finance:

HMRC credit extended to construction (and other) firms acting as tax-collection agents appears to be quantitatively important especially for the medium-sized construction firms. Is it a ‘free lunch”? Firms may argue that the benefit they obtain from holding such financial balances merely offsets the administrative costs they bear as tax collection agents. However, at the margin, any change towards being allowed to hold such balances for longer would appear to offer a ‘free lunch’.

4. Project Bank Accounts:

There is no evidence in our findings that supports the idea that medium sized tier 2 firms as a rule need the protection offered by project bank accounts. However, our data does not cover the smallest firms, and our coverage of tier 3 and lower firms is limited. Their trade credit position, the price they are able to charge for extending credit and vulnerability to delayed payment may be quite different.

5. Government as client in construction:

Policy of government as client for construction, especially policies intended to develop efficiency savings through building supply chains, needs to note that relationships between firms in construction supply chains are in large part complex

chains of financial (trade credit and debt) interdependence, and not merely relationships for dealing with specialisation or with risk.

Limitations of the research and recommendations for further research

This study shows what can, and what cannot, be done using common-size financial statement and business ratio analysis to compare sub-industries. The sub-industries being compared are assumed to be similar in attributes (similar demand and supply conditions and market structures) other than financial structures bearing on profitability. If the assumption holds, observed difference in sample mean ROCEs can be attributed to observed difference in offering and taking of trade credit. There is an association (not a proven causality) between differences in the taking and giving of trade credit and differences in average ROCE; and we know of no obvious alternative explanations for why Tier 2 contractors should have higher ROCE than Tier 1 firms.

Analysis using many possible explanatory variables to explain the 'scatter' of values of profitability for many individual firms might well lead to modification of our findings, as regards the implied price of trade credit.

Tier 3 and small (under £6m turnover) contractors appear to be extending significant trade credit to both Tier 2 and Tier 1 medium and large sized contractors, and this study suggests that at least some of this credit flow may not be fully economically priced at present (in that the more credit the Tier 1 and 2 medium and large contractors receive, the more profitable they seem to be). This is a strong reason for recommending further research into small firms' financial structures, use of trade credit and financial performance in the UK contract construction industry.

The UK construction industry increasingly obtains its construction materials and components (CMCs) as imports. This study has shown that in aggregate suppliers of CMCs are extending considerable trade credit to UK contractors, and has suggested that at least some of this credit flow may not be fully economically priced at present. This deserves further research.

Chapter 1 – Introduction to the study

Statement of the problem

As part of the Construction Sector Strategy Analysis being conducted by the Department (BIS) to inform and underpin the government's new Construction Sector Strategy, the consultants were requested to undertake a study of the availability of trade credit to UK construction firms and their reliance upon such trade credit to support their operations and deliver construction output.

The reason for this request was a more general concern in the Department with the sector's access to finance of all kinds, a desire to set issues of access to bank finance in the relevant broader context, to improve understanding of how construction companies finance their work, the relative importance of trade credit in this, and how this compares to companies in the economy as a whole.

Particular questions we were asked to address were:

- How do companies in the construction sector finance their work? What is the balance between assets, bank borrowing and trade credit? How important is the role of trade credit for construction companies?
- How do finance structures within the construction sector compare to those of the economy as a whole? Do construction companies make more use of trade credit than other sectors?
- How does the way construction companies fund themselves differ between main contractors and subcontractors? How does this vary by firm size?
- What implications do these findings have for companies in the construction sector?

Possible implications of the findings might include throwing light upon whether:

- Capitalisation is lower than it should be for parts of the UK's construction industry
- Construction SMEs have enough access to finance
- Since the financial and banking crisis the structure of construction industry finance has significantly altered

Approach and analyses

Availability of finance and capital can only be considered relative to the need for it. The hypothesis behind this study is that construction firms' need for capital and / or for bank finance depends mostly upon the extent to which they give and are able to receive business-to-business trade credit. Subsidiary hypotheses derived from this are:

a) That in times of financial difficulty, a lack of availability of trade credit, arising either from a decline in the credit rating of construction firms by their suppliers or from constraints biting on the ability of those suppliers to provide trade credit finance, could generate a 'trade credit crunch' that would threaten the survival of construction firms and limit the capacity of the industry;

b) That the relative respective costs of three kinds of finance (equity, bank credit and trade credit) will have significant implications for construction contractors, and for their relative preferred source of short-term finance. If access to the lowest-cost source of capital is constrained, the financing mix may then affect the industry's overall cost of capital.

The methods adopted to explore these propositions are described in **Chapter 3**.

Whilst the majority of the theory literature on financial structure ignores trade credit (strangely), its general assumption has been that actual financing structures will tend to arise for some 'efficiency' reason – economising on agency or transaction costs, and placing the financing of activity with the parties best able to provide finance at lowest overall economic cost. However, the consultants decided not to reject a priori the idea found in many statements by the representatives of Small and Medium Enterprises (SMEs), and particularly in construction, that they find themselves obliged to offer trade credit to larger customers, despite being less able than their customers to source the finance required, and are unable to charge an economic price (equal to opportunity cost) for the credit they extend. These issues are discussed in **Chapter 2**. That chapter concludes by listing propositions or ideas for analysis derived from the review of the trade credit literature.

Trade credit is given and taken to some extent in almost all businesses and in the majority of all business-to-business (b2b) transactions. Paul and Wilson (2006) report earlier studies finding that trade credit is used in around 80% of all business-to-business transactions in the UK. However, the particular nature and business practices of construction contracting make its use particularly prevalent in this sector.

Scope of the study

To investigate the giving and receiving of trade credit in the construction industry, and its relative importance for construction firms both as a source of finance and as a demand upon their finances, the consultants have undertaken a study of the financial (audited) accounts of a large sample of construction firms and a large benchmark sample of firms in the rest of the economy, to provide a point of reference and comparison.

The period covered is 2005 to 2011. The nature of the samples, and the definitions used for 'construction' (in essence, SICs 41 - Construction of Buildings; 42 - Civil Engineering; and 43 - Specialised Construction Activities) and 'rest of the economy' are set out and discussed in **Chapter 3**. It is necessary however to note from the outset that we have attempted to look specifically and only at construction contractors, and not at other kinds of business often included within aggregate statistics for the construction industry, such as housing developers or PFI companies, which have been excluded from our samples. Contractors have been divided into Tier 1 and Tier 2 according to their SIC: 41 or 42 = Tier 1 ('main contractors'); 43 = Tier 2 ('specialist contractors', also known as 'subcontractors'). Tier 1 contractors are so called because they are in direct contract for delivery of whole projects with customers for construction (project owners) that are themselves outside the construction industry, and are thus the first tier in the chain supplying those customers. Specialist contractors, in contrast, are mostly in contract with Tier 1 contractors as the buyers of their output (they act mostly as 'subcontractors'), and not for the most part in direct contract relationship with project owners, unless the scope of the project is limited to works in a few trades. They are thus the second tier in the chain.

The conceptual and measurement framework of the study is that of the system of company accounting, but with economic theory being used to generate hypotheses and for interpretations of findings. The strengths, but also the limitations, of using data from company accounts are discussed in **Chapter 3**.

As the sample of construction firms that we have used is a very large one, containing firms that together account for a high proportion of all construction output, and is limited to actual contractors, an additional valuable side-benefit of the study will be the light cast upon the financial performance of the contract construction industry. The sample contains 1022 firms, together accounting for between 25 and 30% (varying from year to year) of the industry's total output, and for at least between 19 and 22% of the industry's total remuneration of employees (a substantial proportion of sampled firms did not report remuneration). Given that the sample excludes housing developers, has been 'edited' so that it contains little double-counting of the same output (as would be the case in a sample that contained both subsidiaries and their owner-firm's parent or consolidated group accounts) and also excludes 'micro' and most 'small' contractors (see below), its coverage ratio for the output of non-'small' contractors will be around 60%[*]. See **Chapter 3**.

The known particular features of construction technology and what we call the institutions of the UK construction business system need to be taken into account, to shape an appropriate set of analyses. These 'institutions' are discussed below, in this chapter. This

[*] Here 'small' refers to firms exempt under the Companies Act from having to file full accounts at Companies House

discussion leads to identification of appropriate analyses. The results of the analyses we have decided to perform are presented in **Chapter 4**.

Construction institutions

Construction projects take much longer to complete and deliver than most business transactions. If contractors had to wait to get paid by their clients until they completed their projects then they would in effect have to extend many months or even years of trade credit to those customers. They would be financing the gap between when construction resources were used on projects and when construction projects were completed, so they would consequently require large amounts of working capital per million pounds of annual construction output.

It is instructive to see how 'national' these construction institutions can be by comparing UK with Germany. In Germany, construction projects are deemed to 'belong' to the contractor until they are completed, and the whole value of work done on uncompleted projects appears in the assets of the contractor. This reflects German law, which allows construction contractors to retain possession of projects on which the client defaults on payment. Any payments made by the client to the contractor before a project is completed are regarded, in this German setting, as pre-payments and thus as so much trade credit advanced by clients to contractors (Deutsche Bundesbank, 2012). In the UK, in contrast, at the end of each month or milestone the tranche of work done is regarded as 'belonging' to the client, and any portion of that tranche for which the contractor has not yet received payment from the client is regarded as so much trade debt owed by the client. In effect, the project is conceived as a series of mini-projects, and the expectation is that each mini-project should be paid-for soon after it is completed, and the convention is thus that, if it has not yet been fully paid-for, then the contractor is extending trade credit to the client.

In practice, construction clients pay for work done for them by their contractors in instalments, either as milestone payments or following monthly valuations of work done, and thus it is the industry's clients that finance most of the gap between resource use and project completion. The timing and size of such interim payments by clients determines the amount of contractors' trade credit extended to their clients (trade debtors).

Despite interim payments by clients, the balance sheets of construction contractors are still dominated by the holding of current assets, rather than fixed assets, and the largest items of current assets are usually work-in-progress and trade debtors.

Any business's need for working capital is given by the formula:

- Working capital I = Stocks & work-in-progress (WIP) + trade debtors – trade creditors

Equation 1: Determinants of working capital I

This report is in part an investigation into how much working capital UK construction contractors need per unit (£ million) of output (turnover), and how they raise (finance) that capital requirement – whether by using their own equity capital, or by bank borrowing.

It is obvious from the formula that by themselves receiving trade credit from their suppliers, construction contractors can reduce their need for working capital, and thus their need to find equity capital and / or bank finance.

The construction contractors we have been considering so far are known as Tier 1 or 'main' contractors, because they are in direct contract with the industry's clients, and thus it is those clients to whom they extend trade credit and from whom they obtain their revenues and cash inflows. However, the most important suppliers to Tier 1 contractors are other firms within the construction industry, the Tier 2 or 'specialist' contractors. These Tier 2 firms extend trade credit to their customers, the Tier I firms, and it is from the latter that they receive their revenues and cash inflows.

Thus the need for working capital of Tier 1 contractors is reduced to the extent that they purchase from either suppliers outside the industry (manufacturers or importers of materials and components; builders' merchants; or suppliers of general business goods and services) of from Tier 2 contractors on terms of trade credit.

Accounting distinctions

The accounting distinction between work-in-progress and trade debtors used formerly, in construction, to be between work done but for which no interim valuation certificate had been issued ('work in progress') and work for which the customer had acknowledged a precise liability (by issuing such a certificate) but had not yet made payment ('trade debt'). However, many (but by no means all) construction contractors now record work as 'trade debt' from the moment it is done (thus no longer reporting substantial values of work-in-progress). So long as it is only the accounts of contractors (and not construction firms developing projects on their own account, such as housing developers) that are under consideration, the distinction between work-in-progress and trade debt is not an absolutely fundamental one, since in both cases it represents work that has already been sold at a specified price. However it is possible that the customer will not accept the quality or query the quantity of work not yet valued in an interim certificate, and it is thus not completely equivalently 'liquid' (near to becoming cash). Nevertheless, for this analysis it will often be necessary to combine 'work in progress' with 'trade debtors' to get a consistent view, across firms, of this element in their current assets.

Similarly, the distinction between 'trade credit' and 'accruals' within the current liabilities of a construction contractor's balance sheet is only that between services or goods received and potentially used (and for which a liability therefore exists) but for which no invoice has yet been received (so that the extent of the liability has to be estimated), called 'accruals', and cases where invoices have been received but not yet paid, called 'trade creditors'. A customer may query an invoice once received, and not acknowledge the amount stated therein as 'trade creditors' until any dispute over the amount due has been resolved. Some customers will do this more than others. Equally, some suppliers will be quicker to issue invoices than others. It will therefore also often be necessary here to combine 'accruals' with 'trade creditors' to get a full and consistent view, across firms, of this element in their current liabilities.

Trade finance positioning and financial structure

We thus arrive at a restated version of the accounting formula for working capital:

- Working capital II = Stocks & WIP + trade debtors – trade creditors – accruals

Equation 2: Determinants of working capital II

This formula measures the net effect of timing of a firm's cash flows (payments, receipts) arising from its transactions with other businesses (its customers and suppliers) upon its balance sheet. For example, if working capital II is zero, then in effect the firm's suppliers are providing all the means for the firm to finance work in progress and provide trade finance to its customers, and the terms of the firm's business-to-business transactions are generating no net need for capital (equity plus long-term borrowing) or for short-term bank borrowing. The need for internal or bank finance of such a hypothetical firm would then be limited to its needs to finance its fixed assets and to hold financial assets sufficient to meet demands for liquidity, including payment of the wages and salaries of its employees, and payment of taxes, plus something for contingent or unforeseen liabilities.

If we consider the construction contracting industry as a whole, the same formula can be used to measure the extent to which the whole industry is a net receiver (working capital II negative) or net giver (working capital II positive) of trade credit, and therefore the extent to which the industry requires capital and / or bank finance for this purpose. This framework is particularly suited to measuring changes or trends in trade (b2b) finance.

Another way of conceptualising the problem is in terms of how the total assets of a firm or the industry are financed. The balance sheet balances. Therefore total liabilities and shareholders funds together equal (and finance) total assets. Total assets comprise fixed assets plus current assets. Current assets normally in construction contractors will consist mostly of Stock and WIP plus trade debtors (though especially after a period of recession some firms may accumulate cash receipts in excess of cash expenditures on purchasing resources for current production, and thus may pile-up considerable sums as 'at bank and deposits' and 'financial investments'). These total assets then need to be financed. Possible sources of finance are:

a) Shareholders' funds (initial and subsequent issues of equity plus accumulated retained profits added to reserves, minus losses met from reserves)

b) Long term liabilities (long-term debt plus other kinds of long term liability, such as deferred corporation tax and pension liabilities)

- *'Capital employed'* = a + b

c) Trade creditors and accruals

d) Short term bank loans and overdrafts

e) Short term tax liabilities (mainly sums collected as PAYE, NI deductions or VAT as agent for HMRC and not yet paid over)

f) Miscellaneous other current liabilities (including nonbank loans, such as group and directors' loans, and hire purchase and leasing liabilities).

This perspective provides a helpful framework for comparing the financial structures of different firms but also of different sectors. It is the main framework used below to compare the financial structure of the construction industry with that of the whole economy. For any sector (or firm) (a) to (f), expressed as shares in total assets, will sum to 1 (= total assets). The ratio of (c) / total assets is of particular interest in the context of this report. But it is equally important to see whether, when (c) is relatively high, say, we find that it is (a) or (a + b) that then tends to be lower, or whether, on the contrary, it is then (d) that tends to be lower.

Gearing and operational ratios

Yet another useful perspective is in terms of a set of gearing ratios and operating multipliers, between the equity or capital base and the output or turnover that base can generate and sustain. Gearing ratios normally capture the extent to which equity is 'geared up' into a larger capital employed: that is, one standard gearing ratio measures the sum of equity plus long-term debt or liabilities ('capital employed') over (divided by) equity. However, a second gearing is possible, if short-term liabilities can be rolled-over and become a recurrent source of finance. 'Current gearing' measures the sum of capital employed plus current liabilities (= total assets) over (divided by) capital employed. The two kinds of gearing (long term and short term) combined thus generate the ratio: total assets / equity.

This takes us into territory where the Du Pont capital return formula is useful. By definition, for any given measure of profit, then return on capital employed (ROCE) can be determined as below:

- ROCE = (profit margin) x (asset-turnover ratio) x (asset-capital ratio)

$$ROCE = \frac{\pi}{K} = \frac{\pi}{T} \times \frac{T}{TA} \times \frac{TA}{K}$$

Where:

π = Profit before interest and tax (PBIT)

T = Turnover or Sales

TA = Total Assets

K = Capital Employed (= TA minus Current Liabilities)

Equation 3: Du Pont identity of ROCE determination

Now, we have seen that 'current gearing' gives the final component on the right hand side (RHS) of the Du Pont formula, the ratio Total Assets / Capital Employed.

The 'operating multiplier' then gives the penultimate component on the RHS, Sales / Total Assets. This tells us how many pounds of sales are generated per year per pound of total assets used. In many types of business activity, this operating multiplier has a value less than 1. This will be the case if, for example, the business requires relatively large amounts of fixed assets (has a high fixed capital-output ratio), or if its current assets turn over into sales only slowly, because of a lengthy production period (as, say, in forestry). However, in UK construction contracting, because of interim payments, despite lengthy production periods, current assets should turn over relatively quickly. Thus operating multipliers greater than 1 are expected to be the rule.

The third and final component on the RHS of the Du Pont Identity, Profit / Sales, is of course the profit margin or 'Operating Margin'. Previous studies of profit margins in UK contract construction have found that they are normally relatively low (see **Chapter 4** for further evidence).

In the context of the concern of the Industrial Strategy with potential constraints on or barriers to growth in sector output, the multiplier and gearing ratios can be read 'in reverse', to identify how much additional capital, or total assets, or current liabilities (including receipt of additional trade credit and additional bank credit) would be required to sustain each additional million pounds of construction output, if current business and financial practices continue. These extra 'demands' can then be compared with estimates of potential supply of each type of finance.

SMEs and contracting tiers

The Department expressed particular interest in potential financial issues affecting SMEs in construction. The share of SMEs in total construction output is relatively high. SMEs are defined by the EU in terms of numbers employed and then either sales or assets thus:

- Micro firms: employ fewer than 10; sales less than 2m Euros or assets less than 2m Euros

- Small firms: employ 10 or more but fewer than 50; sales of 2m Euros or more but less than 10m Euros or assets of 2m Euros or more but less than 10m Euros

- Medium firms: employ between 50 and 249; sales greater than 10m but less than 50m Euros or assets greater than 10m but less than 43m Euros

The Companies Act applies a slightly different definition of 'small', given below.

Also the EU size boundaries do not quite align with those used in Construction Statistics, 2012, 'Table 2.9 Value of work done by size and trade of firm'. The table below shows the nearest equivalents.

Table 1: Value of work done by firm size, Table 2.9, Construction Statistics, 2012

	Employment range	Work done (£m)	Share (%)
Micro firms	0-13	40,312	33.0
Small firms	14-34	16,754	13.7
Medium firms	35-299	30,109	24.6
Large firms	300+	35,093	28.8
Total		122,268	100
All SME combined	0-299		71.2
Small and medium, excluding micro	14-299		38.2

In this Report, therefore, the term ‘micro firm’ is used to refer to firms employing 13 or fewer, or with total assets or sales below £2m. The term ‘small firm’ is used either in distinction to micro firm, as referring to firms employing between 14 and 50 or (in context of ‘Construction Statistics’ data) 34; or inclusively, in the sense of the Companies Act, to refer to both small firms in the above sense and also micro firms The context should indicate which of these senses of ‘small firm’ applies at each place in the text. The term ‘SME’ is used to refer to all firms with fewer than either 250 or (in context of ‘Construction Statistics’ data) 300 employees, and with total assets less than £40m

It is not practicable to analyse the accounts of all ‘small’ sized firms (in terms of the Companies Act 2006, now firms falling below at least two of the following thresholds: turnover of less than £6.5m; assets less than £3.26m; employing less than 50 persons - until recently, turnover less than £5.6m, assets less than £2.8m) because they are not required to report full accounts, including a profit & loss account, to Companies House. A sub-set of the population of small firms do in fact file full accounts, but there is no way of determining whether they are representative of the population of small firms.

In any case, for firms with very small capital, even if they do choose to file full accounts, the distinction between the owner’s income and assets and those of the company may in practice not be sharp. For example, loans to or from directors may dominate the balance sheet, and operating surplus can be ‘taken’ as profit or as directors’ remuneration. We therefore decided we had no option but to exclude firms with sales of less than £1m in any one year of the period analysed from our study. In practice this excludes most firms with 5 or fewer employees, and some firms employing more than 5.

However, it leaves potentially within our sample the sub-set of small firms with sales between £1m and £6.5m that chose to file full accounts. A very low proportion of small

firms (around 0.1%) does in fact choose to file full accounts, and are therefore in our sample. Though there are over 250,000 construction firms employing less than 35[†] (and therefore likely to be exempt from full filing on grounds of falling below employment and either turnover or asset threshold), there are, because of the low proportion choosing to file when exempt, only some 200 'small' firms in our sample of 1022 construction firms. Most of these 200 in fact employ over 34 persons, and very few indeed employ 13 or fewer. Thus in effect our sample does not cover 'micro' firms (if these are defined as firms employing 13 or fewer), and has only very low coverage of firms employing between 14 and 34, or even of firms employing between 35 and 50. See **Chapter 3**. The 'SME' sub-sample of construction firms (783 firms) thus in effect covers mainly 'medium' sized firms.

Size of firm in construction is correlated with whether a firm is a Tier I or Tier 2 contractor – see table below.

Table 2: Value of work done by firm size and tier, Table 2.9, Construction Statistics, 2012

£m	All trades	Tier 1 'main' trades	Tier 2 'specialist' trades
All firms	122,268	62,063	60,205
% shares			
Micro firms: 0-13	33.0	19.1	47.3
Small firms: 14-34	13.7	10.1	17.4
Medium firms: 35-299	24.6	29.0	20.1
SME combined	71.2	58.1	84.8

Thus differences in the financing structures of larger and smaller construction firms will be in part 'explained' by differences in the financing structures of main and sub-contractors, and vice versa.

[†] Construction Statistics Annual, 2012: Table 3.1

Trends in need for working capital

We have seen that at any one moment the Need for Working Capital (NWC) to finance operations and the Need for External Finance (NEF) is given by:

(A) NWC = WIP + Trade Debtors – Trade Creditors – Accruals

(B) NEF = NWC + Fixed Assets – Equity

Equations 4 (A) and (B): Need for Working Capital and Need for External Finance as functions of Accounting concepts

New orders turn into a lagged distribution of work done. This distribution is sufficiently predictable for a firm (or its banker), knowing its orders in hand, to be able to predict the value of work it will perform in a month several months ahead. That work done turns, with a further lag, into cash receipts. If the average lag between work done and a receipt of cash is the Trade Debtor Days period, expressed in months, (D), and this is both known and stable, then the firm and its bank will be able to predict the inflow of cash receipts from operations.

Over the next period t (one month) cash inflow will be:

- (1) Cash Inflow in month t = Work Done in month t – D

Equation 5: Cash flow as function of work done and Trade Debtor days

Similarly, the Adapted Creditor Period, expressed in months, is C. The firm pays its trade suppliers this month for their inputs to work done C months ago. It pays its employees without a credit period (pays at the end of the month or week for labour performed in that month or week).

(A) The Implied Credit Purchases Ratio = (cost-of-sales - remuneration of employees)/ turnover.

(B) The Remuneration Ratio = remuneration of employees / turnover.

Equations 6 (A) and (B): Implied Credit Purchases and Remuneration ratios as function of Accounting concepts

The cash outflow in month t will be:

- (2) Cash Outflow in month t = (Work Done in month t - C times the firm's implied credit purchases ratio) + (Work Done in month t times the firm's remuneration ratio.)

Equation 7: Cash outflow as function of Accounting concepts

The Net Cash flow = (1) – (2).

The Change in NWC (w) is this month's Net Cash flow minus last months, with the sign reversed.

Therefore change in NWC can be expressed as:

- $w = \{ t (2 – 1)\} – \{t\text{-}1 (2 – 1)\}$

Equation 8: Change in NWC as functions of cash inflow and outflow

The Change in NWC (w) can be met either by incurring additional net debt or by injecting additional equity (either retained profit or otherwise).

- Need for Additional Debt Finance (NADF) = w – addition to equity

Equation 9: Need for additional finance as function of net cash flow and equity

We are finally now in a position to consider what might cause NADF to be positive (i.e. might cause a firm to need to increase its borrowing from its bank). Loans may or may not be needed to finance growth. If sales (new orders) grow, then work done grows. Thus, after D months cash inflow will grow, but remuneration costs grow immediately and payments for credit purchases grow after C months. In the interim, growth creates a cash flow gap, and thus a Need for Additional Debt Finance arises if C < D and / or the remuneration ratio is high.

Propositions potentially applicable to UK construction contracting firms

For many main contractors, the proposition is that it may be the case that their remuneration ratio is low, and that C > D. If so, then growth actually eases their Need for Working Capital. If Work Done is growing month by month and C > D then receipts (a function of the larger amount of work done only D months ago) will rise relative to outgoings (a function of the smaller amount of work done as long as C months ago). Conversely, a period of declining output will create a Need for Working Capital for such firms.

For subcontractors, however, the proposition is that their remuneration ratio will be relatively high, and that C < D. In that case, growth in sales and work done will generate an increased need for Working Capital (a positive 'w') and thus a positive Need for Additional Debt Finance.

However, loans may also be needed because D is increasing relative to C (the firm, Tier 1 or Tier 2, is collecting from its customers more slowly, on average). The average value of D will of course be pushed up if the proportion of 'very late' trade debts rises. It may also be pushed up if customers on average decide to pay their invoices rather more slowly, so as to economise on their own need for working capital. A proportion of 'very late' trade debts may transpire to be bad debts (uncollectable).

Alternatively, or additionally, D might increase relative to C because C itself falls – that is, if the suppliers of trade credit reduce the period of credit they are prepared or able to offer.

Trade credit reduction and impact

How might suppliers effect a reduction in C for their customers (from the suppliers' perspective, a reduction in D, their trade debtor days)? In effect, in an industry where discounts for payment within a specified period are not used but where there is much repeat business, the decision to trade with Party P is a decision to extend them as much trade credit on that transaction as they decide to take, but the supplier can reduce their average Trade Debtor period by refusing to engage in repeat trades with slow-paying customers.

In economic theory, the idea is that over time, a 'matching' occurs, with slow-paying buyers served only by suppliers prepared to accept high Debtor Days. These suppliers will divide into those who do this only because they cannot attract orders from faster-paying buyers, and those who have decided they can earn their opportunity cost of capital (the return on the extra capital required coming in the form of higher margins from higher selling prices than are available in the other part of the market). In the other part of the market, relatively quick-paying buyers will attract suppliers willing to offer lower prices in return for the expectation of quicker payment.

Suppliers with a particularly low cost of capital will choose to extend the most credit. Buyers with a particularly low opportunity cost of capital will earn a higher return (in the form of lower prices) from using more of their capital to make prompt payments than they could earn in other ways.

Alternatively, instead of thinking in terms of firms with different costs of capital, another form of the model distinguishes between firms that do and do not face a 'biting' financing constraint. Firms that are tightly financially constrained will prefer not to increase their own need for working capital by offering extensive periods of trade credit, and indeed will prefer to reduce the amount of credit they offer, even if this comes at a price of lower sales or lower selling prices.

Firms' cost of capital and risk

It seems plausible to suggest that recent years may have seen an increasing proportion of 'financially constrained' suppliers, and thus that the trade credit period obtained by UK construction firms (offered by their suppliers) may have been falling. On the other hand, poorer business opportunities imply a lower opportunity cost of capital, in which case an increased proportion of those suppliers with sufficient access to finance may prefer to switch towards the parts of the construction market that require them to extend more capital in the form of trade credit.

The perception of the risk involved in offering trade credit is surely of critical importance in determining which of the above forces is stronger. The risk involved is the risk of partial or full creditor default. Offering trade credit is at one level a form of investment, foregoing a (smaller) present income for a (larger) future income. As such it is affected by discount rates (the cost of capital) but also by changes in the perceived riskiness of the cash flows involved. Construction trade creditors are normally unsecured creditors, and thus fully exposed to risk of borrower default. For specialist (Tier 2) contractors in particular, the sums at risk in their dealings with a particular customer may be relatively large.

The adverse economic and financial conditions of recent years may well have increased the risk to Tier 1 contractors that construction clients, especially property developers, may default on payment, turning part of the total advanced by contractors to trade debtors into bad debts. Additionally, the same conditions may have increased the proportion of clients paying unexpectedly late.

Similarly, if Tier 1 contractors are under increased financial constraint, the result might be an increased proportion of unexpectedly late payments by Tier 1 contractors to Tier 2 contractors.

Chapter 2 – Review of trade credit literature

Trade credit and economic theory

For economic theory, the phenomenon to be explained is why, given the existence of financial institutions specialising in the supply of credit, firms whose business is to produce and sell products nevertheless systematically also engage in provision of credit to their customers, that is, trade credit?

The classic literature on trade credit stresses the 'financing motive', the two key ideas being that sellers have cheaper access to capital than do buyers, and that there is a gap between the rate of interest a firm may obtain by lending into the financial system and the rate it pays when borrowing from financial institutions.

Schwartz (1974) sets up a model with large, mature seller firms, typically holding large liquid reserves (bank deposits, holdings of government bills or of commercial paper; or trade debtors), and smaller or newer or fast-growing buyer firms, with constrained or relatively expensive access to conventional capital market finance, including bank finance. The former then find it pays them better to use their liquid reserves to extend trade credit than it would to deposit those balances with banks. That is, the implied rate of interest (the return from the higher 'list' price) obtainable on trade credit loans exceeds the rate of interest from lending to the bank. Schwartz further assumes that the existence of invoice factoring ensures that accounts receivable remain a fully liquid asset, available to be used against contingencies. In Schwartz's model, if the effective rate of interest faced by buyers is less than the effective rate faced by sellers, then instead of observing trade credit being offered and taken we will observe prepayment by buyers, possibly in return for lower prices. The examples cited include prepayment by government on defence equipment contracts, and by shipping companies on shipbuilding contracts.

Schwartz's model predicts that in periods of 'tight' money SMEs will substitute trade credit for bank credit and large firms will extend more trade credit, whereas in periods where monetary policy and practice is 'loose', the reverse will occur, and SMEs will substitute bank credit for trade credit.

However, of the three flows of trade credit found in construction (from producers of building materials and components to contractors; from Tier 2 contractors to Tier 1 contractors; and from Tier 1 contractors to commercial and government construction clients) only the first seems likely normally to be characterised by larger firms with cheaper access to capital on the seller side of the market than on the buyer side. Thus Schwartz's theory seems of limited value to explain construction trade credit practices.

Emery (1984) offers a development on Schwartz's model, in which (risk-adjusted) interest rates paid by borrowers to banks exceed interest rates paid to depositors both because of an element of bank monopoly rent (arising from barriers to entry restricting competition in the banking system) and because banks face higher costs than do supplier firms in

obtaining information on borrower default risk. As a result, both buyer and seller can gain by circumventing the financial system, and one borrowing directly from the other.

In addition to this financing motive, Emery also considers an operational motive, demand smoothing. Following Alchian (1970), he proposes that changing 'list' prices is costly for sellers, and that, faced with economic shocks causing unexpected fluctuations in demand they will find it preferable to change trade credit terms rather than change prices. That is, sellers will react to a temporary shortfall in demand with a temporary relaxation of credit terms, and to a temporary excess of demand with a temporary tightening of credit terms. If we characterise the period 2002-7 as one in which a temporary excess demand for construction emerged in the UK, on Emery's theory we would expect to find a tightening of trade credit terms by sellers and, as in Schwartz's theory, buyers substituting bank credit for trade credit; and the reverse for the period since 2008, insofar as the fall in demand is seen as temporary.

Smith (1987) extends Emery's idea of difference in information costs of discovering risk of borrower default faced by banks and by sellers. In Smith's model, because sellers have invested sunk costs in cultivating buyers, they are prepared to incur borrower monitoring costs that banks would not incur. Smith's model assumes the use of two-part trade credit terms, with a specified discount and discount period as well as a net period. Sellers offer expensive credit, and observe which buyers take the credit rather than obtaining the discount for payment within the discount period. They draw the inference that such buyers must be unable to obtain alternative finance, and that this means they are relatively high default risks. The sellers then focus their monitoring efforts on the buyers who take the trade credit offered.

However, Smith's model is of limited use to explain patterns of construction trade credit simply because two-part credit terms are rare in construction, at least as regards transactions between main and sub-contractors or between main contractors and construction clients.

One view is that trade credit arises to solve information problems concerning product quality, as well as buyer creditworthiness. On product or service quality, offering credit is a way of signalling confidence in product quality, by allowing the buyer to discover quality before paying (Smith, 1987). Most reviews and empirical tests of the theories of trade credit (Petersen and Rajan, 1997; Ng, Smith and Smith, 1999) give prominence to trade credit as quality signalling, especially if the phenomenon to be explained is credit being given by smaller and newer sellers to larger buyers with more established reputations, as often in construction. This branch of theory, however, assumes that sellers offering trade credit are not worried about buyer opportunism (taking-and-not-paying) because suppliers will be hard for a buyer to replace, and can reclaim possession of goods (under the law of some countries) if still in the possession of a non-paying buyer, whilst specialised goods will often have low 'diversion value' (if the buyer diverts the goods to a third party) (Giannetti, Burkart and Ellingsen, 2011). However, whilst diversion is not an issue in construction (because of the spatially fixed nature of the end product), the seller in this setting cannot repossess products supplied, because they will have been incorporated in a building or structure belonging to the construction client. Nor can a construction buyer choose to 'return' defective products to a supplier, once the supplier's goods or services have been transformed and incorporated into the building.

Giannetti et al (2011: 1263) present evidence from the US that, for a range of industries, suppliers with strong reputations offer as much trade credit as those without reputations. This is disconcerting for the quality signalling theory.

The same authors also found that a majority of US firms receive trade credit at relatively low cost, and that large firms with many suppliers are offered more and longer trade credit. Not only do they find that two-part terms with discounts are not the norm, they also find that, within a given industry, firms with large accounts payable have a lower cost of inputs (Giannetti et al, 2011: 1264). These findings are inconsistent with most of the more recent theories of trade credit, which, though differing on other points, tend to agree that trade credit will be more expensive than bank credit.

Trade credit and gearing

The empirical trade credit literature is in total rather small relative to the wider literature on corporate finance, of which it is a part. Bevan and Danbolt (2002) find that, though financial gearing can be defined theoretically as any ratio of non-equity liabilities to assets, most empirical studies of the determinants of the capital structure and gearing of UK, European and US companies, including perhaps the most influential (Rajan and Zingales, 1995; Titman and Wessels, 1988), do not include trade credit received by firms within their definition of gearing. Examining data for the UK for 1991, Bevan and Dunbolt (2002) find that whereas the total debt (TD) to total asset (TA) ratio of UK companies was 18% (at book value), the ratio of TD plus trade credit and equivalent (TTCE) to TA (total non-equity liabilities / total assets) was 49%, and thus that TTCE was equal to 30% of total assets, and 63% of total non-equity liabilities, and was 1.7 times the size of total (non-trade credit) debt. Bevan and Danbolt's data source was 'all' company financial statements held on Datastream, for non-financial companies in the UK. They found that long-term debt accounted for 8% of total assets (over half of this being long term bank borrowing, and the remainder being securitized debt). Short-term bank borrowing accounted for 8% of total assets. Their statistical analysis finds "that trade credit and equivalent are used to finance non-fixed assets (predominantly current assets)" (Bevan and Danbolt, 2002: 166), and that the size of use of trade credit (in proportion to debt) was greater in firms with low proportions of fixed assets to total assets. Construction firms are known to fall in the latter category. The same study (Bevan and Danbolt, 2004: Table 4) found that more profitable firms (those with higher return on total assets) made relatively less use of trade credit from their suppliers, but within a context of making relatively less use of all kinds of debt.

Trade credit and sectors

Within the trade credit literature, relatively few studies use industry or sector as a variable. Most of these few studies do not contain quantitative analyses of financial structure. One that does is the study BERR commissioned from Professor Nick Wilson of Leeds University Business School's Credit Management Research Centre into business-to-business payment trends and behaviour in the UK, 1997-2007 (Wilson, 2008).

Chapter 5 of that study (Wilson, 2008) gives an interesting insight into the overall importance of trade credit, sector by sector, using a broadly similar method to the present study, analysis of a large sample of company accounts. This study also is notable for measuring creditor days using 'implied cost of business-to-business purchases' as the

denominator, recognising that remuneration costs are not eligible for trade credit. The number of companies sampled across the whole economy (with profit and turnover data) varied from year to year, from 228,892 for 1997 to over 300,031 for 2006. It appears that firms were classified to sectors purely using their self-reported primary SIC code. The report contains no account of dispersions, only presenting means, or of any measures taken to remove implausible data. Perhaps as a result, many of the means show high volatility from year to year, and so Wilson's attempt to investigate trends had rather limited success.

For construction, debtor days (trade debtors / turnover x 365) and creditor days (trade creditors / cost of supplies x 365) were broadly similar, at around 70 days each at the start of the period, and around 50-60 days each towards the end. Net trade credit (credit given minus credit received) by construction firms was +5 days in 1997, +12 days in 2005 but –8 days in 2006. Construction net trade credit was found to be negative, in terms of 'days', in 4 years and positive in 6. Because the creditor and debtor period ratios do not share a common denominator, negative net days does not necessarily imply that, in £s, the construction firms in those years were receiving more credit than they were giving.

For construction, the average ratio of trade creditors to total liabilities showed less volatility and a relatively clear upward trend, rising steadily from 66% in 1997 to 79% in 2006. Construction together with business services had the highest sector means for this ratio. By comparison, the average of trade debtors as a proportion of total assets was much less, at around 39%, and showed no trend change.

Unfortunately, these were the only financial ratios investigated. Nevertheless, Wilson's analyses were sufficient to suggest that construction broadly fell in the middle band of sectors in terms of amount of trade credit given relative to assets (trade debtors / total assets), but at the top of sectors in terms of trade credit received relative to liabilities (trade creditors / total liabilities). Construction's creditor and debtor periods both fell in the mid-range for the 13 sectors, being similar to textile manufacturing and transport, higher than retail sector, motor trades, hotels & restaurants, but lower than real estate & business services, wholesale sector, publishing & printing, and machinery manufacturing.

Wilson (2008) also contains some analysis by size of firm (though none by size and sector of firm). Unfortunately, his sample of so-called 'large' (£10m + total assets) firms seems to have contained data outlier problems, showing implausibly high mean values (for example, mean debtor days of over 1,000).

Trade credit and SMEs

Owners of SMEs commonly complain that they suffer from 'late payment', and much of the literature on trade credit and SMEs focuses upon the 'problem of late payment' (for example, Paul and Boden, 2012; Federation of Small Businesses, 2011; European Commission, 2009) but this is not a discrete phenomenon affecting a defined set of transactions. Many studies have shown that it is relatively unusual for trade terms to specify a discount date (payment prior to which generates a discount on price), nor is it at all common to charge explicitly for payment after a specified date, in the form of an extra interest charge. Though transactions do mostly specify a 'net period', and payments can be divided into those made inside and those outside the net period, so many payments are made outside the net period (Wilson and Summers, 2002, p327, found that 40% of all

small business invoices are paid outside the net period) that it is therefore hard to define in a practical way what is and is not ‘late’ or to construe the concept of ‘late payment’ other than as one tail in the dispersion of debtor days – ‘lateness’ is a matter of degree, and not a dummy or binary variable.

A study of the accounts of 10,000 UK SMEs (drawn from the four sectors of manufacturing, construction, wholesale trade and business services) for the period 1988-97 (Poutziouris et al, 2005), estimated that trade debtors represent liabilities equal to 28% of total assets of UK SMEs, and that this percentage was somewhat higher (around 32%) for construction SMEs. Debtor days averaged 45

in the whole sample, but 55 days for construction firms. Creditor days averaged 55 in the whole sample, but only 50 for construction firms.

An analysis of a panel of 47,000 SMEs across Europe (Garcia-Teruel and Martinez-Solano, 2010), using AMADEUS (a pan-European equivalent of FAME, both developed by Bureau van Dyck) found for the UK that total accounts receivable (trade credit given) were 28% of the SMEs’ total assets (33% for construction SMEs), and total accounts payable (trade credit received) were 19% of total assets (29% for construction SMEs), a net excess of accounts receivable over accounts payable of 9% of total assets (4% for construction SMEs). This study’s analysis of data tended to support theories predicting that firms with better and cheaper access to capital markets (larger, established firms) will grant more trade credit than others, and that fast-growing firms will receive and make more use of trade credit from their suppliers.

Using data for small and large firms in the US, Petersen and Rajan (1997) found that “not only do small firms borrow less through trade credit, they also extend less trade credit” (Petersen and Rajan, 1997; 669). In construction, small firms’ mean accounts payable were 5.4% of sales and accounts receivable 10.4%, whereas for large construction firms the ratios were 17.0% and 15.8%. Thus whilst the large construction firms were heavily involved in trade credit they were only minor net receivers of trade credit. However, the small construction firms were substantial net givers of trade credit (p670).

Petersen and Rajan (1997: 675) also have some evidence that bears on Emery’s ‘economic shock’ hypothesis, discussed above (Emery, 1984). Firms that have seen their sales decline and that are making losses, tend to offer more trade credit (higher ratio of accounts receivable to sales).

The same study also finds that firms of observable higher credit quality (as measured by size and profitability) receive significantly more credit from their suppliers. There is thus evidence for the view that suppliers do not vary the price of trade credit with buyer creditworthiness, but instead vary the quantity of credit offered (Petersen and Rajan, 1997:678).

Trade credit and dominant buyers

It was noted in **Chapter 1** that representatives of construction subcontractors often claim that they are obliged to offer cheap trade credit to dominant buyers – large Tier 1 contractors. This involves the idea that certain sets of Tier 1 contractors are able to exercise economic power in their transactions and relationships with certain sets of Tier 2 contractors.

If this view is correct, it must follow that the implicit interest rate obtained by Tier 2 contractors on the trade credit they extend to Tier 1 contractors must be below the rate of interest at which Tier 1 firms could borrow from their banks, so that Tier 1 firms positively prefer to receive trade credit rather than bank credit. In this aspect the 'dominance' model generates a similar prediction to Schwartz's (1974) model. However, the models diverge in respect of the predicted relative returns to Tier 2 firms to supplying trade credit versus the return they could earn on capital by deploying it in another way – their opportunity cost of capital. In the 'dominance' hypothesis, the subcontractors earn less than their opportunity cost of capital, and perhaps less than their own cost of borrowing, on their trade credit, whereas in Schwartz's model both seller / lenders and buyer / borrowers benefit from offering and taking trade credit and eliminating financial intermediation by banks.

Relatively few empirical studies have tested this dominance hypothesis. Two that have touched upon it are Paul and Wilson (2006) and (2007). The latter study found that over 38% of firms in its multi-industry sample (19% of which were construction firms) "operate in markets that are dominated by large buyers of their products", and therefore decided to test the proposition that "bargaining power (in) markets dominated by large buyers is likely to result in (sellers) offering longer trade credit periods" (Paul and Wilson, 2007: 106). The same study also tested the proposition that firms (such as construction main contractors) that are obliged to offer more trade credit to their own customers will then tend to demand to obtain more trade credit from their suppliers, to finance their accounts receivable from their accounts payable. The study found support (statistically significant at 1% confidence level) for positive association between proportion of accounts receivable in total assets and proportion of accounts payable. In other words, firms such as Tier 1 construction contractors that need more finance (because of the trade credit they are required to offer their customers, reflecting market power of those customers) seem able to demand and obtain more trade credit from their suppliers, possibly reflecting market power of those firms over their suppliers.

Trade credit, equity and bank finance

If we sum and average figures for samples or populations of individual firms, then trade credit received or given appears to far outweigh bank finance as a source of credit, and to be roughly on a par with equity in importance as a component of total assets or liabilities. Several studies have reported this result. Paul and Wilson (2006) found credit given (trade debtors) to be between 30 and 40% of all firms' balance sheets. Our own finds likewise (see **chapter 4**). However, we must then ask: where do the firms that offer trade credit themselves raise their finance? Do they obtain their finance from banks, from equity, of from other firms? For the non-financial company sector as a whole, it is the net balance of trade debtors (credit given) minus trade creditors (credit received) that can be compared

with equity and bank finance to indicate their relative importance in financing the company sector.

Also, if we consider the construction sector as a whole, how much of its combined assets are financed by trade credit received from firms in other supplying industries, and how much is one construction firm's trade credit given cancelled out by another's trade credit received? Studies using data from company accounts will be unable to answer this at the level of a single firm, as such data does not identify who (which suppliers, in which industries) is providing a firm with trade credit, only that in total such credit is provided. However, if we are able accurately to divide a sample of construction contractors into Tier 1 and Tier 2 contractors, then the combined trade debtors of the Tier 1 firms will represent credit extended by the construction industry to customers outside the industry, and the combined total of trade credit given by Tier 2 contractors will show the extent to which those firms are financing the assets of the Tier 1 firms, and can be 'netted out' to arrive at an estimate of total credit received by the construction industry from suppliers outside the industry.

Strategic management of cash flow in construction

In addition to the trade credit literature, also relevant to this study is a small construction economics and management literature on the 'strategic management of organisational cash flow' (Kenley, 2003) by main contractors, which proposes that the latter are able (so long as their turnover does not shrink) to generate large recurrent positive net cash surpluses from operations (essentially, from being paid by customers before they pay their suppliers), and obtain their corporate profits as much from investing these surpluses as from final profit margins on projects (Punwani, 1997). Kenley (2003, chapters 7 and 8) develops a mathematical model with plausible assumptions in which final profit margins per project of 5% of turnover on average generate cash surpluses from the portfolio of projects of a minimum of 20% of turnover. Keeping turnover growing is critical however. "Under conditions of recession, there is evidence of a change in direction of the working capital profile. As total workload falls, there is a net reduction in the stream of interim payments from clients. Although the levels of debtors, stock and work in progress begin to fall, outstanding liabilities to creditors on old projects are still due." (Punwani, 1997)

The argument is as follows. "The construction industry has low barriers to entry, and permits small undercapitalised operators to enter and exit at will…This encourages a culture where working capital is generated from operations, as firms struggle to overcome their lack of financial backing. There is a great deal of evidence that contractors manipulate the (progress) payment system in order to achieve this end" (Kenley, 2003: 232). Useful tools in that 'manipulation' are held to be: front-loading (unbalancing the prices for elements in a bid, so that earlier elements are 'overpriced' and later elements 'underpriced'); delaying payment to suppliers beyond the due date; attaching favourable 'milestone' schedules to projects without monthly valuations using bills of quantities, such as design-and-build or guaranteed maximum price contracts. If these methods are used, then Kenley's model suggests cash surpluses much larger than 20% of turnover. Elazouni and Metwally (2000) suggest that ability to gain access to cash flow is a main reason why powerful main contractors have, over time, shifted from in-house production to outsourcing (subcontracting), and that "subcontracting is a practice that contractors rely on to partially finance projects". Kenley (2003: 256) concludes that: "it can be seen that for a very small investment there is a huge return (for the main contractor). The funds generated from

operations are potentially far greater than the value of the organisation managing them. This, properly managed, gives the contracting organisation significant opportunities, but also leads to significant risk for the system".

Chapter 3: Method

This Chapter will deal with issues of data sampling, cleaning, quality and coverage as well as calculation of variables and analyses performed.

Possible approaches to analyses

Two broad types of approach are possible for empirical research into trade credit. One is to take the single transaction as the unit of observation, and to identify the terms of the transaction and attributes of the buyer and of the seller. This can yield high-quality information on actual transactions, but it is very difficult indeed to construct samples of transactions that are large enough or representative of all transactions involving a particular industry, such as construction.

The other approach, and that taken here, is to take the annual activity of a company as the unit of observation, that is, to use audited annual financial statements. If balance sheet data are used to estimate average credit periods for transactions by calculating Creditor Days or Debtor Days, two caveats must be noted. First, the original data relates to all the different kinds of sales and purchases in which a company is engaged, and this set may be wider than the set of research interest. That is, if the researcher wishes to focus on activities covered by SICs 41 to 43, and to this end selects companies whose primary activity is covered by one of those codes, one must face the fact that their accounts may include non-construction activities under their non-primary SIC codes. Some companies report both a primary and several subsidiary SIC codes, but accounts of course do not indicate the proportions of turnover, assets or profit attributable to each coded activity. Second, there is a necessary assumption that the day of drawing-up of the balance sheet is a typical day, and that firms have not deliberately delayed or brought forward expenditures or receipts so as to ‘improve’ the appearance of their performance as shown in their annual accounts.

Data Source

The source data was sampled using the Financial Analysis Made Easy (FAME) database. This service collates the financial statements companies submit to UK Companies House, the agency responsible for collecting and making available information on companies according to the UK Companies Acts.

The advantage of this data source is the access it gives to all available balance sheets and profit & loss accounts of UK companies, thus allowing formation of large samples of accounting data. If the focus of interest is a particular industry, as here, it has the added advantage that company returns to Companies House include (self-classified) allocation of the company to a Standard Industry Classification (SIC) code (between 2 and 5 digit levels), for its primary activity. If the focus of interest is in a particular business activity found within an industry (here, construction contracting) there is the additional advantage of the Trade Description each company provides.

The data source also allows formation of a control or benchmark sample, against which to measure results for the industry sample of interest, in order to test whether we can reject, with statistical confidence, the null hypothesis that the results for the two samples (industry and benchmark) could in fact have been obtained by drawing two samples from a single underlying distribution. If we can reject the null hypothesis, then we can state with confidence that the results found for the construction industry do indeed show that there are real differences between the distribution of the values for the variables of interest in construction and in the benchmark.

The benchmark chosen here is simply a FAME sample drawn from and named the 'Rest of the Economy'.

Forming the samples

To define the principal comparative samples of 'Construction Industry' and 'Rest of Economy' specific search steps were applied within the FAME database to filter out firms that were not suitable for inclusion in our samples.

The following search criteria and associated Boolean 'AND' or 'NOT' application of each step were used to create each sample, with the numbers of firms meeting each requirement shown. Numbers removed and remaining are given as rounded approximations, because FAME is a 'dynamic' database in which numbers of firms continually change as they are born and die. The purpose here is to indicate which exclusion criteria were applied, and why, and which steps removed many and which only removed few firms.

- FAME contains (in 2013) approximately 8,400,000 companies.

- **Step 1:** The first restriction is to limit the sample to those with one of four legal forms: private, public quoted, public AIM, public not quoted. This removes, amongst others, limited liability partnerships, foreign companies and unlimited companies. The information required for the analysis is not available for partnerships, the terms on which trade credit can be given or obtained will be quite different for companies with unlimited liability, and the Department's brief was to limit scope to UK companies. The effect of this step is to remove around 500,000 companies. This leaves around 7,900,000.

- **Step 2:** The next restriction is to limit the sample to firms still trading ("Active – not in receivership or dormant"). One intention of this and other steps listed below is to allow an analysis of trends over time based as far as possible upon data for the same set of firms in each year. Companies not trading in all the years under study (2005 to 2011) would not report full or relevant accounts, or yield any information on use of trade credit in trading, for one or more years. However, this requirement did also have the effect of excluding some companies put into receivership in 2012 or 2013 that might have reported full accounts of active trading in 2005-11. The application of this step limits the sample to firms still actively trading in 2011, and other steps listed below limit the sample to firms already existing in 2005.

This step removes companies that are dissolved, in liquidation, in receivership, or dormant. The effect of this step is to remove around 5,400,000 companies. This leaves around 2,500,000 companies.

- **Step 3:** The next restriction is to limit the sample to companies reporting a positive value for Shareholders Funds in each of the years 2005 to 2011. One intention of this and other steps listed below is to allow an analysis of trends over time based as far as possible upon data for the same set of firms in each year. Firms without positive shareholders funds in a year will either be dormant, not yet formed or have liabilities in excess of their assets. In the latter case the firms should not continue to trade. Since Shareholders Funds is the denominator in many measures of profitability, allowing negative values introduces meaningless values for rate of profit. The effect of this step is to remove around 2,000,000 firms, mainly firms classed as 'small' under the Companies Act and thus allowed to file abbreviated balance sheets, but also firms that started trading after 2005, some that ceased trading by 2011 but whose legal status is still 'Active', and a smaller number with negative values for Equity in one or more years. This step leaves around 500,000 companies.

- **Step 4:** The next restriction is to limit the sample to companies reporting a capital employed (Total Assets minus Current Liabilities) of at least £10,000 in each of the years 2005 to 2011. The intention of this step is to remove the smallest 'micro' firms, for which there may be no clear distinction between income and assets of company and individual owner. Companies with at least £1 million of turnover (another requirement – see below) that state they have less than £10,000 of capital are often in fact using the personal assets of the proprietor as guarantees or collateral for bank credit or as a direct source of short term loans, thus yielding misleading values for capital, and thus for ROCE. It is also likely that such companies have working proprietors, and that the 'profit' may include the implicit wage income of the proprietors. On the other hand, director's remuneration may outweigh profit. The effect of this step is to remove around 170,000 firms, some of which may be 'exempt' firms that do report shareholders funds but do not report capital employed. This step leaves around 330,000 firms.

- **Step 5:** The next restriction is to limit the sample to companies reporting some value (positive or negative) for profit before interest, in each of the years 2005 to 2011. The intention of this step is to remove firms for which rates of profit cannot be calculated. The preponderant reason for firms not reporting a value for profit is that they are exempted under the Companies Act, as small firms, from the requirement to submit a Profit & Loss Account. The effect of this step is to remove a further 275,000 firms, approximately. This step leaves around 55,000 firms.

- **Step 6:** The next restriction is to limit the sample to firms reporting a positive value for trade creditors in each of the years 2005 to 2011. FAME adopts the practice of entering all liabilities in principle as 'minus £X', meaning simply that liabilities are to be deducted from assets to arrive at net assets. Its formulae then correct for this by stating the liability item as - (-£X). Sometimes, confusion of signs arises in transcription at FAME. If the minus sign is omitted in the transcription, the outcome is that the company appears to have negative liabilities, a logical absurdity. One objective of this step is therefore to remove such cases of miss-transcription. An alternative, and more common, reason for no reported value for trade creditors is that the firm has submitted an incompletely itemised (abbreviated) balance sheet, allowed if it is classed as small under the terms of the

Companies Act. Obviously, if there is no useable data for trade creditors, there is no point in including a firm in the sample. The effect of this step is to remove a further 25,000 firms, approximately. This step leaves around 30,000 firms

- **Step 7:** This step limits the sample to firms reporting a value for turnover of at least £1m in each year for 2005 to 2011. Now, there are in fact only around 32,000 such firms out of the whole 8.4 million in the database (though some 150,000 with such a turnover in at least one of the years 2005 to 2011). Much of the difference between the 150,000 and 32,000 arises from fluctuations taking a small firm's turnover below the £1m level in one year. However, the decision to require the specific minimum of £1m, rather than some other value, is somewhat arbitrary. The intention is to remove 'micro' firms, to permit focus on analysis of ratios appropriate to small (not 'micro'), medium and large firms. It was expected that contractors' profit margins would on average be less than 5%. A turnover of £1m with such a margin implies an average profit for the firm of around £50,000 p.a. We took this to be the smallest value at which the actual profit of a small firm can dominate and outweigh the imputed labour income of its working proprietors or directors' remuneration (see Step 4). The effect of this step is to remove a further 11,000 or so of the 30,000 left after Step 6, leaving around 19,000. In effect this step seems to be removing some of the firms that, though exempt from the requirement to do so under the Companies Act, because their turnover is in one or more years below £1m thus putting them well below the £5.6m threshold for exemption, nevertheless choose to file a Profit & Loss Account, and hence have not already been excluded by Step 5.

- **Step 8:** This step limits the sample to firms reporting a value for the ratio of Turnover to Total Assets of no more than 365-to-1. This limit value would imply that a firm turned all its assets into sales every single day of the year. This is therefore a safely conservative upper limit to what could conceivably be a credible value for this ratio. The intention was to remove firm's whose reported values could not conceivably have resulted from trading operations, but only from the effect of overwhelming exceptional or extraordinary items, or from miss-transcription. In practice this step removes only around 50 firms. This step leaves around 19,000 firms.

At the date of formation of the Whole Economy sample, the exact number of companies remaining after applying Steps 1 to 8 was 19,094.

For the formation of the Construction sample and the Rest of Economy benchmark sample, as well as all of the above the following additional steps are applied. The Construction sample and Rest of Economy benchmark sample are thus drawn from and are sub-samples of the Whole Economy sample.

- **Step 9:** This step produces a benchmark (Rest of Economy) sample by removing specific industries. These include: construction (SIC codes 41, 42 and 43, as the comparator industry - approximately 1600 firms); financial services, insurance and pensions (SIC codes 64 and 65, removed as firms with very different financial structures to those in other industries and which therefore are not wanted in the benchmark - approximately 770 firms); and firms listed as within public administration and defence (SIC code 84 - approximately 20 firms). The remaining 16,700 firms then form the benchmark Rest of Economy sample used in comparative analyses.

- **Step 10:** Primary SIC code 41 or 42 or 43 (construction sector). Step 10 identifies all firms within the Whole Economy sample, given by steps 1 to 8, that classify their main activity as within the construction industry, as represented by the SIC codes 41 (Construction of Buildings), 42 (Civil Engineering) and 43 (Specialised Construction Activities). As a reasonably accurate distinction between Tier 1 and Tier 2 Contractors, 41 and 42 represent 'Main' Tier 1 Contractors, with 43 representing 'Specialist' Tier 2 Contractors. This step removes 17,500 or so firms (those with non-construction primary SIC codes), and leaves around 1,600.

- **Step 11:** This step recognises that the 1,600 generated by Step 10 will include many firms that are not in fact contractors, but actually property or housing developers (housing developers are classed to SIC 41), or other firms whose business, whilst built-environment related, does not involve performing construction work on contract for customers. This is done by excluding firms with words within their FAME Trade Descriptions that highlight the fact they are engaged in some other type of built environment sector activity. These Boolean NOT terms are variants on the word 'develop' plus 'property' plus 'housebuilding' plus 'homes' plus 'infrastructure'. In the main, the firms excluded by these NOTs comprise developers who seek profit on the appreciation of the property assets they own over time, that is they do not profit only from the activities of physical construction of building and infrastructure for owners thereof. The term infrastructure was made a Boolean NOT to remove those firms that own and maintain infrastructure and may classify themselves as SIC 41, 42 or 43 but who are not in fact construction contractors. For example, Network Rail Infrastructure Ltd classify themselves as SIC 41, and would be in the sample according to the above criteria were it not for the addition of this search term. Few firms that are actually primarily contractors will have been removed from the construction sample by applying these exclusions. This step removes some 500 firms. The step leaves some 1,150 potential firms for the construction contractor sample. On the day of formation of the construction sample it left exactly 1,183 firms.

- **Steps 12 and 13:** The 1,183 firm sample was then examined to identify cases of double-counting, that is where a subsidiary is present as well as its parent and so the turnover, assets, etc. of the subsidiary are counted both at that lower level as well as at the level of the parent. The search for cases of double counting used two methods.

First, inspection of the sample by alphabetical name order revealed cases of firms with very similar names. We then checked ownership trees (in files for individual companies in FAME) to ensure that these were in fact cases of double counting, and removed the subsidiary rather than the holding company, so long as the latter did not include substantial non-contracting turnover and shared the same 2-digit SIC classification. If these conditions were not met, we removed the holding company instead. Checking names also revealed some companies that had clearly (as confirmed by their Trade Descriptions) misclassified themselves to a construction SIC, such as Specsavers Plc (opticians), Encon Insulation Ltd, SIG Plc (manufacturers and distributors), and Homeserve Membership Ltd (retail sale of insurance). Such companies were removed from the sample; as were companies identified, initially by their name, as PFI special purpose companies. This was necessary because the balance sheets of PFI companies are fundamentally different from those of construction contractors, with far higher proportion of assets to turnover and far higher long-term gearing.

Second, for the 50 largest construction groups (top companies as listed at www.theconstructionindex.co.uk), and for the largest 100 companies by turnover in the sample of 1,183, lists of all group companies and ownership-trees were compared with the sample list. Our initial construction sample sometimes did not contain the most appropriate level of companies within the largest (top 50) construction groups. It sometimes contained companies at too high a level, so that some of their turnover was not from construction contracting, or the 'wrong' subsidiary companies from within a group (e.g. facility management companies and / or not the construction contracting companies), either because firms had given themselves SIC codes inappropriate to their trade description (for example some ultimate-owner firms report their industry as SIC 70 'Activities of head offices', even though the activity of the group of companies in question is clearly mainly limited to construction), or used one of our NOT words in their trade description though manual inspection revealed the company to be a contractor; or there might simply be double-counting of the same turnover. Finally there were a few large companies that, though contractors, obtained their turnover as holding companies of overseas subsidiaries, and are thus not financed by UK trade credit.

These two measures led to the exclusion of 206 firms from the sample (Step 12) but also to the addition of 45 firms to the sample (Step 13). Most additions at Step 13 were in fact replacements of less appropriate companies within the same ownership group, removed at Step 12. All 45 additions relate to the larger groups of construction companies. This left a final construction sample of 1,022 firms.

These samples, taken on specific days from the dynamically evolving FAME database were then: (1) saved as 'search results', to allow a subsequent re-visit of FAME to look again at exactly the same set of companies; (2) exported from FAME into Excel for initial analytics, and from thence into SPSS for statistical analysis.

The row Step Results shown below indicate the number of companies in the FAME database that meet the specific criterion of that row alone.

Table 3: Search step results for sample creation in FAME

Step	Criteria	Step result
1.	Legal form: Private, Public quoted, Public A.I.M., Public not quoted	7,858,963
2.	All active companies (not in receivership nor dormant)	2,782,719
3.	Shareholders Funds (th GBP): 2011, 2010, 2009, 2008, 2007, 2006, 2005, **min=0**, for all the selected periods	714,573
4.	Total Assets less Cur. Liab. (th GBP): 2011, 2010, 2009, 2008, 2007, 2006, 2005, **min=10**, for all the selected periods	432,502
5.	Profit (Loss) before Interest paid: **All companies with a known value**, 2011, 2010, 2009, 2008, 2007, 2006, 2005, for all the selected periods	128,879
6.	Trade Creditors (th GBP): 2011, 2010, 2009, 2008, 2007, 2006, 2005, **min=0**, for all the selected periods	61,480
7.	Turnover (th GBP): 2011, 2010, 2009, 2008, 2007, 2006, 2005, **min=1,000**, for all the selected periods	32,122
8.	Total asset turnover ratio: 2011, 2010, 2009, 2008, 2007, 2006, 2005, **max=365**, for all the selected periods	78,289
9.	UK SIC (2007): Primary codes only: **41** - Construction of buildings, **42** - Civil engineering, **43** - Specialised construction activities	564,307

Steps 12 and 13, above, exclude from or add to the sample individual firms by specifying their unique registration numbers. Note that the Boolean application means that companies identified in Step 13 are added regardless of other search criteria and companies identified in Step 12 are actively removed from the final sample regardless of their adherence to other steps.

The Rest of Economy sample is all the firms within the economy in all industries (beside those stated) that meet the requirements of Steps 1 to Step 9. This results in a very large sample (over 16,500 companies) that will of course be very heterogeneous in terms of the size, type, activity and structure of firms. Because of its size, it proved impracticable to subject it to the same kind of manual checking for double-counting of parent and subsidiary as was performed for the construction sample. This does mean that Step 12 and Step 13 produce a construction sample that is not generated on a completely like-for-like basis to the rest of economy sample. These steps do somewhat raise the average size of the firms in the construction sample. However, the proportion of firms in the final

construction sample added or removed by Step 12 and Step 13 is modest and in our view not sufficient to invalidate comparison of means and medians for size-normalised ratios between the construction and whole economy samples.

Step 12 and Step 13 were undertaken in order to improve the 'quality' of the construction sample. By that term what is meant is that the sample has as high a coverage ratio as possible (as far as is practicable, that every non-micro contractor that existed throughout the period is included), given the other Step requirements, and that it contains as far as is practicable only companies that are actually construction contractors.

Small construction firms deserve a separate study of their financial structures. The method however for such a study should be to first form a sample of small firms from the FAME or similar databases, and then to obtain the necessary information on financial structure, turnover, profit and use of trade credit by a questionnaire survey of those firms.

The samples in this study are of 'survivor' firms only. That is, they comprise only firms that existed already in 2005 and still existed in 2011. Again, the financial structure in years immediately prior to entering receivership of non-surviving firms deserve a separate study, as do the financial structures of very recently established firms.

Whole and Restricted (implied credit purchases) construction samples

The 1,022 Construction Contractors identified above form the core sample of the Construction Industry analysis. However, to focus specifically on the impact of Trade Credit, a sub-sample of 710 were identified that report in each year both Cost of Sales as well as Remuneration. The presence of these variables allows the calculation of what is referred to in this report as 'Implied Purchases on Credit':

- Implied Purchases on Credit = Cost of Sales minus Remuneration of Employees

Equation 10: Calculation of Implied Purchases on Credit

The relevance of this variable is to remove the costs companies incur that are not subject to Trade Credit, this in the main being Remuneration of Employees with whom there are strict payment terms usually either weekly, bi-weekly or monthly. The residual of Cost of Sales – Remuneration are costs which represent purchases from other firms, on which a company can feasibly obtain trade credit, that is defer payment to supplier for some period of time subject to, or sometimes in excess of, agreed payment terms. This is used to calculate the Adapted form of the variable Creditor Days to account for the fact wages and salaries (on which trade credit is not available) account for differing proportions of firms' Costs of Sales. Whereas the standard calculation of Creditor Days is:

- (Trade Creditors / Turnover) * 365

the Adapted form is calculated as;

- (Trade Creditors / Implied purchases on Credit) * 365.

Equations 11 A & B: Alternative calculations of Creditor days

Data cleaning

Outliers

No manual data cleaning was applied to the data. Very high (outlier) values for some variables were observed in firms in individual years resulting in high annual standard deviations in some cases. These represented much less than 1% of annual samples and have not been removed in part to allow for easier replication of results. Further work could be undertaken to remove their influence, though as the study focuses on period averages for firms, the influence of these high values for individual years only will be much reduced.

Missing values

In addition to the criteria applied via the FAME search steps detailed above, some additional criteria were applied to the data for single years to improve final data quality. These included:

- Must record a Turnover in each respective year
- Must record a Total Assets value in each respective year
- Must record a Profit Before Interest and Tax in each respective year
- Profit margin (PBIT/ Turnover) must be below 100% in each respective year

Thus, for example, a firm not reporting a key variable (such as turnover or total assets) in year x was removed from the calculation of averages for year x. It was not however removed from the sample.

The impact of these criteria on removing firms in individual years is minimal, with much less than 1% of the total observations (N firms times 7 years) being affected.

Period averages

Where single averages for variables are presented, they represent either the arithmetic average of firm level period averages, or weighted averages based on summed period averages of the numerator, divided by summed period averages of the denominator.

A firm level period average is calculated as the arithmetic average of the firm's annual results throughout the study period. For example, the firm level period average operating margin is its unweighted average over the seven years, that is, each year has the same weight in terms of a firm's period average operating margin.

Trend analyses

Where trends of variables over time are presented, these represent annual weighted averages. Weighted averages can be related to sectoral national accounts data. If for example total bank lending to construction were to increase over time, as a proportion of construction sector assets, this would be expected to show up as an increase in the sample weighted average for the ratio bank credit / total assets.

Weaknesses of financial accounting data

Working with the data, the most apparent weakness is missing values for firms for particular variables in particular years. Some variables are generally well reported but with gaps in one or a few years. Other variables are only reported in any years by a fraction of all firms in the sample. The Step criteria include some steps that ensure the sample is comprised of firms that report key variables such as profit and capital employed well throughout the study period. Where year gaps were present, for x years, analyses involving that variable for that firm were processed for the 7 – x years, as better than removing the firm completely from the analysis. In such cases the corresponding numerator or denominator variables appearing in ratios using the missing variable were also removed for the affected firms for the affected years.

When dealing with databases of company accounts there is the issue of erroneous data. The recording, submission, collection and collation of such vast amounts of data are a complex set of processes that involves some opportunity for error to enter. The chance of encountering some inaccurate values when dealing with such large datasets is high. Non-credible values occur here and there, having disruptive effects on the averages calculated for certain variables. Confusion between £s and £000s seems a main source of such errors, resulting in values that are in error by several orders of magnitude. It would be fair to assume that the occurrence of erroneous values is completely random as in the main they are likely the result of transcription error. However, their random nature does not mean they can be ignored as the vast majority of the variables we are concerned with are constrained to positive values, hence randomly arising large positive values are not cancelled out by random large negative values. To remove them would involve imposing limits that might also remove valid observations, so at this stage they have been left in. As stated, in any event, the effect of a single extreme value in any one year will be diluted by both a focus on period averages for the firm, rather than year by year comparisons, as well as by the large sample sizes being observed.

Another issue with accounting data is of course the different forms of accounting standards. The two standards present in the samples analysed include the International Financial Reporting Standard (IFRS) and the UK GAAP standard. They do differ in the way they account for certain aspects of the balance sheet, profit and loss, and cash flow. It is partly for this reason that we incorporate Trade Creditors with Accruals and Trade Debtors with Work in Progress.

One particularly pertinent issue for analysis of financial data is the reduced requirement for smaller firms to report data, particularly ‘small’ firms not required to submit a profit and loss account and only an abbreviated balance sheet. This rules out the possibility of using accounts databases to construct completely random samples of the population of all firms.

Coverage ratios

The samples used are of large size. To give an indication of the proportion of the construction industry covered within our data, the table below presents coverage ratios for some key variables. These ratios indicate the proportions of total construction industry gross value added, remuneration and sales contributed by the firms within our sample. The key measure here is that of turnover. The 25% coverage ratio for turnover in the six years of the study period indicates the sample is a good one in terms of representing the wider medium and large firm contract construction industry, accepting that it excludes micro sized firms (who account for 33% of all construction output) and under-represents small non-micro firms (who account for around 14% of output), and excludes housing developers (who account for around 16% of output). In other words, a complete 'census' of non-exempt contractors would cover around 44% of total construction industry output (the 53% by firms above 'exemption' size of the 84% of construction output that is by contractors and not by developers). Our coverage (28%) is thus around 60% of that achievable by a complete census.

The denominators for these ratios were sourced from the 2012 Blue Book. See below for alternative measures of coverage ratio.

Table 4: Sample Coverage ratios for GVA, Remuneration and Turnover

Coverage ratios for Construction sample	Sample Sum GVA / Industry GVA	Sample sum Remuneration / Industry Remuneration	Sample Sum Turnover / Industry Total Output
2005	0.122	0.197	0.222
2006	0.127	0.198	0.232
2007	0.123	0.190	0.230
2008	0.134	0.208	0.267
2009	0.143	0.219	0.275
2010	0.148	0.215	0.260
2005 - 2010			0.248

GVA is equal to Remuneration of Employees plus Gross Operating Surplus (including mixed income of the self-employed). The GVA coverage ratio is below the remuneration coverage ratio because of the importance of the mixed income (i.e. the entire income, undivided between a wage element and a profit element) of working proprietors in the Gross Operating Surplus of the construction industry. The sample does not include the micro firms of such working proprietors.

The Remuneration coverage ratio is below the Turnover / Gross Output coverage ratio because many firms in the sample do not report Remuneration.

We can see from Table 1, **Chapter 1** that 'micro' firms account for 33% of all 'work done' (a concept intermediate between gross and net output) in the construction industry. It is reasonable therefore to assume that they also account for 33% of total output in the construction industry.

The total output of housing developers (classed to the construction industry) is not measured by the Construction Statistics series, 'Value of Output – new housing, private', which attempts only to measure the value of construction work in the houses built and sold by the private house building industry, and thus excludes the value of the land sold. To estimate the total value of turnover (sales) of all housing developers the best approach is to multiply an appropriate measure of quantity sold (DCLG / ONS Housing Statistics Table 241 - Dwellings Completed, private: UK Historic Series by Calendar Year) by an appropriate measure of average market price of newly built dwellings (DCLG / ONS Housing Statistics Table 503 - Simple Average Prices, new dwellings: UK). This method generated column 2 in the following table.

Table 5: Calculation of effective sample coverage ratios of Construction industry

	1 Construction Industry total output at basic prices (UK Blue Book) £m	2 Estimated total output of housing developers £m	3 = 1 - 2 Estimated total output excluding housing developers £m	4 Estimated total output of 'micro' contractors (33% share of 3) £m	5 = 3 - 4 Estimated 'non-micro' firms total output £m	6 Estimated total output of firms not exempt under Companies Act (53.3% share of 3: see Table 6) £m	7 Sample Sum Turnover £m	8 = 7 / 6 Effective coverage ratio (%): Sample turnover / est. total output of firms not exempt
2005	196,894	27,997	168,897	55,736	113,161	90,022	43,676	48.52
2006	211,255	37,696	173,559	57,274	116,285	92,507	49,044	53.02
2007	235,479	55,309	180,170	59,456	120,714	96,031	54,214	56.45
2008	229,467	39,369	190,098	62,732	127,366	101,322	61,292	60.49
2009	207,084	25,994	181,090	59,760	121,330	96,521	56,890	58.94
2010	207,863	21,413	186,450	61,529	124,921	99,378	54,062	54.40
2005-10								55.60

This method of measuring the 'effective' coverage ratio involves two assumptions:

1) Since the data from which we can calculate the share of Micro and Small firms in construction output (Construction Statistics Annual, Table 2.9) defines them in terms of number of employees, but our effective definition is, 'companies excluded from the Sample

because they do not meet one of Steps 1 to 8', and that is likely to be because they are a company allowed under the Companies Act not to file a Profit & Loss Account and to file only an abbreviated balance sheet (and thus was most likely excluded by Step 3 – Shareholders Funds not reported, or by Step 4 – Capital Employed not reported, or by Step 5 – Profit / Loss not reported, or by Step 6 – Trade Creditors not reported), we need to be able to 'translate' number of employees into one of the two other criteria (the third criterion is having 50 or less employees) then existing under the Companies Act to give exemption, that is, turnover below £5.6m or total assets below £2.8m. Since construction companies tend to have relatively high ratios of turnover to total assets (median ratio of 2.4 for the whole construction sample), so that a firm falling above threshold on turnover, say £6m, would fall below threshold on total assets, at around £2.5m, it is thus likely that most construction firms falling below the overall threshold will do so because their total assets are less than £2.8m, plus one or other of the other two thresholds.

To see what size of firm in terms of turnover corresponds to different numbers of employees, the consultants examined a sub-sample (firms with names beginning with the letter A-G, and employing less than 100) of our sample. Few of these firms (approximately 1 in 6) employed less than 50 persons. Turnover per employee (in 2011) had a wide range, from a minimum £70,000 up to a maximum £2,154,000. However, 40% of firms in the sample had turnover per employee of £135,000 or less, and 20% had turnover per employee of £121,000 or less. At £120k turnover per employee, £5.6m turnover 'translates' to 47 employees, roughly equal to the 50 employees of the Companies Act definition of 'small'. At £135k turnover per employee, £5.6m 'translates' to only 41 employees. Thus most (80%) firms at the employment threshold will be above the turnover threshold. It thus tends to be falling below the employees threshold that gives firms exemption from full filing, rather more often than it is falling below the turnover threshold.

Thus we conclude that in effect most firms employing less than 50 persons will be exempt, and find that most of these do exercise their exemption rights. Thus, in effect our sample is mainly drawn from and covers mainly only firms employing 50 or more. To allow a 'safety margin' (and reflect the fact that 1 in 6 firms in our sub-sample of firms employing less than 100 did in fact employ less than 50), we might consider the 'bar' for being required to report full accounts as being set "at or above" 34 employees, a boundary used in Construction Statistics, Table 2.9. This is a 'conservative' assumption, tending to understate the market share of firms actually exempted – in practice many firms employing between 34 and 50 persons will be exempt, whilst fewer firms employing less than 34 will not be exempt – and thus to understate the sample coverage ratio, by overestimating the value of the denominator in the coverage ratio.

Table 6: Value of work done by size and trade of firm

Employment range	Work done (£m)	Share (%)
0-13	40,312	33.0
14-34	16,754	13.7
0-34	57,066	46.7

Source: Construction Statistics 2012, Table 2.9 Data are for 2011, 3rd quarter.

Thus the estimated share in total output of firms not exempt from full filing (not 'small' in terms of the Companies Act) is 100 – 46.7 = 53.3%.

2) The second assumption made is that the shares of 'micro' (employing 0-13) and 'small' (exempt from full filing because below size thresholds of Companies Act) are similar for the activities of housing developers and for those of contractors. In practice, the house building market is known to be more concentrated than the construction contracting market, so this is a 'conservative' assumption, tending to understate the share of micro / small firms in construction contracting output, and thus to overstate the estimated output of firms not exempt (column 6, above), the denominator in the effective coverage ratio. We can therefore be reasonably confident that the effective coverage ratio achieved by the sample is at least the percentage shown in column 8.

High coverage ratios, in terms of % of relevant total output covered, have the implication that sample weighted means may be reasonable approximations of 'population' weighted means, that is fair approximations for the industry.

Coverage ratios can also be calculated in terms of the proportion of total number of firms (as opposed to proportion of total output) included in the sample. The FAME database contains 228,000 sets of accounts for 'active' private and public limited companies with Primary SIC codes 41-3. However, of these: some 181,000 have full exemption; a further 16,000 file 'small company' accounts; and account type is not recorded for 19,000. Only 8,300 file 'full accounts'. Thus between 86% and 95% (depending on how we treat 'type not recorded') of all registered construction companies do not file full accounts because they are exempted by virtue of small size.

Almost exactly twenty per cent of firms in the construction sample have annual average turnovers of £5.6m or less (value for the second decile of the Turnover variable distribution = £5,637,000). Thus of the 1022 sampled firms, 200 are 'small' firms (Companies Act turnover definition) and some 800 are not. Splitting the coverage ratio into two components, we can say that the sample covers only a very small proportion of 'small' firms but a much higher proportion of other firms. There are 200 out of some 200,000 'small' construction companies in the sample (a coverage in terms of proportion of number of firms of 0.1%) and some 800 plus out of 8,300 'non-small' (filing full accounts) companies sampled (10%).

It also follows that the 0.1% sample coverage of 'small' firms indicates how low a proportion of the 200,000+ firms entitled to claim exemption do not in fact do so. It is the firms with turnovers below £5.6m that nevertheless file full accounts that have found their way into the sample and constitute the 0.1%.

Chapter 4 – Findings

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Thus for example Table 1 A is: Size of firm – construction and rest of economy.

Statistical testing of arithmetic means

Independent sample t-tests have been applied to arithmetic means to test whether the differences observed results from mere chance on sampling, or are the result of the defining characteristic of the sample (for example Construction industry versus Rest of the Economy). Asterisks (*) are used to indicate if statistically significant differences have been observed.

Construction contractors compared to rest-of-economy benchmark

Comparison of size of firms

The firms in the construction sample (CC) are smaller than in the benchmark rest-of-economy (RE) sample. The mean turnover of construction firm is only one-third that of the benchmark sample (£53m against £169m). The median turnover of construction firms however is only slightly below that of the rest of the economy (£14.7m against £16.5m). The respective total asset means show an even greater disparity in average size: £32m for CC against £195m for RE (one-sixth). The median value of total assets of construction firms is £7m against £12m for RE. For capital employed, the respective figures are: CC mean £15m, median £2.7m; RE mean £117m, median £5.8m (CC less than one-seventh the RE mean).

Our 'representative' size (median) construction firm then has a turnover / total assets ('operating multiplier') ratio of 14.7 / 7.2, compared with the representative RE firm with a ratio of 16.5 / 11.8. Thus we see immediately that construction firms do tend, as expected, to have relatively high 'operating multipliers', of around 2:1. (See **Chapter 1**: 'Gearing and operational ratios', for definition of the 'operating multiplier', discussion of the implications of a high 'operating multiplier', and explanation of why it is expected to be relatively high in construction companies.)

Table 1 A

£m	CC - median	CC - mean	RE - median	RE - mean
Turnover	14.66	53.42**	16.52	169.37
Total Assets	7.16	32.39**	11.83	194.96
Capital Employed	2.67	14.61**	5.79	116.73

* - significant difference to 95% level ** - significant difference to 99% level

The difference between the proportions of medians to means in the two samples arises because the construction sample contains a smaller and less extended tail of very large firms. In such one-tailed size distributions, if we want to imagine a 'representative' firm, the median firm is a better choice for our focus than the firm whose values approximate to the mean. For an alternative concept of a 'representative firm', applicable when analysing ratios rather than sizes, it is possible to use weighted means. In effect, weighted means for a ratio are the sum of the values for the numerator (using period averages for all firms) divided by the sum of the values for the denominator (period averages for all firms). The weight given to a firm is proportional to its share in the sum of the denominator values. If we imagine an investor (UK PLC?) owning all the shares of all the firms in the sample, firms carry relative weights in that investor's portfolio equal to their relative size. The sample's weighted mean ratios would be the performance ratios for that investor's portfolio.

If, for instance, larger firms tend to have lower values and small firms have higher for a ratio (such as ROCE), then the weighted mean ROCE will be lower than the simple arithmetic mean of the ROCEs of each firm (in which each firm counts equally).

Values in the top and bottom deciles of the distribution for a ratio are more likely for a small firm than a larger firm (because a larger firm's results are more likely to be the outcome of an internal averaging across many markets and lines of business).

If implausible 'extreme values' for a ratio are relatively more common amongst small firms and rare amongst larger firms (as is likely, because less corrected after errors being identified and reported by users), then the influence of those extreme value cases is much reduced upon a weighted mean, compared to a simple mean. This is a useful property if those extreme values may for example result from a clerical confusion of £s and £thousands in data logged at Companies House. Such errors of orders of magnitude for larger firms are perhaps less likely to be made in the first place, but also if made are less likely to survive uncorrected in the Companies House or FAME database, because more Companies House and FAME users will be interested in a larger firm than in a smaller one and thus errors affecting larger firms are more likely to be corrected after being identified and reported to Companies House or to FAME by its users. See **Chapter 3**.

Comparison of financial performance of firms

Because this study is concerned with trade credit, a current liability, the most appropriate form of Du Pont formula is that linking Return on Capital Employed (ROCE) to Return on Total Assets (ROTA). The formulae are:

- (1) PBIT / K (ROCE) must equal PBIT / Turnover (Operating Margin) x Turnover / Total Assets (Operating Multiplier) x Total Assets / Capital ('Current Gearing');

and

- (2) PBIT / Total Assets (ROTA) must equal PBIT / Turnover x Turnover / Total Assets.

Thus;

- (3) ROCE must equal ROTA x Total Assets / Capital ('Current Gearing')

Also

- (4) ROCE must equal PBIT / Turnover (Operating Margin) x Capital Turnover Ratio (Turnover / Capital Employed)

Equations 12, 13, 14 and 15: Du Pont Identities showing Accounting components of ROCE and ROTA

Comparison of these six ratios for the two samples reveals the following.

Table 1 B

% & ratios	CC - median	CC - mean	CC - weighted mean	RE - median	RE - mean	RE - weighted mean
Profit margin (%)	3.48	5.81**	4.33	4.98	7.36	10.17
Operating Multiplier	2.428	2.430**	1.650	1.615	1.920	0.869
ROTA (%)	7.58	9.17	7.14	7.63	9.66	8.83
Current Gearing	2.564	3.680*	2.217	1.811	3.329	1.670
ROCE (%)	20.01	29.64	15.82	15.70	26.89	14.75
Capital Turnover			3.66			1.45

* - significant difference to 95% level ** - significant difference to 99% level

Thus the 'representative' (weighted mean) construction contractor has a slightly lower rate of return on total assets (ROTA) than the representative benchmark firm, but a somewhat higher return on capital employed (ROCE). In terms of the components of Formula (2), above, the construction firms obtain that slightly lower ROTA by having a much below-benchmark profit margin but largely offset by also having a much above-benchmark 'operating multiplier' (total asset-turnover ratio). In terms of the components of Formula (3), above, their ROCE is above-benchmark entirely because the construction firm has above-benchmark level of current gearing, that is, more current liabilities per £ of capital employed.

If ROCE correlates with level of current gearing, the inference is that the cost of that gearing is below the weighted average cost of capital. There is an analogy here with long-term gearing raising Return on Shareholders Funds (ROSF) above ROCE, so long as the cost of long-term debt is below ROCE.

The implied cost of trade credit (the main component of construction current liabilities and thus the origin of higher current gearing: see Table 1C below) is a higher price for purchases and thus lower margin. The relatively high current gearing of the representative construction firm helps explain its relatively low margin.

If the higher 'current gearing' of construction is the result of higher use of trade credit (see below), the cost of that extra credit (in lower margins), however, would appear (as seen in their higher mean ROCE) to be somewhat less than the benefit obtained, in higher turnover per £ of capital employed.

Relative importance of trade credit

The mean value of trade credit plus accruals per firm in the construction sample is £10.1m, and the median value is £2.2m. In the benchmark sample the mean is £27m and the median is £2.1m. Given that the mean construction firm has only one-seventh the capital and one-sixth the total assets (and one-third the sales) of the mean benchmark firm (see above), these simple magnitudes begin to show the relatively greater importance of business-to-business credit received in the balance sheets of construction firms than in the economy taken as a whole.

Table 1 C

Ratios	CC - median	CC - mean	CC - weighted mean	RE - median	RE - mean	RE - weighted mean
Trade Credit / Curr. Liabs.	0.434	0.438**	0.359	0.276	0.311	0.171
Trade Credit + Accruals / Curr. Liabs.	0.601	0.579**	0.586	0.486	0.482	0.272
Trade Debt / Curr. Liabs.	0.572	0.624**	0.372	0.514	0.559	0.196
Trade Credit / Total Assets	0.234	0.263**	0.197	0.101	0.145	0.068
Trade Debt / Total Assets	0.319	0.330**	0.204	0.209	0.233	0.079
Creditor days (Tr. Cr. / Turnover) x 365	37.20	41.06**	43.66	25.37	31.77	28.77
Debtor days (Tr. Db. / Turnover) x 365	52.46	54.05*	45.20	50.15	51.70	33.08

* - significant difference to 95% level ** - significant difference to 99% level

The table shows that trade credit has approximately double the share in the balance sheet (total assets) of construction firms that it has in the balance sheets of the benchmark firms, and that this is so whether we look at the mean or the median. If we look instead at the weighted means, we find that trade credit's share in construction balance sheets is approximately triple its share in benchmark balance sheets.

Whereas construction has a fairly typical period for debtor days‡ (median 52, mean 54 and weighted mean 45 against benchmark median 50, mean 52 and weighted mean 33) and proportion of trade debt to current liabilities (mean 0.62 and median 0.57 against benchmark mean 0.56 and median 0.51, though the respective weighted means show a greater difference and are 0.37 and 0.20), it has much above-benchmark values for creditor days (median 37, mean 41 and weighted mean 44 against benchmark median 25, mean 32 and weighted mean 29) and for trade credit as a proportion of current liabilities (median 0.43, mean 0.44 and weighted mean 0.36 against benchmark median 0.28. mean 0.31 and weighted mean 0.17.

For about 50% of all construction firms, the need for working capital is negative – that is, trade creditors (+ Accruals) exceed trade debtors (+ WIP). For the remaining 50% it is positive. The median value of working capital is near zero. In other words, for the 'representative firm' goods and services received from suppliers ahead of payment entirely finances the production period and the credit they give to their customers.

Bank finance

Table 1 D

Ratios	CC - median	CC - mean	RE - median	RE - mean
Bank credit (sh. tm.) / Curr. Liabs.	0.025	0.081**	0.042	0.109
Bank credit (sh. tm.) / Total Assets	0.014	0.043**	0.016	0.051
Other (i.e. bank) long term loans / Total Assets	0.000	0.034**	0.000	0.052

* - significant difference to 95% level ** - significant difference to 99% level

In contrast, short-term bank credit is even more relatively unimportant in the balance sheet of construction firms than in the rest of the economy as a whole (means of 4% for construction and benchmark 5% of total assets are financed by short-term bank credit).

Comparison of these low mean ratios with the medians and distribution, for construction contractors, show that the importance of the banks is not as a continuing rolling source of substantial finance to the industry as a whole, but more as a provider of temporary credit and contingent facilities to particular firms to cope with fluctuations in operating cash flow.

At any one time, one third of construction contractors have zero overdraft or short-term bank loan. On the other hand, at any one time, for 10% of contractors, short-term bank finance is over 22% of their total current liabilities. Two thirds of all contractors have no

‡ Trade Creditors and Debtors are stocks (balance sheet items). Turnover is a flow (p / l account item). The concepts of debtor and creditor days describe the stock relative to the flow, as equal to so many days flow of sales. Debtor Days = (Trade Debtors / Turnover) x 365; Creditor Days = (Trade Creditors / Turnover) x 365.

long term borrowing at all, and for only 10% of contractors is long-term bank debt financing more than 8% of their total assets.

Total financial structure

Here we looked at the proportions of firms' total assets that were financed by each main source of finance, from equity to trade credit.

Table 1 E

% of Total Assets	CC - median	CC - mean	CC - weighted mean	RE - median	RE - mean	RE - weighted mean
Capital	0.394	0.420**	0.451	0.563	0.552	0.596
Equity	0.314	0.347**	0.254	0.413	0.427	0.336
Long Tm. Liabs.	0.019	0.073**	0.197	0.073	0.135	0.265
Current Liabilities	0.606	0.580**	0.549	0.452	0.461	0.401
Trade Creditors + Accruals	0.332	0.346**	0.321	0.182	0.217	0.109
Sh. Tm. Bank credit	0.014	0.043**	0.034	0.016	0.051	0.037
Current Tax Liabs.	0.054	0.066**	0.032	0.034	0.046	0.023
Other Curr. Liabs.[1]	0.175	0.218	0.164	0.176	0.229	0.226

* - significant difference to 95% level ** - significant difference to 99% level

1. Other Current Liabilities is calculated as a residual of Current Liabilities minus observed components.

Looking at the proportion of assets financed by equity or by capital employed, compared with the rest of the economy, the construction contractors do appear somewhat undercapitalised.

Current liabilities in general, and trade credit in particular, are a significantly larger part of their balance sheet total than in the benchmark sample. Trade creditors plus accruals account for around one third of construction contractors' total assets (mean, weighted mean and median are similar) but on average for only 11% (weighted mean) or 22% (arithmetic mean) of total assets in ROE.

The importance of 'accruals', particularly but not only for construction is revealed by comparing row 5 in Table 1E (Trade Creditors + Accruals / Total Assets) with row 3 in Table 1C (Trade Creditors / Total Assets):

% of total assets	CC - mean	CC - weighted mean	RE - mean	RE - weighted mean
Trade Credit + Accruals (Table 1E)	0.346	0.321	0.217	0.109
Trade Credit (Table 1C)	0.263	0.197	0.145	0.068
Accruals	0.083	0.124	0.072	0.041

The higher weighted mean than arithmetic mean for share of accruals in construction balance sheets shows that here accruals are a particularly large item for the larger firms. This is not the case, however, in the rest of the economy.

The importance of HMRC (tax liabilities) as a source of short-term finance across all industries but especially in construction[§], is not perhaps well known, and is interesting in suggesting a possible 'lever' for government industrial strategy. It may deserve further investigation. That this is clearly more important for small firms than for large ones is shown by the difference between the simple arithmetic means and the weighted means, the latter dominated by the larger firms. Across the economy, short-term tax liabilities are comparable in size to short term bank credit to firms for all but the very large firms.

[§] If the taxes in question are in large part payroll-related, it is possible that this ratio will also be relatively high in other labour-intensive industries, besides construction.

Main contractors (SIC 41 and 42) compared to specialist contractors (SIC 43)

Comparison of size of firms

Table 2 A

£m	Tier 1 - median	Tier 1 - mean	Tier 2 - median	Tier 2 - mean
Turnover	19.79	73.86**	11.29	32.47
Total Assets	10.09	43.15**	5.35	19.94
Capital Employed	3.33	17.67*	2.11	10.13

* - significant difference to 95% level ** - significant difference to 99% level

On all three measures of size, the Tier 1 firms ('main contractors'.) are significantly larger than the Tier 2 contractors ('specialist contractors'). The median main contractor has almost double the sales and assets of the median specialist contractor. However, it is notable that in contrast the median main contractor has only 50% more capital employed than the median specialist contractor. Tier 1 contractors thus have higher proportions of Current Liabilities to Total Assets, (since Capital Employed is defined as = Total Assets – Current Liabilities), which may be attributable to higher levels of Trade Credit received.

Comparison of financial performance of firms

Table 2 B

% &ratios	Tier 1 - median	Tier 1 - mean	Tier 1 - weighted mean	Tier 2 - median	Tier 2 - mean	Tier 2 - weighted mean
Profit margin (%)	3.00	6.05	3.68	3.94	5.16	5.74
Operating Multiplier	2.352	2.406	1.712	2.381	2.475	1.628
ROTA (%)	6.57	8.12**	6.31	8.49	10.26	9.36
Current Gearing	2.772	3.777	2.441	2.385	3.598	1.968
ROCE (%)	19.19	29.05	15.39	21.57	30.49	18.42
Capital Turnover			4.18			3.20

* - significant difference to 95% level ** - significant difference to 99% level

The median and weighted mean financial performance of the Tier 2 firms is somewhat higher, on profit margin and ROTA, than that of the Tier 1 firms. They have somewhat lower current gearing.

In so far as the higher 'current gearing' of main contractors is the result of higher use of trade credit from subcontractors, the cost of that extra credit (in higher purchase prices and thus lower margins) would appear to be at least equal to the benefit obtained, in greater turnover per pound of capital employed. This is shown in the lower weighted mean ROCE of the main contractors than of the specialist contractors.

Relative importance of trade credit

Table 2 C

	Tier 1 - median	Tier 1 - mean	Tier 1 - weighted mean	Tier 2 - median	Tier 2 - mean	Tier 2 - weighted mean
Trade Credit / Curr. Liabs.	0.461	0.459**	0.365	0.414	0.421	0.325
Trade Credit + Accruals / Curr. Liabs.	0.667	0.616**	0.594	0.565	0.546	0.520
Trade Debt / Curr. Liabs.	0.458	0.549**	0.311	0.657	0.691	0.480
Trade Credit / Total Assets	0.256	0.285**	0.216	0.215	0.244	0.160
Trade Debt / Total Assets	0.277	0.294**	0.184	0.352	0.363	0.236
Creditor days (Tr. Cr. / Turnover) x 365	38.95	44.42**	45.97	33.85	37.79	35.85
Debtor days (Tr. Db. / Turnover) x 365	42.80	47.39**	39.16	58.62	59.67	52.97

* - significant difference to 95% level ** - significant difference to 99% level

The key differences between Tier 1 and Tier 2 are in debtor days, the ratio of trade debt to current liabilities, and the relationship between creditor and debtor days.

For the Tier 1 firms, creditor days are approximately equal to debtor days, and trade debt (in £ per firm) is approximately equal to trade credit. That is, the Tier 1 firms receive an amount of trade credit from their suppliers that is just equal to (and so sufficient to finance) the credit they give to their customers, clients outside the industry.

For the Tier 2 firms, creditor days are less than 60% of debtor days, and trade debtors is half as large again (in £ per firm) than trade creditors. That is, the Tier 2 firms receive significantly less credit from their suppliers (mainly, firms outside the construction industry) than they give to their customers, mainly Tier 1 firms in the construction industry.

Thus both Tier 2 firms and ultimately their suppliers are helping to finance the operations of Tier 1 firms, and provide the latter with the finance they then use to extend trade credit to construction project clients.

For Tier 1 firms, the need for working capital to finance operations is usually negative, whereas for Tier 2 firms it is usually positive – see table 2 F below. In the rest of the economy, about 30% of firms have negative need for working capital to finance operations; in construction Tier 1, about 55% of firms do; but in construction Tier 2 only about 25% of firms do.

Insofar as other (non-trade credit) finance or equity capital is needed by firms to finance their working capital, it is clear the need lies mainly with Tier 2 firms in construction.

Table 2 F

£m per firm	Tier 1 - median	Tier 1 - mean	Tier 2 - median	Tier 2 - mean
Need for Working Capital (£m)	0.12	-3.72**	0.51	0.88

* - significant difference to 95% level ** - significant difference to 99% level

Bank finance

Table 2 D

Ratios	Tier 1 - median	Tier 1 - mean	Tier 2 - median	Tier 2 - mean
Bank credit (sh. tm.) / Curr. Liabs.	0.001	0.089	0.003	0.080
Bank credit (sh. tm.) / Total Assets	0.001	0.046	0.002	0.046
Other (i.e. bank) long term loans / Total Assets	0.000	0.041	0.000	0.043

* - significant difference to 95% level ** - significant difference to 99% level

These ratios are very similar, and low, for both types of construction contractor. They show that the importance of the banks is not as a continuing rolling source of substantial finance to the firms, but as a provider of temporary credit and contingent facilities to cope with fluctuations in operating cash flow (the difference between median and means shows that

bank credit is negligible at any one time for most firms of both types, but important at any one time for some firms of both types).

Total financial structure

Table 2 E

% of Total Assets	Tier 1 - median	Tier 1 - mean	Tier 1 - weighted mean	Tier 2 - median	Tier 2 - mean	Tier 2 - weighted mean
Capital	0.362	0.405	0.410	0.420	0.430	0.508
Equity	0.290	0.331**	0.216	0.342	0.364	0.345
Long Tm. Liabs.	0.011	0.074	0.193	0.013	0.067	0.163
Current Liabilities	0.638	0.595	0.590	0.580	0.570	0.492
Trade Creditors + Accruals	0.384	0.382**	0.350	0.287	0.313	0.256
Sh. Tm. Bank credit	0.001	0.046	0.037	0.002	0.046	0.026
Current Tax Liabs.	0.041	0.052**	0.026	0.069	0.080	0.048
Other Curr. Liabs.[1]	0.174	0.226	0.157	0.165	0.215	0.144

* - significant difference to 95% level ** - significant difference to 99% level

1. Other Current Liabilities is calculated as a residual of Current Liabilities minus observed components.

The financial structures of the two types of contractor are broadly rather similar, with two exceptions. Trade credit received is relatively more important as a means of financing total assets in the balance sheets of Tier 1 firms than of Tier 2. Weighted mean equity share in total assets is lower in Tier 1 than in Tier 2.

Current tax liabilities are relatively more important as a means of financing assets in the balance sheets of Tier 2 firms than in those of Tier 1 firms. This is perhaps because the majority of such liabilities may be payroll tax related, and Tier 2 firms tend to be more labour-intensive (have lower value of total assets per employee).

SME contractors compared to large contractors

Comparison of size of firms

Table 3 A

£m	SME - median	SME - mean	Large - median	Large - mean
Turnover	10.08	13.17**	82.93	183.03
Total Assets	4.83	8.85**	40.13	105.24
Capital Employed	1.77	4.82**	12.29	43.42

* - significant difference to 95% level ** - significant difference to 99% level
Note: 'Large' firms here defined as those with period average turnover over £40m. 'Small and medium enterprises' (SME) here defined as those with period average turnover of £40m or less. Hence there is no surprise that there is statistical difference in the size measures of the two samples.

Comparison of financial performance of firms

Table 3 B

Ratio	SME - median	SME - mean	SME - weighted mean	Large - mean	Large - mean	Large - weighted mean
Profit margin (%)	3.51	5.75	5.12	3.15	5.11	4.14
Operating Multiplier	2.339	2.428	1.488	2.437	2.484	1.739
ROTA (%)	7.49	9.34	7.61	7.41	8.74	7.20
Current Gearing	2.410	3.511*	1.835	3.157	4.263	2.424
ROCE (%)	19.45	28.84	13.96	23.48	32.82	17.44
Capital Turnover			2.73			4.22

* - significant difference to 95% level ** - significant difference to 99% level

SME and large construction contractors have similar median margins, turnover / total asset ratios (operating multipliers) and ROTA. Large firms have somewhat higher ratios of Total Assets to Capital Employed (current gearing) and higher ROCE. The inference from association of levels of current gearing with ROCE is that the cost of that gearing (mainly the cost of trade credit) is below the weighted average cost of capital. That is, greater use (taking) of trade credit raises current gearing by more than it depresses profit margin (and

thus depresses ROTA). Larger firms take relatively more trade credit (have higher current gearing), and gain higher ROCE, despite having almost identical ROTA.

Insofar as the higher 'current gearing' of large firms is the result of higher use of trade credit from suppliers, the cost of extra trade credit (in higher purchase prices and lower margins) appears to be less than the benefit obtained, in terms of greater turnover per £ of capital employed, thus resulting in a higher mean ROCE for the larger firms.

Relative importance of trade credit

Table 3 C

Ratio	SME - median	SME - mean	SME - weighted mean	Large - median	Large - mean	Large - weighted mean
Trade Credit / Curr. Liabs.	0.439	0.443	0.388	0.422	0.431	0.347
Trade Credit + Accruals / Curr. Liabs.	0.583	0.562**	0.521	0.701	0.642	0.584
Trade Debt / Curr. Liabs.	0.609	0.662**	0.461	0.434	0.490	0.337
Trade Credit / Total Assets	0.228	0.258	0.176	0.246	0.284	0.204
Trade Debt / Total Assets	0.325	0.342**	0.210	0.281	0.289	0.198
Creditor days (Tr. Cr. / Turnover) x 365	35.47	40.40	43.27	38.76	43.31	42.73
Debtor days (Tr. Db. / Turnover) x 365	52.79	56.18**	51.44	44.19	45.60	41.56

* - significant difference to 95% level ** - significant difference to 99% level

Whereas the share of trade creditors in current liabilities is similar for SME and large construction firms, the large firms have significantly higher ratios of accruals to current liabilities (as is seen by comparing rows 1 and 2). This suggests either that suppliers are more prepared to invoice larger firms periodically, rather than for each delivery, or that large firms are slower than SMEs in recognising invoices as trade creditor liabilities, or that large firms' suppliers are perhaps more likely to be SMEs than are the suppliers to SMEs, and that SMEs are slower at issuing invoices. The last explanation would be in line with the findings of other studies (Paul and Boden, 2012). Whatever the explanation may be, the differential importance of accruals does suggest that previous quantitative studies that

have omitted attention to accruals and focused only on data for trade creditors may have missed a key part of the phenomena of business-to-business payment.

The key differences between SMEs and large firms are in debtor days, and the relationship between creditor days and debtor days. For large firms, creditor days are approximately equal to debtor days, and trade debt (in £ per firm) is approximately equal to trade credit. The large firms receive an amount of credit from their suppliers that is sufficient to finance the credit they give to their customers. For the SMEs, creditor days are around 70-75% of debtor days. That is, small firms receive significantly less credit from their suppliers than they give to their customers. Large firms and SMEs receive similar amounts of trade credit (as proportions of turnover), but the SMEs collect receipts from their customers relatively more slowly.

However, it is noteworthy that the differences between net debtor days (debtor days minus creditor days) here (debtor days minus creditor days for SMEs has net debtor days mean = 16 and median = 17; for large enterprises, net debtor days mean = 2 and median = 5) are smaller than those found above, between Tier 1 and Tier 2 firms (net debtor days for Tier 1 has mean = 3, median = 4; for Tier 2 net debtor days mean = 22, median = 25). The difference of means between Tier 1 and Tier 2 is 19 net debtor days; the difference of means between SMEs and larger firms is 14 net debtor days.

Given the Tier 2 firms tend to be smaller and Tier 1 firms larger, the inference is that it is Tier as such, rather than size, that has the bigger impact (the prediction would be that a Tier 1 SME would have a lower net debtor days than a Tier 2 large enterprise).

Bank finance

Table 3 D

Ratio	SME - median	SME - mean	Large - median	Large – mean
Bank credit (sh. tm.) / Curr. Liabs.	0.005	0.094**	0.000	0.055
Bank credit (sh. tm.) / Total Assets	0.003	0.051**	0.000	0.030
Other (i.e. bank) long term loans / Total Assets	0.000	0.035	0.000	0.031

* - significant difference to 95% level ** - significant difference to 99% level

There is no evidence here to support the idea that in construction SMEs receive less finance from banks (relative to their balance sheet totals) than do larger construction firms taken as a whole. In fact they seem to access more short term credit as proportions of their balance sheet totals.

Total financial structure

Table 3 E

% of Total Assets	SME - median	SME - mean	SME - weighted mean	Large - median	Large - mean	Large - weighted mean
Capital	0.416	0.435**	0.545	0.318	0.361	0.413
Equity	0.341	0.367**	0.315	0.251	0.282	0.242
Long Tm. Liabs.	0.009	0.067	0.230	0.021	0.080	0.171
Current Liabilities	0.584	0.565**	0.455	0.682	0.639	0.587
Trade Creditors + Accruals	0.299	0.325**	0.237	0.422	0.420	0.343
Sh. Tm. Bank credit	0.003	0.051**	0.055	0.000	0.030	0.027
Current Tax Liabs.	0.058	0.071**	0.041	0.038	0.053	0.010
Other Curr. Liabs.	0.149	0.201**	0.115	0.237	0.282	0.163

* - significant difference to 95% level ** - significant difference to 99% level

Looking at the proportion of total assets financed by equity or by capital employed, the larger contractors appear more undercapitalised than the smaller contractors (Table 1E: rest of economy arithmetic mean for capital / total assets = 0.552; weighted mean = 0.596).

Current liabilities in general, and trade creditors in particular, are a larger part of the balance sheet of the larger contractors than of the SME contractors.

Analysis of adjusted creditor periods for firms reporting remuneration

The analysis of 'adjusted' trade creditor period as not:

- (Trade creditors / turnover) x 365,

but instead;

- (Trade creditors / implied b2b purchases) x 365

is superior in principle if we wish to use the ratio to estimate the actual number of days of trade credit taken by purchasers in a typical construction transaction, and thus to relate this to number of days of trade credit given (trade debtor days) by suppliers.

However, it is only possible to derive Implied b2b purchases by deducting Remuneration of employees from Cost of Sales (see **Chapter 1**).

Of the 1022 firms in the construction sample, only 710 report Remuneration fully.The following analyses therefore are for this 710 firm sub-set.

First, a comparison of the size and business type of firms in the sub-set with those in the whole construction sample, reveals that the restricted (710 firm) analysis is relatively biased towards larger firms but not towards Tier 1 firms.

In terms of performance characteristics, the restricted sample has slightly lower profit margins and profitability ratios (the difference is statistically significant for arithmetic mean margins and ROTA but not for ROCE).

Table 4 A and B

£m	Whole (W) construction sample n = 1022	Restricted (R) construction sample n = 710
Turnover: mean	53.42	68.81
Turnover: median	14.66	20.17
Total Assets: mean	32.39	37.86
Total Assets: median	7.16	9.26
Capital: mean	14.61	14.98
Capital: median	2.67	3.36

Ratios		
Profit margin: mean %	5.81**	3.92
Profit margin: median %	3.48	3.12
Profit margin: weighted mean %	4.33	3.80
Operating multiplier: mean	2.43	2.41
Operating multiplier: median	2.43	2.40
Operating multiplier: weighted mean	1.65	1.82
ROTA: mean	9.17**	7.99
ROTA: median	7.58	6.79
ROTA: weighted mean	7.14	6.91
Current gearing: mean	3.69	3.73
Current gearing: median	2.56	2.88
Current gearing: weighted mean	2.22	2.53
ROCE: mean	29.64	26.41
ROCE: median	20.01	19.56
ROCE: weighted mean	15.82	17.47

* - significant difference to 95% level ** - significant difference to 99% level

Table 4 G

	Number (Whole)	Number (Restr.)	Proportion of sample: (Whole)	Proportion of sample (Restr.)
Tier 1	516	362	0.51	0.51
Tier 2	506	348	0.50	0.49
Large enterprises	239	204	0.23	0.29
SMEs	783	506	0.77	0.71
Total	1022	710	1	1

Total financial structure

Table 4 E

% of Total Assets	R sample - median	R sample - mean	R sample - weighted mean	Whole sample - median	Whole sample - mean	Whole sample - weighted mean
Capital	0.370	0.399*	0.396	0.394	0.420	0.451
Equity	0.307	0.337	0.257	0.314	0.347	0.254
Long term liabilities	0.025	0.062	0.139	0.019	0.073	0.197
Current liabilities	0.630	0.601*	0.604	0.606	0.580	0.549
Trade creditors + accruals	0.366	0.375**	0.360	0.332	0.346	0.321
Short-term bank credit	0.014	0.041	0.032	0.014	0.043	0.034
Current tax liabilities	0.052	0.061*	0.034	0.054	0.066	0.032
Other current liabilities	0.181	0.230	0.181	0.175	0.218	0.164

* - significant difference to 95% level ** - significant difference to 99% level

It is clear that changing the basis of the construction sample results in few significant changes to the total financial structure, and none in terms of relative proportions of bank credit, or equity. However, one of those few changes is that the arithmetic mean share of trade credit plus accruals is significantly larger in the restricted sample than in the whole sample.

Relative importance of trade credit

Table 4 C

Ratio	R sample - median	R sample - mean	R sample - weighted means	Whole sample - median	Whole sample - mean	Whole sample - weighted means
Trade Credit / Current Liabilities	0.455	0.451	0.350	0.434	0.438	0.359
Trade Credit + Accruals / Current Liabilities	0.631	0.610**	0.596	0.601	0.579	0.586
Trade Debt / Current Liabilities	0.566	0.598	0.368	0.572	0.624	0.372
Trade Credit / Total Assets	0.244	0.277	0.218	0.234	0.263	0.197
Trade Debt / Total Assets	0.319	0.332	0.222	0.319	0.330	0.204
Creditor days: turnover measure	39.94	43.01	44.18	37.20	41.06	43.66
Adapted Creditor Days	75.34	73.01	71.39	n.a.	n.a.	n.a.
Debtor days: turnover measure	53.57	54.32	45.35	52.46	54.05	45.20

* - significant difference to 95% level ** - significant difference to 99% level

Comparison shows very similar means and median values for the restricted sample as for the whole sample, for the ratios used in earlier tables to measure the relative importance of trade credit, with the single exception of the ratio of Trade Credit plus Accruals to Current Liabilities, which is significantly higher in the restricted sample.

The new ratio (Creditor days = 365 x {trade creditors / (cost of sales minus remuneration of employees)} provides the best estimate for the average number of days construction firms take to pay their b2b suppliers of goods and services. Comparison of this value with

that for debtor days reveals that, on average, construction firms do not “pay when paid”, but rather pay their suppliers substantially after themselves being paid by their customers.

Debtor Days and Creditor Days (b2b purchases): Tier 1 and Tier 2 firms – restricted sample

Table 5 C

Ratio	Tier 1 - median	Tier 1 - mean	Tier 1 - weighted mean	Tier 2 - median	Tier 2 - mean	Tier 2 - weighted means
Adapted Creditor days	67.99	61.34**	65.41	75.32	84.79	60.81
Debtor days	42.80	47.39**	39.16	58.62	59.67	52.97

* - significant difference to 95% level ** - significant difference to 99% level

Thus, typically, a Tier 1 contractor gives its customers (construction clients) 43(median) or 47 (mean) days trade credit, but receives 68 days (median) or 62 days (mean) trade credit from its suppliers, who will include Tier 2 contractors. In contrast, typically a Tier 2 contractor gives its customers (Tier 1 contractors) 59 days trade credit, but receives 75 days (median) or 85 days (mean) trade credit from its suppliers, who will mainly be firms outside the construction industry.

It would appear that Tier 1 contractors pay their subcontractors (Tier 2 contractors) almost exactly as slowly (59.67 days mean for Tier 2 firms’ debtor days, used here as a proxy for subcontractor-specific creditor days of Tier 1 contractors) as they pay all suppliers, including manufacturers and merchants (61.34 days).

Debtor Days and Creditor Days (b2b purchases): SMEs and large enterprises – restricted sample

Table 6 C

Ratio	SME - median	SME - mean	SME - weighted mean	Large - median	Large - mean	Large - weighted mean
Adapted creditor days	73.56	73.48	59.32	66.87	71.77	65.09
Debtor days	52.79	56.18**	51.44	44.19	45.60	41.56

* - significant difference to 95% level ** - significant difference to 99% level

Thus, typically (medians), a large contractor gives its clients 44 days trade credit, but receives 67 days trade credit from its suppliers. In contrast, typically, a SME contractor gives its clients 53 days trade credit, but receives 74 days trade credit from its suppliers.

Time series of financial structure and performance

Graphs 1: Construction sample (Whole)

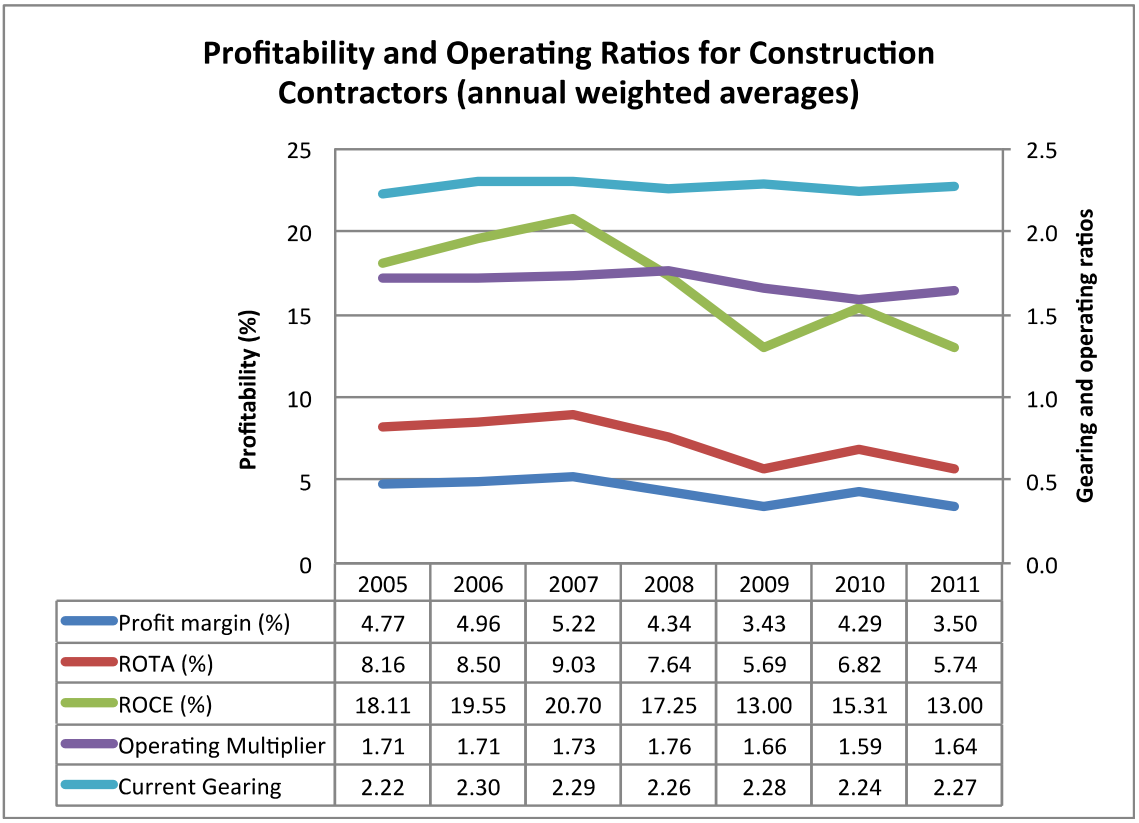
Graphs 2: Rest of Economy sample

Graphs A: Profitability and Operating Ratios

Graphs B: Sources of Finance as proportions of Total Assets

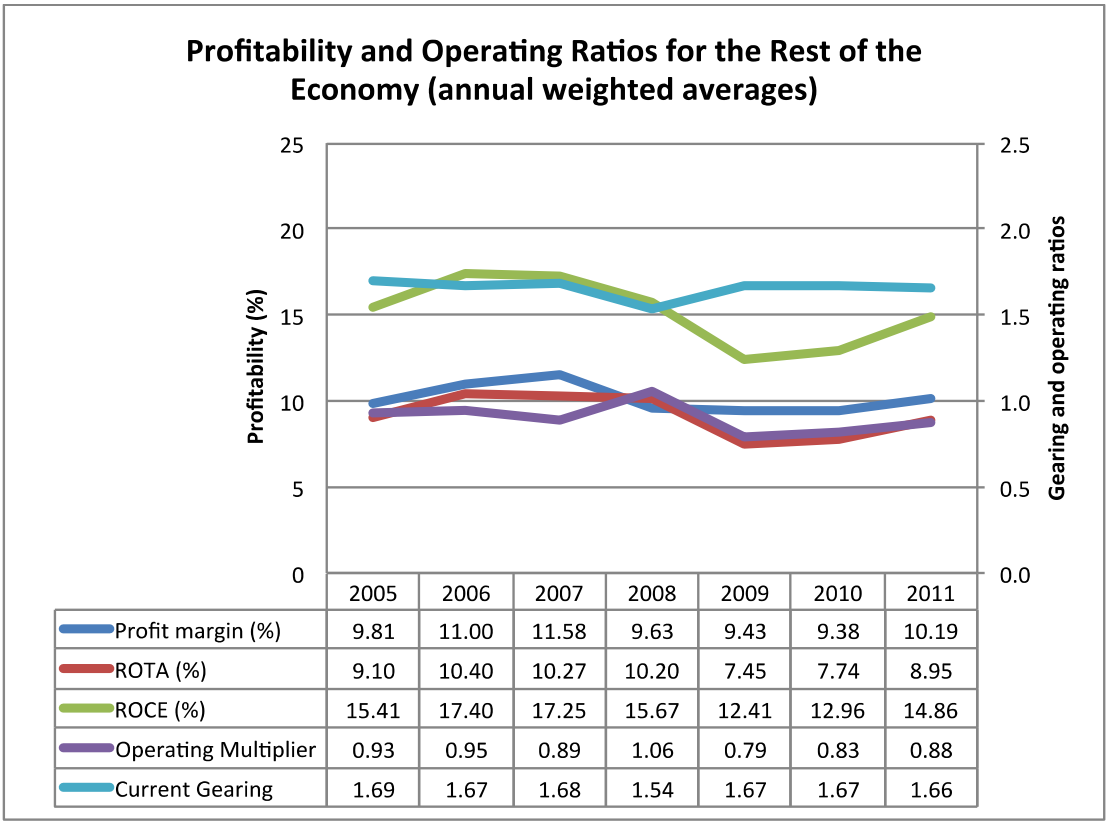
Financial performance trends – construction and whole economy

Graph 1 A: Construction sample: Time series - Profitability and Operating Ratios



	2005	2006	2007	2008	2009	2010	2011
Profit margin (%)	4.77	4.96	5.22	4.34	3.43	4.29	3.50
ROTA (%)	8.16	8.50	9.03	7.64	5.69	6.82	5.74
ROCE (%)	18.11	19.55	20.70	17.25	13.00	15.31	13.00
Operating Multiplier	1.71	1.71	1.73	1.76	1.66	1.59	1.64
Current Gearing	2.22	2.30	2.29	2.26	2.28	2.24	2.27

Graph 2 A: Rest of Economy sample: Time series - Profitability and Operating Ratios



	2005	2006	2007	2008	2009	2010	2011
Profit margin (%)	9.81	11.00	11.58	9.63	9.43	9.38	10.19
ROTA (%)	9.10	10.40	10.27	10.20	7.45	7.74	8.95
ROCE (%)	15.41	17.40	17.25	15.67	12.41	12.96	14.86
Operating Multiplier	0.93	0.95	0.89	1.06	0.79	0.83	0.88
Current Gearing	1.69	1.67	1.68	1.54	1.67	1.67	1.66

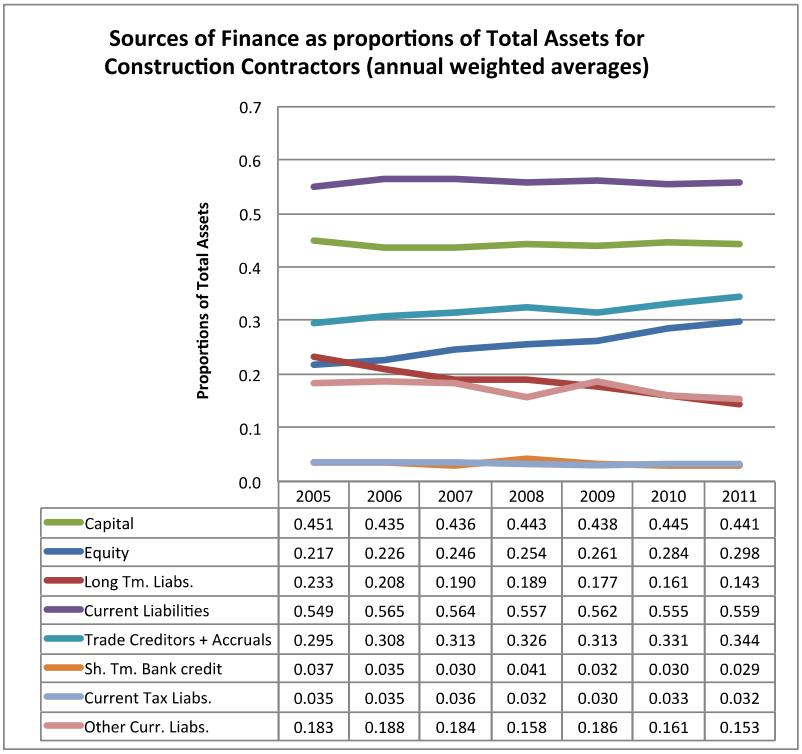
Over the period 2005 to 2011, profit margins, ROTA and ROCE have all fallen by around 30% of their 2005 values in construction, and by 33% (margin) and 37% (ROTA and ROCE) comparing 2011 with the peaks in 2007; whereas in the rest of the economy they have only fallen back by 12% (profit margin) and 14% (ROTA and ROCE) to near 2005 values from their peaks in 2006-7.

Operating multipliers (turnover / total assets) and current gearing (total assets / capital) have shown relative stability across the period, both in construction and in the rest of the economy.

Because the operating multiplier (T / TA) is more stable than profit margins in both samples, most of the decline in ROTA is attributable to decline in Profit Margins. The peak-to-trough fall in profit margins is around 12% of peak value in the rest of the economy, but 33% in construction.

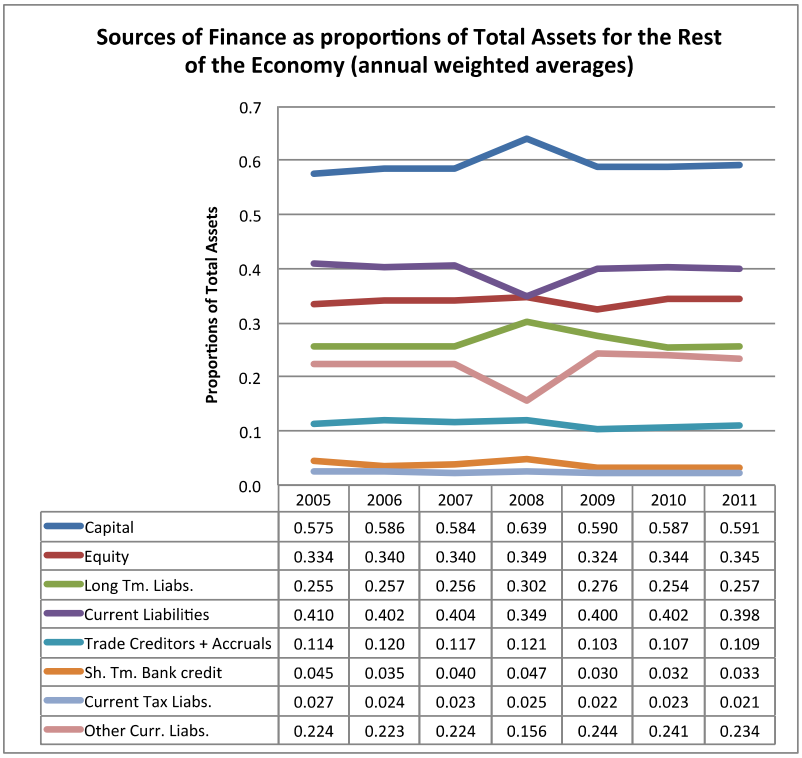
Sources of Finance as proportions of Total Assets

Graph 1 B: Construction sample: Time series - Sources of Finance as proportions of Total Assets



	2005	2006	2007	2008	2009	2010	2011
Capital	0.451	0.435	0.436	0.443	0.438	0.445	0.441
Equity	0.217	0.226	0.246	0.254	0.261	0.284	0.298
Long Tm. Liabs.	0.233	0.208	0.190	0.189	0.177	0.161	0.143
Current Liabilities	0.549	0.565	0.564	0.557	0.562	0.555	0.559
Trade Creditors + Accruals	0.295	0.308	0.313	0.326	0.313	0.331	0.344
Sh. Tm. Bank credit	0.037	0.035	0.030	0.041	0.032	0.030	0.029
Current Tax Liabs.	0.035	0.035	0.036	0.032	0.030	0.033	0.032
Other Curr. Liabs.	0.183	0.188	0.184	0.158	0.186	0.161	0.153

Graph 2 B: Rest of Economy sample: Time series - Sources of Finance as proportions of Total Assets



	2005	2006	2007	2008	2009	2010	2011
Capital	0.575	0.586	0.584	0.639	0.590	0.587	0.591
Equity	0.334	0.340	0.340	0.349	0.324	0.344	0.345
Long Tm. Liabs.	0.255	0.257	0.256	0.302	0.276	0.254	0.257
Current Liabilities	0.410	0.402	0.404	0.349	0.400	0.402	0.398
Trade Creditors + Accruals	0.114	0.120	0.117	0.121	0.103	0.107	0.109
Sh. Tm. Bank credit	0.045	0.035	0.040	0.047	0.030	0.032	0.033
Current Tax Liabs.	0.027	0.024	0.023	0.025	0.022	0.023	0.021
Other Curr. Liabs.	0.224	0.223	0.224	0.156	0.244	0.241	0.234

In the Rest of the Economy sample, there is a modest fall in the share of trade credit received (and accruals) as a proportion of (and means of financing) total assets, from 12% in 2008 down to less than 11% in 2009, 2010 and 2011. In the Construction sample, on the contrary, there is a small but clear increase in the share of trade credit received (including accruals) as a proportion of total assets, from 30% in 2005 to 34% in 2011. This upward trend is only slightly and temporarily affected by the financial crisis of 2008.

In the Rest of the Economy sample, short-term bank finance has fallen in importance, from over 4% of total assets in the period 2005-8 to 3% in the period 2009-11. In the Construction sample there is a similar fall in importance, after the 2008 peak at 4%, down to below 3% in 2011.

In the Construction sample, a stable share of capital employed in total assets is made up of a falling share of long-term liabilities and a rising share of equity.

Chapter 5 – Conclusions and recommendations

How do finance structures within the construction sector compare to those of the economy as a whole? Do construction companies make more use of trade credit than companies in other sectors?

Construction firms are relatively undercapitalised, compared with firms across the rest of the UK economy. That is, the weighted mean shares of their combined balance sheets contributed by both capital employed (45%) and equity (25%) are much lower than in the rest of the economy (60% and 34% respectively). This is most especially the case for Tier 1 contractors (capital 41% and equity 22%) and for large contractors (capital 41% and equity 24%). Undercapitalisation both puts firms at more risk of financial failure and limits their ability to invest in business models requiring injections of capital.

Taken as a whole, construction firms take much more trade credit (from their suppliers) as a proportion of their balance sheet than do firms in the rest of the economy. They also give much more credit to their customers as a proportion of their balance sheet. (Trade Credit and Trade Debt, respectively, in Table 1C)

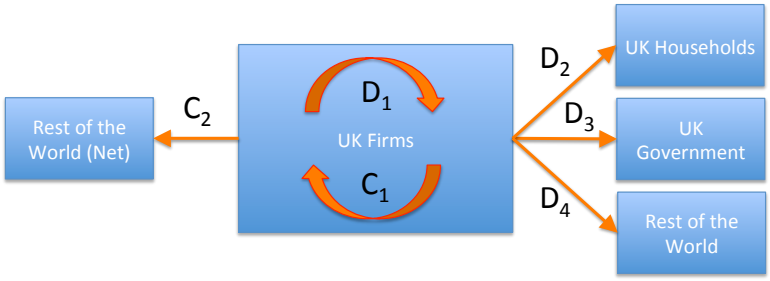
For the construction industry as a whole, accounts payable are equal to and sufficient to finance accounts receivable, and accruals (products received but not yet invoiced by suppliers) are equal to and sufficient to finance work in progress (work done but not yet invoiced to customers). By comparison, in the rest of the economy, trade credit allowed by firms to corporate and non-corporate customers (accounts receivable) slightly exceeds trade credit received by firms from other firms (accounts payable). That is, in the rest of the economy firms as a whole are (relatively minor) net providers of trade finance to (customers in) the non-corporate sectors.

To explore this further, the report broke total trade credit received by construction firms into two components: trade credit offered by suppliers of construction materials and components (or other industrial services) to supply-and-fix specialist contractors; and trade credit offered by supply-and-fix specialist contractors (described in the report as Tier 2 contractors) and other suppliers to main contractors (described as Tier 1 contractors).

Tier 1 firms were found to be net receivers of trade credit (with creditor days in excess of debtor days, and trade debtors a smaller proportion of total assets than was trade creditors), whereas Tier 2 firms were found to be large net providers of trade credit (with creditor days much less than debtor days, and trade debtors a much larger proportion of total assets than was trade creditors) (Table 2C). In other words, it is highly likely that the trade credit flow from Tier 2 to Tier 1 contractors substantially exceeds in size the trade credit flow from suppliers outside the construction industry to Tier 2 contractors.

Figure 1: Giving and taking – net balance: Rest of Economy

$$We\ observed: \Sigma D > \Sigma C \quad so: D_1 + D_2 + D_3 + D_4 > C_1 + C_2$$
$$By\ definition: D_1 = C_1 \quad so: D_2 + D_3 + D_4 > C_2$$



Where: C = Trade Credit D = Trade Debt

Figure 2: Giving and taking – net balance: All Construction

$$We\ observed: \Sigma D \cong \Sigma C \quad so: D_1 + D_2 + D_3 + D_4 \cong C_1 + C_2 + C_3$$
$$By\ defnition: D_1 = C_1 \quad so: D_2 + D_3 + D_4 \cong C_2 + C_3$$

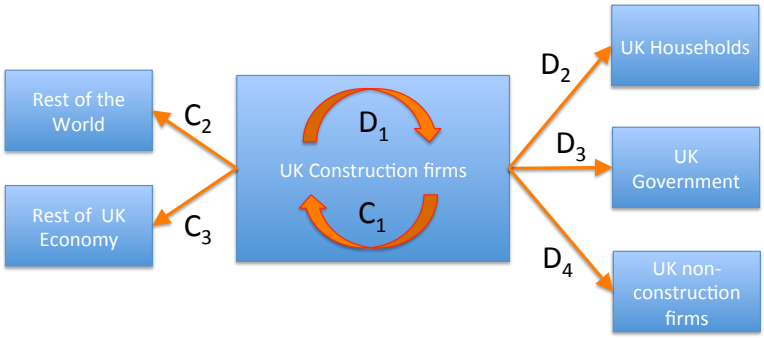
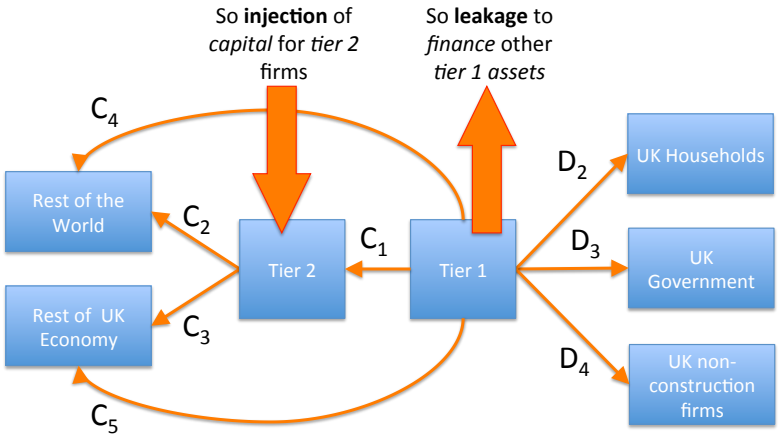


Figure 3: Giving and taking – net balance:

$$We\ observed: C_1 (\equiv D_1) > C_2 + C_3$$
$$and: D_2 + D_3 + D_4 < C_1 + C_4 + C_5$$



Construction firms employ less capital (less long-term debt and less equity capital) per pound of their total assets than do firms in the rest of the economy.

Their current liabilities other than trade creditors and accruals are broadly in proportion with the ratios to total assets found in the corporate economy at large. The key difference in the structure of financing of assets in construction is the higher proportion of trade creditors and accruals (weighted mean 32% in construction compared to 11% in the rest of the corporate economy: Table 1E).

Greater use of trade credit allows each pound of capital employed by construction firms to support first a larger value of total assets (around £2.2 compared with £1.7 in the rest of the corporate economy), and second (when combined with construction's high average ratio of sales to total assets), to support a larger value of output or sales (£3.7 compared with £1.5 in the economy as a whole) (Table 1B).

As part of a relatively under-capitalised industry, construction firms are highly dependent upon sustained access to trade credit in order to finance their levels of output and turnover. Limits on firms' ability to access the necessary trade credit may limit their ability to compete for projects, and force firms to decline growth opportunities. Growth of construction output would require growth in available trade credit. Reading the ratios 'backwards', each £ of growth of construction sales requires a 62pence increase in total assets, and that in turn requires a 20pence increase in trade credit (but only 15p increase in construction equity); whereas in the corporate economy at large, each £ of growth of sales requires £1.16 increase in total assets, and that in turn requires a 16pence increase in trade credit (but a 35p increase in equity capital) (Tables 1B and 1E). This conclusion requires the assumption that these ratios (of sales to total assets, and of total assets to trade credit) are 'fixed' by the operating methods and business models in use. The ratios in question certainly show great stability over time (Graphs 1A and 1B).

In any growth of construction output, it is, clearly, the Tier 2 contractors that will require additional trade credit from outside the industry, largely indeed so that they can extend extra trade credit to Tier 1 contractors so that, in turn, the latter can extend extra trade credit to the construction industry's customers (Tables 2C and 2E).

The implied price of trade credit and the effect of giving and taking trade credit on ROCE

Construction firms as a whole seem to obtain a small net benefit, in higher Return on Capital Employed (ROCE), from the heavy use they make of trade credit. The price they pay for trade credit (in higher prices of purchases, and thus lower profit margins) appears to be slightly less than the benefit they obtain in higher turnover per pound of capital employed, when compared to the average for firms in the whole economy (Table 1B). In the seven years examined, only in 2011 did construction ROCE fall below the whole-economy average (Graphs 1B and 2B). This is a notable result, for a period (2005-2011) covering a very major construction recession, and in which construction output has fallen markedly as a proportion of GDP. At least part of the explanation for it may lie in the relatively heavy use the industry makes of relatively low-cost trade credit.

Again, this was further explored by looking at the ROCE of Tier 1 and Tier 2 contractors (Table 2B). The conclusion is that the low-cost trade credit appears to be that offered by suppliers outside the industry (or by small construction firms outside our sample) to Tier 1 and Tier 2 construction firms. Though the Tier 2 firms were large providers of trade credit

to the Tier 1 firms (see above) the price they obtained for this in terms of higher margins (higher selling prices) appears to fully offset the cost in terms of lower turnover per pound of capital employed. This is reflected in the higher weighted mean ROCEs of the Tier 2 than of the Tier 1 contractors. The implication is that the prices paid by the industry's clients may be forced upwards by the industry's heavy reliance on relatively expensive trade credit.

The implications of the findings regarding SMEs in construction

SME construction firms obtain a similar amount of trade credit from their suppliers (as a proportion of their balance sheets) to that obtained by large construction firms (Table 3C). However, a difference emerges for trade credit plus accruals (Table 3E), which is a significantly larger proportion of the balance sheet of larger firms.

If we look instead of 'standard' creditor days at 'adapted' creditor days, which we measured as: {Trade Creditors not including accruals / Implied Purchases from Supplier Firms} x 365, we observe (Table 6C) a similar result to Table 3C – construction SMEs obtain as many 'adapted creditor days' of trade credit as do the larger firms.

The larger contractors appear to benefit, in terms of higher ROCE, from obtaining more trade credit + accruals, and to pay a price for that credit in terms of lower profit margins that is perhaps slightly less than the benefit obtained from higher turnover per pound of capital employed, and thus have higher ROCE (Table 3B). However, the difference in ROCE is not statistically significant.

The findings of this study are consistent with the idea that construction SMEs face some limits in the amount of trade credit their suppliers are willing to afford them, specifically in the form of 'accruals', and that these limits are tighter than those facing larger construction firms.

In construction contracting, size of firm is strongly correlated with Tier. That is smaller firms are more likely to be subcontractors (than to be main contractors), and subcontractors are much more likely (than are main contractors) to be SMEs. The findings of this study are consistent with the idea that it is whether a firm is Tier 1 or Tier 2 that has more impact on its financing structure and receipt of trade credit than does its size alone.

The study findings tend to contradict the idea that, in construction, SMEs as a whole receive less finance from banks (relative to their balance sheet totals) than do larger construction contractors.

The implications of the findings regarding specialist (Tier 2) firms in construction

The role of trade credit in financing UK construction activity has been shown to be cascade-like. Whilst demand and orders for work flow upstream, from clients via main contractors and then specialist contractors to manufacturers and merchants, the flow of trade finance runs downstream. An initial flow of trade credit coming from supplier firms outside the construction industry (or from small Tier 3 construction firms) plays a dominant and critical part in financing the industry's specialist Tier 2 contractors; this initial flow, widened by injections of equity and long-term debt capital by the specialist Tier 2 contractors, allows and finances a second somewhat larger flow of trade credit, from specialist Tier 2 contractors to Tier 1 main contractors; that in turn finances a third and roughly equal flow of trade credit, from main contractors to their clients. The flows over the downstream 'cataracts' depend upon the initial inflow, and those downstream flows would be reduced and the ability of the sector (clients and contractors together) to sustain its activity would be reduced or its need for alternative finance and alternative business models increased were anything to imperil or cause the initial flow to be reduced, or to fail to grow in line with the value of UK construction demand.

The strength of the balance sheets and (trade) credit-worthiness of the UK's specialist contractors is therefore shown to be of system-wide importance.

Other conclusions

1. Accruals are important. The variable to be measured in trade credit studies should be 'trade creditors plus accruals', rather than just 'trade creditors'. Both involve the same fundamental economic phenomenon (see **Chapter 1**). Not only are accruals quite large relative to trade creditors (about two-thirds the size on a weighted average, both for construction and the rest of the economy) but also the ratio of accruals to trade creditors varies substantially across sizes and types of firm.

2. Current tax liabilities are important. HMRC acts as a kind of lender to its corporate tax-collecting agents, allowing them to hold balances of VAT, PAYE and National Insurance collected on its behalf, as well as current corporation tax liabilities. This is at least as important as short-term bank credit as a source of finance for all but very large firms.

3. Other (miscellaneous) current liabilities are important. Table 1E shows that these are second (after trade creditors + accruals) in the composition of total current liabilities of construction contractors, and first in importance in the total current liabilities of firms in the rest of the economy. As defined and measured in this study they comprise: non-bank loans (group loans, directors loans); hire purchase and leasing; dividends declared but not yet paid; and unspecified 'other current liabilities'.

4. We found some evidence in support, particularly as regards construction firms, for the Schwartz / Emery prediction that in periods of 'loose' money, smaller firms will make increased use of bank credit, and will make less use of bank credit in periods of 'tight' money. However, we did not find full evidence for 'switching' between bank

credit and trade credit, in that, between 2005 and 2008 construction firms were making increased use of both bank credit and trade credit. However, the period since 2008 does seem to show 'switching', with bank credit falling in relative importance and trade credit rising (in construction).

5. Rather than seeing bank credit and trade credit as alternative means of obtaining regular and recurrent financing of operations, our interpretation of our evidence is that in construction trade credit is the first, by far the most important, and most widespread (used by all firms, all the time) source of finance for operations; whereas short-term bank finance is an expedient used by some firms some of the time. If switching is occurring (and the importance of trade credit is rising over time), the simple relative magnitudes for construction suggest substitution must be largely with Capital (particularly, Equity) or Other Current Liabilities, as the only balance sheet items large enough to sustain significant substitution.

Policy implications of findings

1. BIS and Bank of England monitoring:

In this particular industry, it is clearly important to have continuous monitoring of the trade credit situation, either by regular survey or by establishment of statistics covering such credit, because trade credit is the most important source of finance for the whole construction industry – and as crucial for industry output, capacity and competition as the resources covered by existing construction statistics. Such surveys should include a focus on monitoring changes in the trade-credit worthiness and access to trade credit of tier 2 and tier 3 firms, because they stand at the head of the cascade of trade credit on which tier 1 contractors and construction customers rely. It should also perhaps include monitoring indicators of the risk of potential bad trade debt flowing up the cascade from developers and tier 1 contactors.

2. Procurement and form-of-payment policy:

The undercapitalisation of tier 1 contractors and their reliance on business models generating negative need for working capital may in practice be as decisive as industry attitudes to risk and models of risk transfer in determining whether intended changes to procurement and forms of payment (milestone payments; performance-based contracting) will be taken up by the industry, and with what effect on competition.

3. Tax liability finance:

HMRC credit extended to construction (and other) firms acting as tax-collection agents appears to be quantitatively important especially for the medium-sized construction firms. Is it a 'free lunch"? Firms may argue that the benefit they obtain from holding such financial balances merely offsets the administrative costs they bear as tax collection agents. However, at the margin, any change towards being allowed to hold such balances for longer would appear to offer a 'free lunch'.

4. **Project Bank Accounts:**

   There is no evidence in our findings that supports the idea that medium sized tier 2 firms as a rule need the protection offered by project bank accounts. However, our data does not cover the smallest firms, and our coverage of tier 3 and lower firms is limited. Their trade credit position, the price they are able to charge for extending credit and vulnerability to delayed payment may be quite different.

5. **Government as client in construction:**

   Policy of government as client for construction, especially policies intended to develop efficiency savings through building supply chains, needs to note that relationships between firms in construction supply chains are in large part complex chains of financial (trade credit and debt) interdependence, and not merely relationships for dealing with specialisation or with risk.

Limitations of the research and recommendations for further research

1. The fundamental differences found between Tier 1 and Tier 2 contractors' financial structures and offering and taking of trade credit suggest it would be worthwhile to conduct further study, breaking Tier 1 firms into building main contractors and civil engineering contractors, and breaking Tier 2 contractors into 'trades' or sets of trades each associated primarily either with building or with civil engineering. Such a study could reveal whether the pattern found exists across all construction, or is characteristic of particular parts of the sector. This could be done in principle by using the same methods of classification for analysis as in this study, that is, SIC codes and firms' trade descriptions. Ive and Yu (2011) shows that a very large number of firms classed to SIC 43 (specialist contractors) in fact also or mainly operate as main contractors (historically this was a main cause of UK Construction Statistics' underestimating of construction new orders). It would thus be preferable in such further research to use trade descriptions and not simply to rely on SIC codes. The presence of such misclassified firms in the samples analysed here, however, makes it all the more striking that we found such significant differences between the financial structures and performance of the Tier1 (SIC 41 and 42) and Tier 2 (SIC 43) samples.

2. This study only investigated 'survivor' firms, ones that were in business already in 2005 and still in business at the end of 2011. Separate studies of start-up firms' financing structures and use of trade credit, and of non-survivors would complement the present study and illuminate specific issues on which the present report has nothing to contribute. Such studies could in principle be done using databases derived from Companies House.

3. This study did not investigate the smallest firms, because such firms are below the size at which they are required to file full accounts at Companies House.

   In construction such small firms are numerous and in aggregate account for a substantial proportion of output. The finding that the in effect mostly medium-sized construction SMEs in the sample obtained less trade credit (mainly, received goods

and services a shorter time ahead of invoicing, i.e. had less 'accruals' on their balance sheets) than the large firms might be taken to suggest it is probable that micro and small construction firms receive even less access to trade credit. A follow-on study of such small construction firms is therefore recommended. Any such study could perhaps construct its sample from Companies House data, but would have to find an alternative method of obtaining primary data on sampled firms, almost certainly by survey.

4. This study shows what can, and what cannot, be done using common-size financial statement and business ratio analysis to compare industries or sub-industries. Our conclusions based solely on this method of analysis regarding the implied price of trade credit involve making several assumptions. The industries being compared are assumed to be similar in attributes bearing on profitability other than financial structures. These assumptions are more likely to be valid for sub-sets of construction (Tier 1 and Tier 2 contractors; SME and Large contractors) than they are for comparison of construction with the rest of the economy. Particular caution should therefore be exercised over attributing difference in ROCE between construction and the rest of the economy to differences in use of trade credit. On the other hand, it is more plausible to assume that Tier 1 and Tier 2 construction firms face similar economic conditions (similar demand and supply conditions and market structures), and that the assumption that, absent trade credit, the two sets of firms would show similar mean ROCEs, albeit with 'swings-and-roundabouts' differences, arising from different production technologies, in capital turnover ratios and profit margins (so that actually observed difference in sample mean ROCEs can be attributed to observed difference in offering and taking of trade credit), is more plausible. There is an association (not a proven causality) between differences in the taking and giving of trade credit and differences in average ROCE; and we know of no obvious alternative explanations for why Tier 2 contractors should have higher ROCE than Tier 1 firms.

5. The present study follows the logic of looking for explanations for difference in one average ratio between two samples in differences in other component average ratios. Specifically, we were only able to attribute differences in ROCE between samples and sub-samples to differences in average component ratios for financial structure.

   To go further and explore the role of multiple factors on the interesting dependent variables (and in particular to explore the influence on profitability of financial structure and the implied price of trade credit) requires an econometric analysis, using regression analysis techniques. Analysis using many possible explanatory variables to explain the 'scatter' of values of profitability for many individual firms might well lead to modification of our findings, particularly as regards the implied price of trade credit.

6. The findings of this study on financing structures of construction contractors may have implications for procurement policy, and suggest research is required on this point. The implications of client procurement practices on Tier 1 contractors' value of trade debtors and thus need for finance and for trade credit may in practice be decisive in determining whether intended changes will be taken up by the construction industry, or in influencing the effects of such changes. Research into

this question will need to combine project cash flow modelling of the kind discussed in **Chapter 2** with analysis of company accounts.

Data coming from company accounts cannot isolate or separate the effects of specific payment practices upon financial structure or performance ratios. For example, retentions (by clients and by main contractors) and their effects cannot be separated in such studies from the general flow of cash in and out of construction businesses. There has however been some recent academic progress in developing models of project cash flow (Cui et al, 2010) that can do exactly that, and also in converting (using simulation) sets of project cash flows into construction business cash flows (Kenley, 2003). This line of research requires further work to develop models that yield modelled business cash flows that are consistent with the 'stylised facts' (for adapted creditor days and debtor days, for example) revealed by research into the relevant sets of company accounts.

7. Tier 3 and small (under £6m turnover) contractors appear to be extending significant trade credit to both Tier 2 and Tier 1 medium and large sized contractors, and this study suggests that at least some of this credit flow may not be fully economically priced at present (in that the more credit the Tier 1 and 2 medium and large contractors receive, the more profitable they seem to be). This is a further reason for recommending further research into small firms' financial structures, use of trade credit and financial performance in the UK contract construction industry.

8. The UK construction industry increasingly obtains its construction materials and components (CMCs) as imports. This study has shown that in aggregate suppliers of CMCs are extending considerable trade credit to UK contractors, and has suggested that at least some of this credit flow may not be fully economically priced at present (in that the more of this credit UK contractors receive, the more profitable they seem to be). However, we do not know whether this credit is actually extended by exporters to the UK or by intermediaries, nor do we have a tested economic model of factors influencing its implied price.

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