Credit channel, trade credit channel, and inventory investment: evidence from a panel of UK firms

by

Alessandra Guariglia*

(*University of Nottingham*)

and

Simona Mateut

(*University of Nottingham*)

Abstract

In this paper, we use a panel of 609 UK firms over the period 1980-2000 to test for the existence of a trade credit channel of transmission of monetary policy, and for whether this channel plays an offsetting effect on the traditional credit channel. We estimate error-correction inventory investment equations augmented with the coverage ratio and the trade credit to assets ratio, differentiating the effects of the latter variables across firms more or less likely to face financing constraints, and firms making a high/low use of trade credit. Our results suggest that both the credit and the trade credit channels operate in the UK, and that the latter channel tends to weaken the former.

Keywords: Inventory investment, Trade credit, Coverage ratio, Financing constraints.

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* *Corresponding author:* Alessandra Guariglia, School of Economics, University of Nottingham, University Park, Nottingham, NG7 2RD, United Kingdom. Tel: 44-115-8467472. Fax: 44-115-9514159. E-mail: alessandra.guariglia@nottingham.ac.uk.

1. Introduction

According to the credit channel, monetary policy is transmitted to the real economy through its effects on bank loans (bank lending channel) and firms' balance sheet variables (balance sheet channel). In the case of a tightening in monetary policy, for instance, bank loans supplies to firms are reduced. This diminishes the ability of those firms that are more bank-dependent to carry out desired investment and employment plans. Similarly, a tightening in monetary policy is associated with a rise in borrowers' debt-service burdens, a reduction in the present value of their collateralizable resources, and a reduction in their cash flow and net worth. Once again, this makes it more difficult and/or more costly for firms for which asymmetric information issues are more relevant to obtain loans, forcing them to reduce their activities (Mishkin, 1995; Bernanke and Gertler, 1995).

A number of studies have estimated regressions of firms' investment in fixed capital or inventories on cash flow, the coverage ratio[1], the stock of liquidity, or other balance sheet variables, on various sub-samples of firms. These types of regressions can be seen as indirect tests for the existence of a credit channel of transmission of monetary policy. In fact, if a firm's activity is strongly affected by financial variables, then, in periods of tight monetary policy, when the supply of bank loans is reduced and all firms' financial situations become worse, this firm will have to contract its activity. Furthermore, if the credit channel were operative, one would expect financial variables to mainly affect the behavior of those firms which are relatively more constrained in credit markets (namely more bank-dependent firms, which are typically smaller, younger, and less collateralized), and this effect to be stronger in periods of recession and tight monetary policy.

The majority of the above mentioned studies have found a positive correlation between financial variables and firms' activities, generally stronger for firms facing tighter financing constraints (see for instance Fazzari et al., 1988; Kashyap et al., 1994; Carpenter et al., 1994, 1998; Guariglia, 1999, 2000 etc.). Yet, other authors, who have mainly focused on firms' investment behavior, have found that the sensitivity of investment to financial variables is in fact weaker for firms likely to face

[1] The coverage ratio is defined as the ratio between the firm's total profits before tax and before interest and its total interest payments. It indicates the availability of internal funds that firms can use to finance their real activities and can also be thought of as a proxy for the premium that firms have to pay for external finance (Guariglia, 1999). The coverage ratio has been widely used in the literature on the effects of financing constraints on firms' activities (see Carpenter et al., 1998; Gertler and Gilchrist, 1994; Guariglia and Schiantarelli, 1998; Guariglia, 1999, 2000; and Whited, 1992).

particularly strong financing constraints (Kaplan and Zingales, 1997; Cleary, 1999). The latter findings cast a cloud over the existence and the actual strength of a credit channel[2].

One argument which could be put forward to explain why some firms exhibit a low sensitivity of investment to financial variables is that, particularly in periods when bank-lending is rationed, or, more in general, when external finance becomes more difficult to obtain and/or more costly, these firms make use of another source of finance to overcome liquidity shortages, namely trade credit.

Trade credit (i.e. accounts payable) is given by short-term loans provided by suppliers to their customers upon purchase of their products. It is automatically created when the customers delay payment of their bills to the suppliers. Trade credit is typically more expensive than bank credit especially when customers do not use the early payment discount (Petersen and Rajan, 1997)[3]. Yet, according to Berger and Udell (1998), in 1993, 15.78% of the total assets of small US businesses were funded by trade credit. Similarly, Rajan and Zingales (1995) document that in 1991, funds loaned to customers represented 17.8% of total assets for US firms, 22% for UK firms, and more than 25% for countries such as Italy, France, and Germany. Finally, according to Kohler et al. (2000), 55% of the total short-term credit received by UK firms during the period 1983-95 took the form of trade credit.

It is therefore possible, that even in periods of tight monetary policy and recession, when bank loans are harder to obtain and/or more costly, financially constrained firms are not forced to reduce their investment too much as they can finance it with trade credit[4]. Trade credit issuance can increase in periods of tight

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[2] Cummins et al. (1999); Bond and Cummins (2001); and Bond et al. (2002) estimated *Q*-models of investment augmented with cash flow, where firms' investment opportunities are more accurately controlled for than in traditional models, and found that the coefficients associated with cash flow were poorly determined for all types of firms. They therefore concluded that cash flow attracted a positive coefficient in studies such as Fazzari et al. (1988) simply because it proxied for investment opportunities, which were not properly captured by the traditionally used measures of *Q*. This conclusion is challenged by Carpenter and Guariglia (2003).

[3] A common form of trade credit contract is known as the "2/10 net 30" type. "2/10" means that the buyer gets a 2% discount for payment within 10 days. "Net 30" means that full payment is due 30 days after the invoice date. After that date, the customer is in default. The combination of a 2% discount for payment within 10 days and a net period ending on day 30 defines an implicit interest rate of 43.9%, which can be seen as the opportunity cost to the buyer to forgo the discount in exchange for 20 additional days of financing (Ng et al., 1999; Petersen and Rajan, 1997). Unfortunately, the data that we use in this study do not contain information on when the buyers making use of trade credit actually make their payments.

[4] Biais and Gollier (1997) claim that by using trade credit, firms that cannot initially access bank debt may actually enhance their subsequent access to bank debt. The use of trade credit can in fact be seen as a signal revealing to banks the suppliers' unique information relative to the firm, and causing banks

money (we will refer to this phenomenon as the trade credit channel hereafter) because the risks of issuing trade credit are always lower than those of issuing bank loans: suppliers can in fact closely monitor their clients during the normal course of business; they can threaten to cut off future supplies to enforce repayment; and can easily repossess goods in case of failed payment (Petersen and Rajan, 1997; Kohler et al., 2000)[5]. The presence of a trade credit channel could therefore weaken the relationship between firms' real activities and traditionally used financial variables, such as the coverage ratio and cash flow, and more in general, could weaken the credit channel of transmission of monetary policy.

Although the hypothesis that a trade credit channel might weaken the traditional credit channel was first suggested in 1960 by Meltzer[6], recent empirical tests of the hypothesis are limited. Using US data, Nilsen (2002) shows that during contractionary monetary policy episodes, small firms and those large firms lacking a bond rating or sufficient collateralizable assets increase their trade credit finance. Similarly, Choi and Kim (2003) find that both accounts payable and receivable increase with tighter monetary policy. Using UK data, Mateut and Mizen (2002) and Mateut et al. (2002) show that while bank lending typically declines in periods of tight monetary policy, trade credit issuance increases, smoothing out the impact of the policy. Focusing on net trade credit, Kohler et al. (2000) observe a similar pattern. Based on a disequilibrium model that allows for the possibility of transitory credit rationing, Atanasova and Wilson (2004) find that to avoid bank credit rationing, smaller UK companies increase their reliance on inter-firm credit. De Blasio (2003) uses Italian data and finds some weak evidence in favour of the hypothesis that firms substitute trade credit for bank credit during periods of monetary tightening. Finally, Valderrama (2003) shows that Austrian firms use trade credit to diminish their dependence on internal funds. Except for the latter two studies, which are based on

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to update their beliefs about the quality of the firm, which might lead them to start supplying funds to the firm (also see Alphonse et al., 2003).

[5] By helping a customer in difficulty to stay in business, suppliers may actually benefit in the longer run, through future sales made to that customer (Atanasova and Wilson, 2001). Calorimis et al. (1995) provide evidence that in periods of recession, large firms borrow in order to extend more finance to their financially constrained customers. Furthermore, Cunat (2003) documents that when customers experience temporary liquidity shocks that may threaten their survival, suppliers tend to forgive their debts and extend their maturity periods at no extra cost (also see Petersen and Rajan, 1997; and Wilner, 2000). Finally, it should also be noted that lending through trade credit might also serve non-financial purposes: for instance, firms can use trade credit to price discriminate (Brennan et al., 1988; Petersen and Rajan, 1997).

[6] Also see Brechling and Lipsey (1963).

continental European economies, the above listed studies generally focus on the determinants of trade credit and on its behaviour over the business cycle, without looking at how trade credit actually relates to firms' real activities.

This paper contributes to the literature by providing, for the first time, rigorous tests of whether trade credit affects UK firms' activities and, more specifically, of whether the trade credit channel of transmission of monetary policy plays an offsetting effect on the traditional credit channel in the UK (this hypothesis will be referred to as the offsetting hypothesis hereafter). Focusing on the UK rather than on continental European economies is particularly interesting: the UK financial system is in fact mainly market-based, whereas continental European countries are characterized by bank-based financial systems (Demirgüç-Kunt and Maksimovic, 2002). One would expect therefore the trade credit channel to be stronger in the UK. Yet Demirgüç-Kunt and Maksimovic (2001) document that firms in countries with larger and privately owned banking systems generally offer more financing to their customers and take more financing from them. To perform our tests, we will make use of 609 UK manufacturing sector companies over the period 1980-1999, collected by Datastream[7].

In our econometric analysis, we will focus on the direct effect that trade credit plays on firms' inventory investment, and on the indirect effect that it has on the sensitivity of firms' inventory investment to the coverage ratio. Three reasons justify our choice of inventory investment in our analysis. First, inventory investment plays a crucial role in business cycle fluctuations (Blinder and Maccini, 1991). Second, because of its high liquidity and low adjustment costs, inventory investment is likely to be more sensitive to financial variables (including trade credit) than investment in fixed capital (Carpenter et al., 1994). Third, trade credit is often related to the financing of inventories (Valderrama, 2003; Petersen and Rajan, 1997). We will only focus on accounts payables as a measure of trade credit usage, considering the firms in our data sets as borrowers[8].

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[7] These companies are all traded on the London Stock Exchange. Datastream has been widely used to test whether financial variables affect firms' activities in the UK, and more in general to test for the presence of a credit channel of transmission of monetary policy (see for instance Blundell et al., 1992; Bond et al, 2002; Bond and Meghir, 1994; Guariglia, 1999, 2000 etc.).

[8] Other authors (Kohler et al., 2000; Choi and Kim, 2003; De Blasio, 2003) also considered the role played by trade credit extended. When bank lending is constrained, firms can in fact find additional financial resources either by relying more on trade credit received or by extending less trade credit to other firms.

Our results suggest that both the trade credit channel and the credit channel operate in the UK, and that there is evidence that the former channel weakens the latter. We find in fact that when trade credit is added as a regressor to an inventory investment equation which already includes the coverage ratio, it generally affects the inventory investment at both financially constrained and unconstrained firms. Yet, the coverage ratio variable remains significant for the former firms. Furthermore, we find that when the effect of the coverage ratio is differentiated across constrained/unconstrained firms making a high/low use of trade credit, the coverage ratio only affects inventory investment at those constrained firms which make a low use of trade credit. This suggests that using trade credit can help firms to offset liquidity problems. All our results are robust to replacing the variables in the coverage ratio with corresponding variables in cash flow. The finding that a strong trade credit channel, able to weaken the credit channel, operates in the UK is important as this channel is likely to dampen the effects of contractionary monetary policies, and more in general to make the recessions that generally follow these policies less severe.

The remainder of this paper is organized as follows. In section 2, we describe our data and present some descriptive statistics. Section 3 illustrates our baseline specification, our tests of the offsetting hypothesis, and our econometric methodology. Section 4 presents our results and Section 5 concludes the paper.

2. Main features of the data and summary statistics

The data set

The data used in this paper consist of UK quoted company balance sheets collected by Datastream. We only consider the manufacturing sector. Inventory investment includes investment in finished goods, raw materials, and work-in-progress.

Our data set includes a total of 3892 annual observations on 609 companies for the years 1980 to 2000. The sample has an unbalanced structure, with the number of years of observations on each firm varying between 3 and 20[9]. By allowing for both entry and exit, the use of an unbalanced panel partially mitigates potential selection and survivor bias. We excluded companies that changed the date of their accounting year-end by more than a few weeks, so that the data refer to 12 month accounting periods. Firms that did not have complete records on inventory

[9] See Appendix 1 for more information on the structure of our panel and complete definitions of all variables used.

investment, sales, the coverage ratio, trade credit, total assets, and short-term debt were also dropped[10]. Finally, to control for the potential influence of outliers, we truncated the sample by removing observations beyond the 1st and 99th percentiles for each of the regression variables.

Sample separation criteria

To test whether financial and trade credit variables have a different impact on the inventory investment of different types of firms, we partition firms according to whether they are more or less likely to face financing constraints using employees as a measure of size. In particular, we generate a dummy variable, $SMALL_{it}$, which is equal to 1 if firm *i* has less than 250 employees in year *t*, and 0, otherwise[11]. We allow firms to transit between size classes[12].

To check robustness, we will explore results obtained using total real assets as an alternative sample partitioning criterion. For this purpose, we will generate a dummy variable, $SMALL1_{it}$, which is equal to 1 if firm *i*'s total assets are in the lowest quartile of the distribution of the total assets of all firms belonging to the same industry as firm *i* in year *t*, and 0, otherwise.

In order to verify whether the effects of financing variables on inventory investment are different for firms that make a higher use of trade credit, we construct two additional dummies. The first one, $HIGHTC_{it}$, is equal to 1 if the ratio of trade credit to total beginning-of-period assets for firm *i* in year *t* is in the highest quartile of the distribution of the ratios of all the firms in that particular industry and year, and 0 otherwise. The ratio of a firm's trade credit to total assets can be interpreted as the percentage of the firm's total assets which is financed by trade credit[13]. The second dummy, $HIGHTC1_{it}$, is constructed in the same way but focuses on the ratio between the firm's trade credit and the sum of its short-term debt and trade credit[14]. The latter ratio can be seen as a "mix" variable similar to that used in Kashyap et al. (1993): it

[10] These are the variables included in our regressions.

[11] A firm with less than 250 employees is much smaller than a typical "small" US firm. However, this number is appropriate in a European context, where firms are typically smaller than in the US (see Bank of England, 2002, for a discussion of various definitions of small, medium, and large firms). This sample separation criterion was also used in Carpenter and Guariglia (2003).

[12] For this reason, our empirical analysis will focus on firm-years rather than simply firms. See Carpenter and Guariglia (2003), Bond and Meghir (1994), Kaplan and Zingales (1997), Guariglia and Schiantarelli (1998), and Guariglia (2000) for a similar approach.

[13] See Fisman and Love (2002) for a discussion of why it is appropriate to deflate trade credit using the firm's total assets.

[14] Short-term debt includes bank overdrafts, loans, and other short-term borrowing.

indicates the percentage of the firm's total short-term finance that comes from trade credit.

Descriptive statistics

Table 1 presents descriptive statistics relative to our full sample of firm-years, and to various sub-samples. Panel I of the Table focuses on the full sample and on the sub-samples based on size. The average firm-year in our sample has 4214.6 employees, whereas the average small and large firm-years have respectively 156.7 and 4714.4 employees. Comparing columns 2 and 3, we can see that those firm-years characterized by relatively high employment display higher sales growth and a higher cash flow to capital ratio, compared to low employment firm-years. They also have a lower short-term debt to assets ratio. Although a slightly higher percentage of their total short-term finance comes from trade credit, these firm-years display a lower trade credit to total beginning-of-period real assets ratio. Finally, they seem to extend slightly less trade credit to other firms. A similar pattern can be observed by comparing columns 4 and 5 of Table 1, which refer respectively to firm-years with relatively low and relatively high real assets.

Panel 2 of Table 1 focuses on divisions based on trade credit usage. Columns 1 and 2 refer respectively to firm-years with a relatively low and a relatively high ratio of trade credit to total beginning-of-period real assets. By comparing the two columns, we can see that those firm-years characterized by a relatively high ratio of trade credit to assets are generally smaller and more indebted, and display a much higher sales growth, and a higher cash flow to capital ratio. Furthermore, they generally have a higher trade credit to short term debt plus trade credit ratio, and extend more trade credit to other firms compared to firm-years with a lower trade credit to assets ratio.

When comparing firm-years according to their trade credit to short-term debt plus trade credit ratios (columns 3 and 4), we can see that the pattern is similar except for the fact that those firm-years displaying a lower use of trade credit relative to short-term debt generally display higher short-term debt to assets ratios, lower coverage ratios, and lower trade credit to assets ratios.

The fact that those firm-years characterized by a relatively high use of trade-credit are generally smaller, and therefore more likely to face financing constraints can be seen as very preliminary evidence in favour of the offsetting hypothesis. In the section that follows, we will formally test whether the trade credit channel plays a statistically significant effect in offsetting the credit channel.

3. Baseline specification, tests of the offsetting hypothesis, and estimation methodology

Baseline specification

The baseline specification that we will use is a variant of Lovell's target adjustment model (1961)[15]. Let I and S denote the logarithms of inventories and sales; and let COV denote the firm's coverage ratio. Equation (1) gives the equation for inventory growth that we initially estimate.

$$\Delta I_{it} = b_0 + b_1 \Delta S_{it} + b_2 \Delta S_{i(t-1)} + b_3 (I_{i(t-1)} - S_{i(t-1)}) + b_4 COV_{it} + v_i + v_t + v_{jt} + e_{it} \quad (1)$$

The subscript i indexes firms; j, industries[16]; and t, time, where t=1981-2000. The terms in COV_{it} and in $(I_{i(t-1)}-S_{i(t-1)})$ can be interpreted as reflecting the influence of a long-run target inventory level. In addition to these level terms, differences of the logs of sales are included in the regression to capture the short-run dynamics. This gives the specification an error-correction format. We expect b_1, b_2, and b_4 to be positive and b_3 to be negative[17].

The error term in Equation (1) is made up of four components: v_i, which is a firm-specific component; v_t, a time-specific component accounting for possible business cycle effects; v_{jt}, a time-specific component which varies across industries

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[15] This specification is very similar to that used in Guariglia (1999). The two specifications differ in two main respects. First, in this paper, we do not include the lagged dependent variable. When this variable was included, its coefficient was in fact poorly determined, and the Sargan test (described below) indicated that its inclusion made the specification generally worse. We checked whether our main results still held when the lagged dependent variable was included in our estimating equation, and found that this was generally the case. Those results are not reported for brevity, but are available from the authors upon request. Another difference between our specification and that used in Guariglia (1999) is that, as explained below, we include industry dummies interacted with time dummies, in addition to simple time dummies. Also see Kashyap (1994), Carpenter at al. (1994, 1998), Small (2000), Choi and Kim (2001), Bagliano and Sembenelli (2002), Bo et al. (2002), and Benito (2002a, 2002b) for similar reduced-form specifications.

[16] Firms are allocated to one of the following industrial sectors: metals, metal goods, other minerals, and mineral products; chemicals and man made fibres; mechanical engineering; electrical and instrument engineering; motor vehicles and parts, other transport equipment; food, drink, and tobacco; textiles, clothing, leather, footwear, and others (Blundell et al., 1992).

[17] The error-correction term, $(I_{i(t-1)} - S_{i(t-1)})$ can in fact be interpreted as a term capturing the cost of inventories being far from a target level that is proportional to sales. Therefore, if inventories are higher (lower) than the target, one would expect inventory investment to decline (rise).

accounting for industry-specific shifts in inventory investment demand (see Carpenter and Petersen, 2002; and Carpenter and Guariglia, 2003, for a discussion of this effect); and e_{it}, an idiosyncratic component. We control for v_i by estimating our equation in first-differences; for v_t by including time dummies; and for v_{jt} by including industry dummies interacted with time dummies in all our specifications.

Tests for the offsetting hypothesis

In order to formally verify the extent to which the existence of a trade credit channel weakens the traditional credit channel of transmission of monetary policy, we will undertake two tests. The first one consists in estimating an augmented version of Equation (1) of the following type:

$$\Delta I_{it} = b_0 + b_1 \Delta S_{it} + b_2 \Delta S_{i(t-1)} + b_3 (I_{i(t-1)} - S_{i(t-1)}) + b_4 COV_{it} + \\ + b_5 \left(\frac{TC_{it}}{A_{i(t-1)}} \right) + v_i + v_t + v_{jt} + e_{it} \quad (2)$$

where TC_{it} denotes firm's i accounts payable at time t; A_{it}, its total assets; and the ratio between these two variables, the percentage of the firm's total assets which is financed by trade credit. We will then verify whether the presence of trade credit in the equation reduces the significance of the coefficient associated with the coverage ratio. If both the coverage ratio and the trade credit variable enter the equation with positive coefficients, then one can conclude that there is evidence that both credit and trade credit channels are operating. If adding trade credit reduces the size and significance of the coefficient associated with the coverage ratio, then this could be seen as evidence in favour of the hypothesis that the trade credit channel actually weakens the traditional credit channel (see De Blasio, 2003, for a similar approach).

As financially constrained firm-years are more likely to be affected by financial variables (including trade credit) than unconstrained firm-years, we will perform this test differentiating the effects of the coverage ratio and trade credit variables on the inventory investment of firm-years more and less likely to face financing constraints. More specifically, we will estimate equations of the following type (including and excluding the terms in trade credit)[18]:

$$\begin{aligned}\Delta I_{it} &= b_0 + b_1 \Delta S_{it} + b_2 \Delta S_{i(t-1)} + b_3 (I_{i(t-1)} - S_{i(t-1)}) + \\ &+ b_{41} * COV_{it} * SMALL(1)_{it} + b_{42} * COV_{it} * (1 - SMALL(1)_{it}) + \\ &+ \{ b_{51} * \left(\frac{TC_{it}}{A_{i(t-1)}} \right) * SMALL(1)_{it} + b_{52} * \left(\frac{TC_{it}}{A_{i(t-1)}} \right) * (1 - SMALL(1)_{it}) \} + v_i + v_t + v_{jt} + e_{it}\end{aligned} \tag{3}$$

The second way in which we test the offsetting effect of the credit channel by the trade credit channel consists in estimating a variant of Equation (1), in which the effect that the coverage ratio plays on firm-years' inventory accumulation is differentiated across the following four sub-categories of firm-years: small firm-years which make a relatively low use of trade credit; small firm-years which make a relatively high use of trade credit; large firm-years which make a relatively low use of trade credit; and large firm-years which make a relatively high use of trade credit. Our estimating equation will take the following form[19]:

$$\begin{aligned}\Delta I_{it} &= b_0 + b_1 \Delta S_{it} + b_2 \Delta S_{i(t-1)} + b_3 (I_{i(t-1)} - S_{i(t-1)}) + \\ &+ b_{411} * COV_{it} * SMALL(1)_{it} * (1 - HIGH(1)_{it}) + b_{412} * COV_{it} * SMALL(1)_{it} * HIGH(1)_{it} + \\ &+ b_{421} * COV_{it} * (1 - SMALL(1)_{it}) * (1 - HIGH(1)_{it}) + b_{422} * COV_{it} * (1 - SMALL(1)_{it}) * HIGH(1)_{it} + \\ &+ v_i + v_t + v_{jt} + e_{it}\end{aligned} \tag{4}$$

If the trade credit channel does play an offsetting effect on the credit channel, then one would expect the financial variables to only affect the inventory investment of those small firm-years that make less use of trade credit. Small firm-years making a higher use of trade credit should not be affected by changes in their liquidity positions

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[18] We also estimated more general versions of this equation, which included the dummy variable *SMALL(1)*$_{it}$ among the regressors. Since the later variable was never precisely determined, we omitted it from our preferred specifications. Note that the inclusion of the dummy did not change the magnitude and significance of the coefficients associated with the other regressors.

[19] Once again, we estimated more general versions of this equation, which included the dummy variables *SMALL(1)*$_{it}$ and *HIGH(1)*$_{it}$. The coefficients associated with the dummies were never precisely determined and the main results were not changed by their inclusion.

as much as other firm-years, as they can use trade credit to overcome the liquidity constraints (see Valderrama, 2003, for a similar approach).[20]

Estimation methodology

All equations will be estimated in first-differences, to allow for firm-specific, time-invariant effects. Given the possible endogeneity of the regressors, we will use a first-difference Generalized Method of Moments (GMM) approach[21]. Two or more lags of each of the regressors including the interaction terms will be used as instruments[22].

In order to evaluate whether the model is correctly specified, we will use two criteria: the Sargan test (also known as *J* test) and the test for second-order serial correlation of the residuals in the differenced equation (*m2*). If the model is correctly specified, the variables in the instrument set should be uncorrelated with the error term in the relevant equation. The *J* test is the Sargan test for overidentifying restrictions, which, under the null of instrument validity, is asymptotically distributed as a chi-square with degrees of freedom equal to the number of instruments less the number of parameters. The *m2* test is asymptotically distributed as a standard normal under the null of no second-order serial correlation of the differenced residuals, and

[20] Valderrama (2003) estimated regressions for investment in fixed capital, not inventory investment. Furthermore, she did not interact her explanatory variables with dummies indicating high/low use of trade credit by firms, but with a variable indicating the actual share of trade credit in short-term debt.

[21] See Arellano and Bond (1991) on the application of the GMM approach to panel data. The program DPD for Ox is used in estimation (Doornik et al., 2002).

[22] An alternative estimator which could be used is the GMM system estimator, which combines in a system the original specification expressed in first-differences and in levels. This estimator, developed in Blundell and Bond (1998) is generally used when the simple first-differenced GMM estimator suffers from serious finite small sample biases. This generally occurs when the instruments used with the standard first-differenced GMM estimator (i.e. the endogenous variables lagged two or more periods) are not very informative. A way to detect whether the simple first-differenced GMM estimator is affected by these finite sample biases is to compare the estimate of the coefficient on the lagged dependent variable obtained from the latter estimator with that obtained using the Within Groups estimator. As the Within Groups estimate is typically downward biased in short panels (Nickell, 1981), one would expect a consistent estimate of the coefficient on the lagged dependent variable to lie above this estimate. Should one find that the estimate obtained using the first-differenced GMM estimator lies close or below the Within Groups estimate, then one could suspect the GMM estimate to be downward biased as well, possibly due to weak instruments (see Bond *et al*., 2001, for further discussion on this point). We therefore estimated a modified version of Equation (1), which included the lagged dependent variable, using the Within Groups and the GMM first-difference estimators. The coefficients associated with the lagged dependent variable were respectively 0.012 and 0.147. Because the GMM first-difference estimate lied above the Within Groups estimate, we concluded that the GMM first-difference estimates were unlikely to be subject to serious finite sample biases. Consequently, we did not report the estimates based on the GMM system estimator. These estimates, as well as the Within Groups estimates, are however available from the authors upon request.

provides a further check on the specification of the model and on the legitimacy of variables dated *t*-2 as instruments in the differenced equation[23].

4. Empirical results

First test of the offsetting hypothesis

Column 1 of Table 2 presents the estimates of Equation (1) performed on the full sample. We can see that sales growth has a positive and significant effect on inventory accumulation whereas the coefficient associated with lagged sales growth is not precisely determined. The coefficient on the error correction term has the expected negative sign, and the coefficient on the coverage ratio, a positive sign, suggesting that financial factors matter in determining inventory investment. Although small, the latter coefficient (0.0007) suggests that a one standard deviation rise in the coverage ratio increases inventory investment by about 3.6%. Compared to a mean inventory growth of 2.3% over the period considered in estimation, this is quite a large effect. Neither the Sargan test nor the test of second-order autocorrelation of the residuals indicate problems with the specification of the model or the choice of the instruments.

Column 2 of Table 2 presents the estimates of Equation (2). We can see that the trade credit to assets ratio attracts a positive, relatively large, and significant coefficient (0.707), which suggests that if the trade credit to assets ratio increases by one standard deviation, inventory investment rises by circa 7.3%. This can be seen as evidence in favour of the presence of a trade credit channel of transmission of monetary policy. Yet, because the coefficient associated with the coverage ratio (0.0006) is still positive, statistically significant, and of similar magnitude as in column 1, we can conclude that although the trade credit channel seems to be stronger, there is no overwhelming evidence that the latter channel offsets the credit channel: both channels seem to be operating side by side. It is noteworthy that comparing the Sargan statistics in column 1 and 2 suggests that adding the trade credit to assets ratio to Equation (1) generally improves the specification of the model[24].

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[23] If the undifferenced error terms are *i.i.d.*, then the differenced residuals should display first-order, but not second-order serial correlation. In our Tables, we report both the test for first-order (*m1*) and the test for second-order serial correlation of the differenced residuals (*m2*). Note that neither the *J* test nor the *m2* test allow to discriminate between bad instruments and model specification.

[24] Following De Blasio (2003), we also tried to differentiate the effects of the coverage ratio and trade credit across periods of recession and tight monetary policy and other periods. It has to be noted, however, that because our equations are estimated in first-differences, using the right-hand side

Columns 3 and 4 of Table 2 present the estimates of two versions of Equation (3): excluding and including the trade credit to assets ratio variables[25]. The results in column 3, which exclude the trade credit variables, show that the estimated effect of the coverage ratio on inventory investment is significant only at small firm-years. Furthermore, the point-estimate on the coverage ratio for small firm-years, 0.001, is larger than the corresponding point-estimate for the full-sample reported in column 1, namely 0.0007. This finding is consistent with the existence of a credit channel of transmission of monetary policy. If a firm's coverage ratio increases, this suggests in fact an improvement in its balance sheet. Especially if the firm is more likely to face financing constraints, this will allow it to accumulate more inventories[26].

Column 4 indicates that when the trade credit to assets ratio is included in the equation, it appears to significantly affect the inventory accumulation at both small and large firm-years in a similar way (the point-estimates are respectively equal to 0.641 and 0.682 for the two types of firm-years)[27]. Moreover, the addition of these trade credit variables to the equation does not affect the signs and significance of the coefficients on the coverage ratio variables. Once again, this result suggests that the credit channel and the trade credit channel operate side by side, the latter being stronger than the former. Similar results were obtained when the firm-years were divided into small and large using total assets instead of employment as a sorting device (columns 5 and 6). In the latter specifications, however, the coefficient

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variables lagged at least twice as instruments, the sample that we actually use in estimation only covers the time period 1982-2000, which includes only two periods of recession/tight monetary policy, namely 1990 and 1991 (Guariglia, 1999). We therefore estimated an inventory investment equation similar to Equation (1), where the term in the coverage ratio was replaced with the following two interaction terms: $COV_{it}*REC_{it}$ and $COV_{it}*(1-REC_{it})$, where REC_{it} represents a dummy equal to 1 in the years 1990 and 1991. We found that the coefficients associated with the interaction terms were both precisely determined, and respectively equal to 0.0009 (t-statistic: 2.31) and 0.0006 (t-statistic: 2.43). A similar pattern was found when interactions of the trade credit term with the dummies REC_{it} and $(1-REC_{it})$ dummies were included in the regression. In that case, the coefficients on the two interaction terms in the coverage ratio were respectively 0.0008 (t-statistic: 2.69) and 0.0006 (t-statistic: 2.58), and those on the trade credit interaction terms were respectively 1.04 (t-statistic: 2.64) and 0.79 (t-statistic: 2.47). These results suggest that both our financial variables have a stronger effect on firms' inventory investment in periods of recession/tight monetary policy.

[25] Note that the number of observations in columns 3 and 4 is slightly smaller than the corresponding number in columns 1, 2, 5, and 6, due to the fact that for some firm-years, the number of employees was missing.

[26] To check robustness, we interacted all the regressors with the $SMALL_{it}$ and $(1-SMALL_{it})$ dummies. In line with the results reported in column 3 of Table 2, we found that the coefficients associated with the coverage ratio were 0.001 (t-statistic: 2.49) and 0.0003 (t-statistic: 1.35), respectively for small and large firm-years. Yet, the Sargan test (p-value: 0.018) indicated problems with this specification. As a further robustness test, we also re-estimated all our regressions replacing all variables in the coverage ratio with corresponding variables in cash flow. The results are presented and described in Appendix 2.

[27] This finding is consistent with Nilsen (2002), according to which large firms also make a significant use of trade credit, although they are assumed to have wider access to other cheaper forms of credit.

associated with the coverage ratio was statistically significant for both small and large firm-years, although always bigger in magnitude for the former[28].

Second test of the offsetting hypothesis

Table 3 reports the results of the estimation of Equation (4), where the coefficient associated with the coverage ratio is differentiated across small firm-years making low use of trade credit; small firm-years making high use of trade credit; large firm-years making low use of trade credit; and large firm-years making high use of trade credit[29]. This differentiation is aimed at assessing the extent to which financially constrained firm-years can use trade credit to overcome liquidity constraints. Columns 1 and 2 use the ratio of trade credit to assets as an indicator for whether a firm makes high or low use of trade credit. Focusing on column 1, where employment is used to partition firm-years into small and large, we can see that the coverage ratio attracts a positive and statistically significant coefficient only for small firm-years that make a relatively low use of trade credit [30]. A similar finding characterizes column 2, where total assets are used instead of employment to partition firm-years across more and less likely to face liquidity constraints.

Finally, columns 3 and 4 of Table 3 use the ratio of trade credit to trade credit plus short-term debt as an indicator for whether a firm makes high or low use of trade credit. Column 3 partitions firm-years into small and large using employment as a sorting device. In this specification, the coverage ratio term for small firm-years making a low use of trade credit attracts a positive coefficient (0.002), significant at the 10% level. Although the corresponding coefficient for small firm-years making a high use of trade credit is significant at the 5% level, it is smaller in magnitude (0.0006). In column 4, total assets are used to partition firm-years into small and large. The coefficient associated with the coverage ratio is once again significant at the 5% level only for small firm-years making a low use of trade credit.

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[28] In column 6, the Sargan test indicates some problems with the choice of instruments and/or the specification of the model. These problems persisted when the instruments were lagged three times instead of twice.

[29] See Appendix 2 for similar regressions where all variables in the coverage ratio are replaced with corresponding variables in cash flow.

[30] We also estimated an alternative specification, which included four additional interaction terms, namely the trade credit to assets ratio interacted with the small/large and the high/low trade credit usage dummies. The coefficients associated with the coverage ratio exhibited a very similar pattern as those described in column 1. The coefficients associated with the trade credit to assets ratio were precisely determined for all categories of firm-years. These results are not reported for brevity, but are available from the authors upon request.

These results can be seen as evidence in favour of an offsetting effect of the credit channel by the trade credit channel. Those firm-years that are small, and therefore more likely to be financially constrained seem in fact to be less constrained by their coverage ratios if they make a relatively high use of trade credit. This suggests that using trade credit can help firms to offset liquidity problems.

In all specifications in Table 3, neither the Sargan test, nor the test for second order autocorrelation of the residuals indicate any problems with the model specification, nor the choice of instruments. The Sargan test actually appears to perform better for this model with many interactions, suggesting that differentiating the effect of the coverage ratio for various categories of firm-years improves the specification of the model.

Overall, our two sets of tests suggest that there is some evidence that both the credit channel and the trade credit channel of transmission of monetary policy operate in the UK, the latter being stronger than the former. Our second set of results also suggests that there is some evidence that the trade credit channel weakens the credit channel. These results are in line with the findings in Atanasova and Wilson (2004), Mateut and Mizen (2002), Mateut et al. (2002), and Kohler et al. (2000).

5. Conclusions

In this paper, we have used a panel of 609 UK firms over the period 1980-2000 to test for the presence of a trade credit channel of transmission of monetary policy and for whether this channel offsets the credit channel. We have conducted two sets of tests to achieve this objective. First, we have augmented a traditional error-correction inventory investment equation with a coverage ratio variable and a trade credit to assets variable, and we have estimated it differentiating the effects of the latter two variables for small and large firm-years. Our second test consisted in the estimation of an inventory investment error-correction equation augmented with the coverage ratio, differentiating the effects of the latter variable across small firm-years making a low use of trade credit; small firm-years making a high use of trade credit; large firm-years making a low use of trade credit; and large firm-years making a high use of trade credit.

The results of our first test suggested that both credit and trade credit channels of transmission of monetary policy operate side by side in the UK, the latter having stronger effects than the former. Those of our second test, according to which the coverage ratio generally plays a stronger effect on the inventory investment of those small firm-years making a relatively low use of trade credit, also showed some evidence in favour of the fact that the trade credit channel weakens the credit channel. These findings are important as they suggest that the trade credit channel is likely to dampen the effects of contractionary monetary policies, and more in general to make the recessions that generally follow these policies less severe.

In the light of our results, we can conclude that a possible explanation for why, contrary to the mainstream literature, authors such as Kaplan and Zingales (1997) and Cleary (1999) found that those firms facing tighter financing constraints actually exhibit a lower sensitivity of investment to financial variables could be that these firms make a heavy use of trade credit, offsetting therefore their liquidity constraints.

An alternative explanation could be that these firms are actually financially distressed. They might therefore have reached the minimum level of investment necessary to carry on production: further reductions in investment would therefore be impossible, even in response to declines in cash flow. Financially distressed firms might also be required by their creditors to use their cash flow to meet interest payments and/or improve the liquidity of their balance sheet (Fazzari et al., 2000; Huang, 2002; Allayannis and Monumbar, 2004; Cleary et al., 2004).

In order to shed more light on these alternative explanations, the behaviour of those financially constrained firms, which face the most severe financing constraints should be carefully analyzed. As firms belonging to the latter category are more likely not to be quoted on the stock market, datasets which contain unquoted firms should be used for this purpose. This is on the agenda for future research.

Appendix 1: Data appendix

Structure of the unbalanced panel:

Number of observations per firm	Number of firms	Percent	Cumulative
3	114	18.72	18.72
4	74	12.15	30.87
5	68	11.17	42.04
6	45	7.39	49.43
7	48	7.88	57.31
8	52	8.54	65.85
9	33	5.42	71.26
10	26	4.27	75.53
11	35	5.75	81.28
12	33	5.42	86.70
13	30	4.93	91.63
14	23	3.78	95.40
15	13	2.13	97.54
16	6	0.99	98.52
17	4	0.66	99.18
18	4	0.66	99.84
20	1	0.16	100
Total	609	100.00	

Inventories:

They are defined as Datastream variable number 364 (v364), which includes finished goods, raw materials, work-in-process less any advances paid, and any other stocks.

Sales:

It is defined as v104, i.e. the amount of sales of goods and services to third parties relating to the normal industrial activities of the company.

Coverage ratio:

It is defined as (v137+v144)/(v150+v151), where

v137 is net profit derived from normal activities of the company after depreciation and operating provisions.

v144 includes dividend income, interest received, rents, grants and any other non-operating income.

v150 shows interest on loans which are repayable in less than five years.

v151 shows interest on loans which are repayable in five years or more.

Trade credit:

It is defined as v276, which includes trade payables within and after one year relating to the normal business activities of the company.

Trade debt:

It is defined as v287, which includes trade receivables within and after one year relating to the normal business activities of the company.

Short-term-debt:

It is defined as v309, which includes bank overdrafts, loans, and other short-term borrowing.

Total number of employees:

It is defined as v219, i.e. the average number of employees as disclosed by the company.

Total assets:

It is defined as v392, i.e. the sum of tangible fixed assets, intangible assets, investments, other assets, total stocks and work-in-progress, total debtors and equivalent, and cash and cash equivalents.

Cash flow:

We define cash flow as follows: v623+v136, where:

v623 is defined as published after tax profit.

v136 is defined as depreciation.

Replacement value of the capital stock:

The replacement value of capital stock is calculated using the perpetual inventory formula (Blundell et al., 1992; Bond and Meghir, 1994). We use v339=tangible fixed assets (net) as the historic value of the capital stock. We then assume that replacement cost and historic cost are the same in the first year of data for each firm. We then apply the perpetual inventory formula as follows:

replacement value of capital stock at time t+1 =

replacement value at time t*(1-*dep*)*(p_{t+1} /p_t)+ investment at time t+1,

where *dep* represents the firm-specific depreciation rate, and p_t is the price of investment goods, which we proxy with the implicit deflator for gross fixed capital formation. To calculate the depreciation rate, *dep*, we use rates of 8.19% for plant and machinery, and 2.5% for land and buildings. These are taken from King and Fullerton (1984). For each observation, we then calculate the proportion of land and building investment, as follows:

(gross book value of all land and building - accumulated depreciation on land and building)/(gross total fixed assets - accumulated depreciation of total fixed assets), i.e. (v327-v335)/(v330-v338).

We then calculate an average value of this ratio for each firm, which we call *mprlb*. The firm-specific depreciation rate would then be given by:

dep = 0.0819*(1-*mprlb*)+0.025**mprlb*.

<u>Deflators:</u>

All variables, except the capital stock, are deflated using the aggregate GDP deflator. The capital stock is deflated using the implicit price deflator for gross fixed capital formation.

Appendix 2: Replacing all variables in the coverage ratio with corresponding variables in cash flow.

To check for robustness, we repeated both our tests of the offsetting hypothesis replacing the coverage ratio with the cash flow to beginning-of-period capital stock in our regressions. This test is also aimed at making our results more directly comparable to those in Benito (2002a, 2002b), Bo et al. (2002), Carpenter et al. (1994, 1998), Choi and Kim (2001), and Small (2000), who used cash flow in their inventory investment regressions. The cash-flow to capital ratio has also been widely used in investment equations to test for the possibility that investment spending is subject to financing constraints (see Fazzari et al., 1988; Kaplan and Zingales, 1997; Cleary, 1999 etc.)

The estimates relative to our first test of the offsetting hypothesis are reported in Table A1. Columns 3 and 5 show that cash flow only affects inventory investment at small firm-years. When the trade credit to assets ratio was added to our inventory investment regression, the coefficient associated with cash flow remained significant, although smaller in magnitude, for small firm-years when employment was used to partition the sample (column 4), but lost significance when total assets were used (column 6). Finally, when we replaced the coverage ratio with cash flow in the regressions without interactions, the coefficient on the latter variable was generally poorly determined (columns 1 and 2). Yet, the Sargan test indicated problems with these simplified specifications. As the coefficients on the trade credit variables were precisely determined in most of the regressions, these results confirm our previous conclusion that the trade credit channel plays an important role in the UK. Furthermore, compared to the estimates reported in Table 2, these results also seem to provide stronger evidence in favour of the fact that the trade credit channel weakens the credit channel.

The estimates relative to our second test of the offsetting hypothesis are reported in Table A2. The results in columns 1, 3, and 4 are in line with those in Table 3, and suggest that cash flow only affects inventory investment at those small firms making a relatively low use of trade credit. Surprisingly, however, the estimates in column 2, where firm-years are partitioned on the basis of total assets and the trade credit to assets ratio, suggest that it is those small firm-years that make a heavier use of trade credit whose inventory investment is most affected by changes in internal finance.

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Table 1: Descriptive statistics.

Panel I

	All firm-years	Firm-years such that $SMALL_{it}$=0	Firm-years such that $SMALL_{it}$=1	Firm-years such that $SMALL1_{it}$=0	Firm-years such that $SMALL1_{it}$=1
	(1)	(2)	(3)	(4)	(5)
Emp_{it}	4214.59 (8878.25)	4714.40 (9289.72)	156.71 (60.62)	5064.83 (9592.94)	329.022 (335.37)
A_{it}	2722.12 (6345.97)	3057.73 (6681.16)	111.50 (83.51)	3289.48 (6873.30)	116.841 (74.19)
DI_{it}	0.030 (0.26)	0.031 (0.25)	0.031 (0.31)	0.038 (0.25)	-0.006 (0.27)
DS_{it}	0.060 (0.19)	0.061 (0.19)	0.056 (0.22)	0.067 (0.19)	0.028 (0.20)
$(I_{i(t-1)}-S_{i(t-1)})$	-1.870 (0.56)	-1.873 (0.55)	-1.858 (0.68)	-1.862 (0.56)	-1.902 (0.60)
$CF_{it} / K_{i(t-1)}$	0.294 (0.31)	0.297 (0.30)	0.268 (0.42)	0.314 (0.30)	0.199 (0.34)
$COVER_{it}$	19.517 (55.98)	18.733 (53.55)	24.589 (68.21)	19.794 (56.95)	18.241 (51.31)
$STD_{it} / A_{i(t-1)}$	0.102 (0.10)	0.099 (0.09)	0.127 (0.13)	0.097 (0.09)	0.122 (0.12)
$TC_{it} / A_{i(t-1)}$	0.177 (0.11)	0.177 (0.10)	0.190 (0.13)	0.176 (0.11)	0.186 (0.11)
$TC_{it} / (TC_{it} + STD_{it})$	0.661 (0.23)	0.666 (0.22)	0.644 (0.25)	0.667 (0.22)	0.636 (0.24)
$TD_{it} / A_{i(t-1)}$	0.290 (0.134)	0.285 (0.13)	0.334 (0.17)	0.283 (0.13)	0.322 (0.14)
Nb. of observations	3892	3435	418	3196	696

Notes: The Table reports sample means. Standard deviations are presented in parentheses. The subscript *i* indexes firms, and the subscript *t*, time, where *t*=1981-2000. $SMALL_{it}$ is a dummy variable equal to 1 if firm *i* has 250 employees or more at time *t*, and equal to 0 otherwise. $SMALL1_{it}$ is a dummy variable equal to 1 if firm *i*'s total assets are in the lowest quartile of the distribution of the total assets of all firms belonging to the same industry as firm *i* in year *t*, and 0, otherwise. *I* represents the logarithm of the firm's inventory investment; *S*, the logarithm of its sales; *A*, its total real assets; *Emp*, its total number of employees; *CF*, its cash flow; *K*, its capital stock; *COVER*, its coverage ratio; *STD*, its short-term debt; *TC*, its trade credit (accounts payable); and *TD*, its trade debt (accounts receivable).

Table 1: Descriptive statistics (continued).

Panel II

	Firm-years such that $HIGHTC_{it}$=0 (1)	Firm-years such that $HIGHTC_{it}$=1 (2)	Firm-years such that $HIGHTC1_{it}$=0 (3)	Firm-years such that $HIGHTC1_{it}$=1 (4)
Emp_{it}	4837.56 (9701.45)	1868.86 (3782.12)	4554.88 (9310.62)	3170.78 (7302.06)
A_{it}	3187.10 (6976.57)	963.88 (2147.23)	3011.91 (6719.83)	1830.90 (4922.04)
DI_{it}	-0.004 (0.23)	0.160 (0.31)	0.030 (0.26)	0.030 (0.25)
DS_{it}	0.035 (0.17)	0.152 (0.24)	0.057 (0.19)	0.070 (0.19)
$(I_{i(t-1)}-S_{i(t-1)})$	-1.849 (0.57)	-1.948 (0.55)	-1.834 (0.56)	-1.977 (0.58)
$CF_{it} / K_{i(t-1)}$	0.279 (0.28)	0.348 (0.40)	0.272 (0.30)	0.362 (0.33)
$COVER_{it}$	19.429 (54.79)	19.848 (60.30)	10.291 (26.89)	47.888 (97.41)
$STD_{it} / A_{i(t-1)}$	0.098 (0.09)	0.116 (0.12)	0.128 (0.10)	0.020 (0.03)
$TC_{it} / A_{i(t-1)}$	0.139 (0.06)	0.322 (0.12)	0.166 (0.10)	0.212 (0.11)
$TC_{it} / (TC_{it} + STD_{it})$	0.633 (0.23)	0.766 (0.17)	0.576 (0.19)	0.923 (0.10)
$TD_{it} / A_{i(t-1)}$	0.260 (0.11)	0.405 (0.17)	0.285 (0.14)	0.306 (0.13)
Nb. of observations	3078	814	2937	955

Notes: The Table reports sample means. Standard deviations are presented in parentheses. The subscript i indexes firms, and the subscript t, time, where t=1981-2000. $HIGHTC_{it}$ is a dummy variable equal to 1 if the ratio of trade credit to total beginning-of-period real assets for firm i in year t is in the highest quartile of the distribution of the ratios of all the firms in that particular industry and year, and 0 otherwise. $HIGHTC1_{it}$ is a dummy variable equal to 1 if the ratio of trade credit to the sum of trade credit and short-term debt for firm i in year t is in the highest quartile of the distribution of the ratios of all the firms in that particular industry and year, and 0 otherwise. I represents the logarithm of the firm's inventory investment; S, the logarithm of its sales; A, its total real assets; Emp, its total number of employees; CF, its cash flow; K, its capital stock; $COVER$, its coverage ratio; STD, its short-term debt; TC, its trade credit (accounts payable); and TD, its trade debt (accounts receivable).

Table 2: Results of the first test of the offsetting hypothesis.

Dependent variable: ΔI_{it}	Full Sample (1)	Full sample (2)	Interaction var.: $SMALL_{it}$ (3)	Interaction var.: $SMALL_{it}$ (4)	Interaction var.: $SMALL1_{it}$ (5)	Interaction var.: $SMALL1_{it}$ (6)
DS_{it}	1.016*** (0.12)	0.838*** (0.13)	1.044*** (0.11)	0.733*** (0.12)	0.969*** (0.09)	0.813*** (0.09)
$DS_{i(t-1)}$	-0.01 (0.04)	-0.0007 (0.03)	-0.018 (0.04)	0.0006 (0.03)	0.004 (0.03)	-0.009 (0.03)
$I_{i(t-1)}$-$S_{i(t-1)}$	-0.915*** (0.13)	-0.825*** (0.13)	-0.920*** (0.11)	-0.811*** (0.10)	-0.868*** (0.09)	-0.800*** (0.09)
COV_{it}	0.0007*** (0.0002)	0.0006*** (0.0002)				
COV_{it}*($SMALL(1)_{it}$)			0.001** (0.0005)	0.001*** (0.0003)	0.001** (0.0005)	0.001** (0.0004)
COV_{it}*(1-$SMALL(1)_{it}$)			0.0003 (0.0002)	0.0003 (0.0002)	0.0004** (0.0001)	0.0004** (0.0002)
$(TC_{it}/A_{i(t-1)})$		0.707** (0.32)				
$(TC_{it}/A_{i(t-1)})$*$SMALL(1)_{it}$				0.641* (0.40)		0.814*** (0.33)
$(TC_{it}/A_{i(t-1)})$*(1-$SMALL(1)_{it}$)				0.682*** (0.27)		0.752*** (0.23)
Sample size	3283	3283	3247	3247	3283	3283
m1	-2.372	-2.786	-3.107	-3.523	-3.645	-3.929
m2	-0.899	-1.779	-0.679	-1.897	-1.207	-1.812
Sargan/Hansen (*p*-value)	0.071	0.129	0.059	0.080	0.087	0.024

Note: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. *m1 (m2)* is a test for first- (second-) order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. Instruments in column (1) are ($I_{i(t-2)}$-$S_{i(t-2)}$); $DS_{i(t-2)};$ $COV_{i(t-2)}$. Instruments in column (2) also include $TC_{i(t-2)}/A_{i(t-3)}$. Instruments in columns (3) and (5) are ($I_{i(t-2)}$-$S_{i(t-2)}$); $DS_{i(t-2)};$ $COV_{i(t-2)}$ *($SMALL_{i(t-2)}$); $COV_{i(t-2)}$ *(1-$SMALL_{i(t-2)}$) and further lags. Instruments in column (4) are ($I_{i(t-2)}$-$S_{i(t-2)}$); $DS_{i(t-2)};$ $COV_{i(t-2)}$ *($SMALL_{i(t-2)}$); $COV_{i(t-2)}$ *(1-$SMALL_{i(t-2)}$); $TC_{i(t-3)}/A_{i(t-4)}$ *($SMALL_{i(t-3)}$); $TC_{i(t-3)}/A_{i(t-4)}$ *(1-$SMALL_{i(t-3)}$) and further lags. Instruments in column (6) are ($I_{i(t-2)}$-$S_{i(t-2)}$); $DS_{i(t-2)};$ $COV_{i(t-2)}$ *($SMALL_{i(t-2)}$); $COV_{i(t-2)}$ *(1-$SMALL_{i(t-2)}$); $TC_{i(t-2)}/A_{i(t-3)}$ *($SMALL_{i(t-2)}$); $TC_{i(t-2)}/A_{i(t-3)}$ *(1-$SMALL_{i(t-2)}$) and further lags. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. Also see Notes to Table 1. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 3: Results of the second test of the offsetting hypothesis.

Dependent variable: ΔI_{it}	Interaction vars: $SMALL_{it}$; $HIGHTC_{it}$ (1)	Interaction vars.: $SMALL1_{it}$; $HIGHTC_{it}$ (2)	Interaction vars.: $SMALL_{it}$; $HIGHTC1_{it}$ (3)	Interaction vars.: $SMALL1_{it}$; $HIGHTC1_{it}$ (4)
DS_{it}	0.857***	0.955***	1.065***	0.960***
	(0.11)	(0.09)	(0.09)	(0.07)
$DS_{i(t-1)}$	0.014	-0.002	-0.02	-0.01
	(0.04)	(0.03)	(0.04)	(0.03)
$I_{i(t-1)}-S_{i(t-1)}$	-0.838***	-0.814***	-0.870***	-0.781***
	(0.09)	(0.08)	(0.09)	(0.07)
$COV_{it}*SMALL(1)_{it}*(1-HIGHTC(1)_{it})$	0.0008***	0.0007*	0.002*	0.001**
	(0.00)	(0.0003)	(0.001)	(0.0005)
$COV_{it}*SMALL(1)_{it}*HIGHTC(1)_{it}$	0.001	0.0016	0.0006***	0.0006
	(0.001)	(0.001)	(0.0001)	(0.0004)
$COV_{it}*(1-SMALL(1)_{it})*(1-HIGHTC(1)_{it})$	0.0002	0.0003	0.0005	0.0006
	(0.0002)	(0.00)	(0.0006)	(0.0004)
$COV_{it}*(1-SMALL(1)_{it})*HIGHTC(1)_{it}$	-0.0002	0.00	0.0002	0.0002*
	(0.00)	(0.00)	(0.0002)	(0.0001)
Sample size	3247	3283	3247	3283
m1	-4.009	-5.098	-4.175	-6.163
m2	-1.340	-0.881	-0.278	-0.468
Sargan/Hansen (*p*-value)	0.061	0.206	0.109	0.218

Notes: Instruments in all columns are $(I_{i(t-2)}-S_{i(t-2)})$; $DS_{i(t-2)}$; $COV_{i(t-2)}*(SMALL_{i(t-2)})*(HIGH_{i(t-2)})$; $COV_{i(t-2)}*(SMALL_{i(t-2)})*(1-HIGH_{i(t-2)})$; $COV_{i(t-2)}*(1-SMALL_{i(t-2)})*(HIGH_{i(t-2)})$; $COV_{i(t-2)}*(1-SMALL_{i(t-2)})*(1-HIGH_{i(t-2)})$ and further lags. Also see Notes to Tables 1 and 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table A1: Results of the first test of the offsetting hypothesis when all variables in the coverage ratio are replaced with corresponding variables in cash flow.

Dependent variable: ΔI_{it}	Full Sample	Full sample	Interaction var.: $SMALL_{it}$	Interaction var.: $SMALL_{it}$	Interaction var.: $SMALL1_{it}$	Interaction var.: $SMALL1_{it}$
	(1)	(2)	(3)	(4)	(5)	(6)
DS_{it}	1.042***	0.813***	1.038**	0.757***	1.013***	0.768***
	(0.13)	(0.13)	(0.13)	(0.14)	(0.12)	(0.11)
$DS_{i(t-1)}$	-0.032	-0.005	-0.031	0.007	-0.034	-0.014
	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)
$I_{i(t-1)}-S_{i(t-1)}$	-0.860***	-0.801***	-0.797***	-0.754***	-0.796***	-0.739***
	(0.15)	(0.13)	(0.12)	(0.11)	(0.12)	(0.10)
$CF_{it} / K_{i(t-1)}$	0.099	0.064				
	(0.09)	(0.08)				
$(CF_{it} /K_{i(t-1)})*(SMALL(1)_{it})$			0.229*	0.179**	0.155*	0.068
			(0.12)	(0.083)	(0.09)	(0.08)
$(CF_{it} /K_{i(t-1)})*(1-SMALL(1)_{it})$			-0.018	-0.031	0.062	0.055
			(0.09)	(0.08)	(0.09)	(0.07)
$(TC_{it} /A_{i(t-1)})$		0.756**				
		(0.31)				
$(TC_{it} /A_{i(t-1)})*SMALL(1)_{it}$				0.446		0.885**
				(0.44)		(0.38)
$(TC_{it} /A_{i(t-1)})*(1-SMALL(1)_{it})$				1.024***		0.818***
				(0.32)		(0.24)
Sample size	3283	3283	3247	3247	3283	3283
m1	-2.792	-2.921	-4.034	-3.631	-3.851	-4.234
m2	-0.232	-1.614	0.157	-1.539	-0.049	-1.363
Sargan/Hansen (*p*-value)	0.053	0.038	0.116	0.001	0.125	0.01

Note: Instruments in column (1) are $(I_{i(t-2)}-S_{i(t-2)})$; $DS_{i(t-2)}$; $(CF_{i(t-2)}/K_{i(t-3)})$. Instruments in column (2) also include $TC_{i(t-2)} /A_{i(t-3)}$. Instruments in columns (3) and (5) are $(I_{i(t-2)}-S_{i(t-2)})$; $DS_{i(t-2)}$; $(CF_{i(t-2)}/K_{i(t-3)})*(SMALL_{i(t-2)})$; $(CF_{i(t-2)}/K_{i(t-3)})*(1-SMALL_{i(t-2)})$. Instruments in column (4) and (6) also include $TC_{i(t-2)} /A_{i(t-3)} *(SMALL_{i(t-2)})$; $TC_{i(t-2)} /A_{i(t-3)} *(1-SMALL_{i(t-2)})$. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. Also see Notes to Table 1. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table A2: Results of the second test of the offsetting hypothesis when all variables in the coverage ratio are replaced with corresponding variables in cash flow.

Dependent variable: ΔI_{it}	Interaction vars: $SMALL_{it}$; $HIGHTC_{it}$ (1)	Interaction vars.: $SMALL1_{it}$; $HIGHTC_{it}$ (2)	Interaction vars.: $SMALL_{it}$; $HIGHTC1_{it}$ (3)	Interaction vars.: $SMALL1_{it}$; $HIGHTC1_{it}$ (4)
DS_{it}	0.980***	0.952***	1.034***	1.003***
	(0.12)	(0.10)	(0.08)	(0.09)
$DS_{i(t-1)}$	-0.020	-0.022	-0.042	-0.043
	(0.04)	(0.04)	(0.04)	(0.04)
$I_{i(t-1)}-S_{i(t-1)}$	-0.823***	-0.813***	-0.852***	-0.796***
	(0.10)	(0.09)	(0.08)	(0.10)
$(CF_{it}/K_{i(t-1)})*SMALL(1)_{it}*(1-HIGHTC(1)_{it})$	0.280*	0.061	0.192**	0.213**
	(0.15)	(0.14)	(0.08)	(0.08)
$(CF_{it}/K_{i(t-1)})*SMALL(1)_{it}*HIGHTC(1)_{it}$	0.110	0.213*	0.044	-0.181
	(0.12)	(0.08)	(0.10)	(0.20)
$(CF_{it}/K_{i(t-1)})*(1-SMALL(1)_{it})*(1-HIGHTC(1)_{it})$	0.071	0.126	0.066	0.117
	(0.09)	(0.08)	(0.06)	(0.09)
$(CF_{it}/K_{i(t-1)})*(1-SMALL(1)_{it})*HIGHTC(1)_{it}$	0.055	0.118	-0.061	0.016
	(0.11)	(0.11)	(0.06)	(0.08)
Sample size	3247	3283	3247	3283
m1	-4.567	-4.715	-5.520	-4.551
m2	-0.262	-0.549	0.010	0.126
Sargan/Hansen (*p*-value)	0.124	0.164	0.071	0.133

Notes: Instruments in all columns are $(I_{i(t-2)}-S_{i(t-2)})$; $DS_{i(t-2)}$; $(CF_{i(t-2)}/K_{i(t-3)})*(SMALL_{i(t-2)})*(HIGH_{i(t-2)})$; $(CF_{i(t-2)}/K_{i(t-3)})*(SMALL_{i(t-2)})*(1-HIGH_{i(t-2)})$; $COV_{i(t-2)}*(1-SMALL_{i(t-2)})*(HIGH_{i(t-2)})$; $(CF_{i(t-2)}/K_{i(t-3)})*(1-SMALL_{i(t-2)})*(1-HIGH_{i(t-2)})$ and further lags. Also see Notes to Tables 1 and 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.