The University of Nottingham

research paper series

Globalisation, Productivity and Technology

Research Paper 2005/23

Inventory Investment, Global Engagement, and Financial Constraints in the UK: Evidence from MicroData

by

Alessandra Guariglia and Simona Mateut

The Centre acknowledges financial support from The Leverhulme Trust under Programme Grant F114/BF

GEP

Leverhulme Centre for Research on Globalisation and Economic Policy

The Authors

Alessandra Guariglia is a Senior Lecturer in the Leverhulme Centre for Research on Globalisation and Economic Policy (GEP), University of Nottingham; Simona Mateut is a Research Fellow in the Experian Centre for Economic Modelling, University of Nottingham.

Acknowledgements

Alessandra Guariglia gratefully acknowledges financial support from The Leverhulme Trust under Programme Grant F114/BF.

Inventory investment, global engagement, and financial constraints in the UK: evidence from micro data

by

Alessandra Guariglia and Simona Mateut

Abstract

We use a panel of 9,381 UK firms over the period 1993-2003 to study the links between firms' financial health and their global engagement status. We estimate error-correction inventory investment equations augmented with financial variables, and interpret the sensitivity of inventory investment to the latter as a measure of the strength of the financial constraints faced by firms. We find that smaller, younger, and more risky firms, on the one hand; and firms that do not export and are not foreign owned, on the other, exhibit higher sensitivities. Moreover, global engagement substantially reduces the sensitivities displayed by the former categories of firms: this suggests that it shields firms from financial constraints.

JEL Classification: D92; E22; F14

Keywords: Financial constraints, Global engagement

Outline

Non-Technical Summary

An intense debate has been taking place in recent years about the extent to which firms' real activities (and in particular their investment in fixed capital) are constrained by the availability of finance. This literature investigates whether firms that are identified a priori as financially constrained show greater sensitivity in their real activities to financial variables. Factors such as firms' size, age, dividend payout ratio, and level of indebtedness have been frequently used as determinants of financial constraints. This paper extends the literature by investigating the possible link between firms' global engagement status (based on their export activities and on whether they are foreign owned) and their financial health. Having access to both internal and international financial markets, globally engaged firms are likely to face an overall lower degree of financial constraints than their purely domestic counterparts. Moreover, being also dependent on demand from foreign countries, exporters are less tied to the domestic cycle, and less subject to financial constraints induced by tight monetary policy and recessions in the home country. Finally, foreign owned firms can access credit through their parent company and thus insure themselves against liquidity constraints.

Using a panel of 9,381 UK manufacturing firms over the period 1993-2003, a large portion of which are not quoted on the stock market, we estimate error-correction inventory investment equations augmented with financial variables, and interpret the coefficients on the latter as measures of the strength of the financial constraints faced by firms. We differentiate the effects of the financial variables across firms more and less likely to face financial constraints in a traditional sense (smaller, younger, and more risky firms), on the one hand; and across globally engaged and purely domestic firms, on the other.

Three reasons justify our choice of inventory investment in our analysis. First, inventory investment equations are less likely than fixed investment equations to suffer from misspecification due to the inappropriate control for investment opportunities. Second, because of its high liquidity and low adjustment costs, inventory investment is likely to be more sensitive to financial variables than investment in fixed capital. Third, inventory investment plays a crucial role in business cycle fluctuations.

We find that, especially for firms more likely to face liquidity constraints in a traditional sense, financial variables play a strong and significant effect on inventory investment. Furthermore, firms that are globally engaged generally display lower sensitivities of inventory investment to financial variables than their purely domestic counterparts. Finally, global engagement substantially reduces the sensitivities of smaller, younger, and more risky firms: this suggests that it shields these firms from financial constraints.

Our findings have important policy implications: they suggest that export promotion policies can be beneficial to the economy, not only through the well-known growth-enhancing role played by exports, but also because they are likely to reduce the degree of financial constraints faced by firms, and consequently to indirectly enhance their investment spending and productivity. The latter effect is likely to be particularly relevant for small and medium-sized enterprises (SMEs), whose investment is often constrained by the lack of finance.

1. Introduction

This paper uses a large panel of UK firms to study the links between firms' financial health and their global engagement status, focusing in particular on whether global engagement can shield firms from liquidity constraints. We consider two dimensions of global engagement. The first is based on whether the firms export, and the second on whether they are foreign owned.

Along the former dimension, Campa and Shaver (2002) find that liquidity constraints are less binding for Spanish exporters compared to non-exporters; while Castañeda (2002) shows that export-oriented Mexican firms faced higher financial constraints before the 1995-2000 financial paralysis. Along the latter, and focusing respectively on Colombia, Côte D'Ivoire, and Estonia, Arbeláez and Echavarría (2002), Harrison and McMillan (2003), and Mickiewicz et al. (2004) show that foreign owned firms face lower financial constraints compared to other firms. De Brun et al. (2002) find no such evidence for firms in Uruguay[1].

All the above mentioned papers analyze financial constraints in the context of fixed investment regressions augmented with financial variables such as cash flow. In particular, they consider the sensitivity of investment to cash flow as an indicator of the degree of financial constraints faced by firms: financially constrained firms (for whom access to external finance is difficult and/or expensive) can only invest if they have sufficient internal funds.

Our contribution to the literature is twofold. First, we explore, for the first time, the links between firms' global engagement and their financial health in the context of inventory investment regressions. We estimate error-correction inventory investment equations augmented with financial variables. As in the investment literature, we interpret the coefficients on the latter as measures of the degree of financial constraints faced by firms. We explore how these coefficients differ across firms classified into financially constrained and healthy in a traditional sense (smaller, younger, and more risky firms), on the one hand; and across globally engaged and purely domestic, on the other. We also

[1] Related studies are Desai et al. (2004a), who find that internal capital markets of multinational firms allow their affiliates to expand output after severe depreciations, when economies are fragile and prone to severe economic contractions; Blalock et al. (2004), who show that following the 1997 East Asian financial crisis which led to a dramatic currency devaluation, only those Indonesian exporters with foreign ownership increased investment significantly; and Harrison et al. (2004), who find that direct foreign investment is associated with a reduction of financing constraints for firms without foreign assets and for domestically owned enterprises.

compare the coefficients across globally engaged financially constrained firms and purely domestic financially constrained firms, with the objective of determining whether global engagement can shield firms from financial constraints.

Three reasons justify our choice of inventory investment in our analysis. First, inventory investment equations are less likely than fixed investment equations to suffer from misspecification due to the inappropriate control for investment opportunities[2]. Second, because of its high liquidity and low adjustment costs, inventory investment is likely to be more sensitive to financial variables than investment in fixed capital (Carpenter et al., 1994). Third, inventory investment plays a crucial role in business cycle fluctuations (Blinder and Maccini, 1991).

Our second contribution to the literature is that we study the effects of global engagement on firms' financial health in the UK. This is important because most of the studies that looked at similar issues generally considered developing or transition countries. Our choice of the UK is motivated by the fact that this country ranks high in terms of global engagement: it is the fifth largest exporter of manufactures in the world and the second largest host of multinational enterprises. Moreover, a rich firm-level dataset is available for the UK, which covers mostly unlisted firms, which are generally small, young, and particularly likely to face financial constraints.

Our results suggest that smaller, younger, and more risky firms, on the one hand; and firms that are not globally engaged, on the other, exhibit higher sensitivities of inventory investment to financial variables. Moreover, when we differentiate among purely domestic financially constrained firms, globally engaged financially constrained firms, and financially healthy firms, we find that the effects of the financial variables are statistically significant only for the former group: global engagement helps firms to overcome liquidity constraints.

From a policy point of view, these results suggest that export promotion policies can be beneficial to the economy, not only through the well-known growth-enhancing role played by exports, but also because they are likely to reduce the level of financial constraints faced by firms, and consequently to indirectly enhance their investment

[2] See for instance Bond and Cummins (2001), Erickson and Whited (2002), Bond et al. (2004), and Cummins et al. (2005) who, within a *Q* model of investment framework, show that financial variables such as cash flow could enter significantly in an investment regression simply because they pick up investment opportunities which are not properly accounted for by Tobin's *Q*. Also see Abel and Eberly (2002, 2004), Alti (2003), Cooper and Ejarque (2001, 2003), Gomes (2001), and Moyen (2004), for recent theoretical contributions showing that positive investment-cash flow sensitivities can arise within models without financial constraints.

spending and productivity. The latter effect is likely to be particularly relevant for small and medium-sized enterprises (SMEs), whose investment is often constrained by the lack of finance.

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

2. Baseline specification and estimation methodology

Baseline specification

The baseline specification that we will use is a variant of Lovell's target adjustment model (1961). Let *I* and *S* denote the logarithms of inventories and sales; and let *FIN* denote a financial variable. Equation (1) gives the equation for inventory growth that we initially estimate.

$$\Delta I_{it} = \alpha + \beta_0 \Delta I_{i,t-1} + \beta_1 \Delta S_{it} + \beta_2 \Delta S_{i,t-1} + \beta_3 (I_{i,t-1} - S_{i,t-1}) + \beta_4 FIN_{it} + \\ + v_i + v_t + v_{jt} + e_{it} \tag{1}$$

The subscript *i* indexes firms; *j*, industries; and *t*, time, where *t*=1995-2003. The term ($I_{i,t-1} - S_{i,t-1}$) can be interpreted as reflecting the influence of a long-run target inventory level. Differences of the logarithms of sales are included in the regression to capture the short-run dynamics. This gives the specification an error-correction format.

Error-correction behavior enters the empirical framework because of adjustment costs. In their presence the firm will not immediately adjust its inventory stock to the target level, which is assumed to be a function of sales. We specify a dynamic adjustment mechanism between *I* and *S* (the details of which are contained in Appendix 1). To be consistent with error-correction behavior, the coefficient associated with the term ($I_{i,t-1}$ - $S_{i,t-1}$) should be negative: if the stock of inventories (*I*) is lower (higher) than the target, then future inventory investment should in fact be higher (lower).

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 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[3].

We consider three financial variables, and interpret the sensitivity of inventory investment to these variables displayed by our firms as a measure of the strength of the financial constraints that they face. The first two financial variables are similar in spirit to the mix variable initially introduced by Kashyap et al. (1993). In particular, we define our first mix variable (*MIX1*) as the ratio of the firm's short-term debt to the sum of its short-term debt and trade credit. Our second mix variable (*MIX2*) is defined as the ratio of the firm's short-term debt to its current liabilities: compared to *MIX1*, it takes into account a wider range of alternative sources of finance. Our third variable is a measure of financial leverage (*LEV*), given by the ratio of short-term debt to total assets[4].

As short-term debt is predominantly made up of bank finance, and as trade credit is typically more expensive than bank credit (Petersen and Rajan, 1997), a high *MIX1* variable, which indicates that the firm has easy access to bank finance, should make it easier for the firm to invest in inventories. Similarly, in periods of tight monetary policy, one would expect the supply of bank loans to decline, and consequently, as trade credit is obviously not a perfect substitute for bank credit, the mix should also decline, and firms' activities should shrink[5]. Especially for firms more likely to face financial constraints, one would therefore expect a positive relationship between *MIX1* and firms' inventory investment. A similar line of reasoning applies to *MIX2* (Oliner and Rudebush, 1996).

---

[3] Firms are allocated to one of the following nine industrial sectors: metals and 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, and footwear; and others (Blundell et al., 1992).

[4] Most studies that estimated reduced-form inventory investment equations used the cash flow to capital ratio or the coverage ratio as explanatory variables (Benito, 2005; Bo et al., 2002; Carpenter et al., 1994, 1998; Choi and Kim, 2001; Guariglia, 1999; Guariglia and Mateut, 2004; and Small, 2000). These variables are often negative in our dataset. For instance, the cash flow to capital ratio is negative in almost half of the observations. This is due to the fact that our dataset includes a number of very small firms, which are typically very young, and possibly start-up firms. As a negative cash flow or coverage ratio cannot really be interpreted as measures of the availability of internal funds to the firm, or of the healthiness of the firm's balance sheet, we preferred not to use these variables in our equations (see Guariglia, 2005, who uses the same dataset as in this paper to study the effects of cash flow and the coverage ratio on firms' fixed investment, paying particular attention to those observations displaying negative values of these variables).

[5] This argument is at the heart of the bank lending channel of transmission of monetary policy (Kashyap et al., 1993; Bernanke and Gertler, 1995; Mishkin, 1995).

A high rate of financial leverage can be seen as an indicator of the good credit standing and high borrowing capacity of firms. As discussed in Dedola and Lippi (2005) and Peersman and Smets (2005), more leveraged firms tend to get loans at better terms. One would therefore expect a positive relationship between *LEV* and firms' inventory investment, which should be stronger for those firms more likely to face financial constraints.

Yet, it is also possible that firms with a high leverage ratio face greater difficulties obtaining funds on the markets, especially during recessions. A high leverage ratio is in fact associated with a worse balance sheet situation, which would increase moral hazard and adverse selection problems, and lead to the inability of firms to obtain external finance at a reasonable cost, and consequently, to a reduction in firms' activities. Should this effect prevail, one would observe a negative relationship between *LEV* and firms' inventory investment, which would once again be stronger for relatively more financially constrained firms.

We therefore expect financial leverage to significantly affect the inventory investment at financially constrained firms. Whether this effect will be positive or negative will be determined by the data. On the other hand, inventory investment at financially healthy firms should not be sensitive to leverage, as these firms can always obtain external funds at reasonable terms independently of their balance sheet situation.

Our analysis will focus on the coefficients associated with these financial variables. We will explore how they differ across firms classified into financially constrained and healthy in a traditional sense (smaller, younger, and riskier firms), on the one hand; and across globally engaged and purely domestic, on the other. In order to determine whether global engagement plays a role in shielding firms from financial constraints, we will also compare the coefficients across globally engaged financially constrained firms and purely domestic financially constrained firms.

Estimation methodology

All equations will be estimated in first-differences, to control 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[6]. Two or more lags of each of the regressors including the interaction terms will be used as instruments.

[6] See Arellano and Bond (1991) on the application of the GMM approach to panel data. The program Stata (version 8.2) is used in estimation.

To check whether the first-difference GMM estimator is likely to suffer from finite sample bias, we compared the GMM and the Within Groups estimates of the coefficient on the lagged dependent variable in Equation (1). Because 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. As our GMM coefficient lied above its Within Groups counterpart, we concluded that the first-difference GMM estimates are unlikely to be subject to serious finite sample bias[7].

In order to evaluate whether our model is correctly specified, we 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 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[8].

3. Main features of the data and summary statistics

The dataset

Our dataset is derived from the profit and loss and balance sheet data gathered by Bureau Van Dijk Electronic Publishing in the *Financial Analysis Made Easy* (FAME) database. The database provides information on companies over the period 1993-2003[9]. The majority of firms included in the dataset are not traded on the stock market, or are quoted on alternative exchanges such as the Alternative Investment Market (AIM) and the Off-

[7] If the estimates obtained using the first-differenced GMM estimator lie close or below the Within Groups estimates, one could suspect the GMM estimate to be downward biased as well, possibly due to weak instruments**.** In such case, the use of a GMM system estimator (which combines in a system the original specification expressed in first differences and in levels) would be required (Blundell and Bond, 1998).

[8] 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.

[9] A maximum of 10 years of complete data history can be downloaded at once. Our data were downloaded early in 2004: the coverage period is therefore 1993-2003.

Exchange (OFEX) market[10]. Unquoted firms are more likely to be characterized by adverse financial attributes such as poor solvency, a short track record, and low real assets compared to quoted firms, which are typically large, long-established, financially healthy companies with good credit ratings. Our data allows us therefore to find proxies for financial constraints, characterized by a wide range of variation across observations in the sample.

The firms in our dataset operate in the manufacturing sector. 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 total inventories, sales, and the financial variables which we included in our regressions, were also dropped. Finally, to control for the potential influence of outliers, we excluded observations in the 1% tails for each of the regression variables.

The panel used in our analysis includes therefore a total of 40,949 annual observations on 9,381 companies, covering the years 1993-2003. It has an unbalanced structure, with the number of years of observations on each firm varying between 3 and 11[11]. By allowing for both entry and exit, the use of an unbalanced panel partially mitigates potential selection and survivor bias.

Sample separation criteria

In order to evaluate whether the sensitivity of inventory investment to financial variables differs at different groups of firms, we use two groups of sample separation criteria. The first group of criteria is aimed at classifying firms into financially constrained and financially healthy, and is based on three traditional firm characteristics: size, age, and riskiness. Smaller and younger firms are particularly susceptible to information asymmetry effects, since little public information is available for them, and it is more difficult for financial institutions to gather this information. Obtaining external finance is therefore likely to be particularly costly for them (Bernanke and Gertler, 1995).

Similar considerations apply to risky firms. Our dataset includes a variable measuring the firm's riskiness (labelled "quiscore"), which is based on information about the credit ratings of the firm. It is an indicator which measures the likelihood of company

---

[10] We only selected firms that have unconsolidated accounts: this ensures that the majority of the firms in our dataset are relatively small. Moreover, it avoids the double counting of firms belonging to groups, which would be included in the dataset if firms with consolidated accounts were also part of it.

[11] See Appendix 2 for more information on the structure of our panel and complete definitions of all variables used. Since a number of regressors are lagged once and since we estimate our equations in first differences, the dataset actually used in estimation only covers the years 1995-2003.

failure in the twelve months following the date of calculation. The lower its quiscore value, the more risky a firm is considered. This is a wider definition of perceived financial health than the commonly used bond rating, which only applies to a small fraction of rated firms (Whited, 1992; Kashyap and Stein, 1994).

We consider the situation of each firm relative to that of other firms in the industry in which that firm operates. In particular, we define as financially constrained within an industry those firms whose total sales, age, or quiscore in a given year are in the lowest 75% of the distribution of the sales, age, and quiscore of all the firms in that particular industry and year. In this way, we allow firms to transit between classes. For this reason, our empirical analysis will focus on firm-years rather than simply firms. We expect firm-years that are financially constrained in a traditional sense to display higher sensitivities of inventory investment to financial variables[12].

Our second group of criteria is based on global engagement variables. In particular, we consider as globally engaged those firms who export, or who are foreign owned. We expect globally engaged firms to face a lower degree of financial constraints compared to other firms, and therefore to exhibit lower sensitivities of inventory investment to financial variables. Having access to both internal and international financial markets, globally engaged firms are in fact likely to face an overall lower degree of financial constraints than their purely domestic counterparts. Moreover, being also dependent on demand from foreign countries, exporting firms are less tied to the domestic cycle, and less subject to those financial constraints induced by tight monetary policy and recessions[13]. Similarly, foreign owned firms can access credit through their parent company and thus insure themselves against liquidity constraints (Desai et al., 2004b)[14]. Moreover, as discussed in Colombo (2001) and Harrison and McMillan (2003), because foreign owned firms enjoy less bankruptcy risk and adopt international standards faster in terms of product quality, they find it easier to gain access to domestic banks.

---

[12] An ongoing debate is taking place in the fixed capital investment literature as to whether a high sensitivity of investment to cash flow can be seen as an indicator of financial constraints. While mainstream studies such as Fazzari et al. (1988) found that it is always the most financially constrained firms that display the highest sensitivities, other authors such as Kaplan and Zingales (1997) and Cleary (1999) found exactly the opposite. Yet, to the best of our knowledge, most studies that looked at inventory investment found that financially constrained firm-years generally exhibit high sensitivities of inventory investment to financial variables (see for instance Bagliano and Sembenelli, 2004; Benito, 2005; Bo et al., 2002; Carpenter et al., 1994, 1998; Guariglia, 1999; Guariglia and Mateut, 2004; and Small, 2000).

[13] According to Campa and Shaver (2002), this leads to a more stable cash flow for exporters compared to non-exporters, which in turn leads to a relaxation of the liquidity constraints for the former.

[14] In a purely domestic framework, Hoshi et al. (1991), Schaller (1993), and Ng and Schaller (1996) consider firms belonging to groups as less likely to face financing constraints.

Summary statistics

Descriptive statistics relative to our entire sample and various sub-samples of firm-years are presented in Table 1. Column 1 refers to the entire sample, columns 2 to 7 to the sub-samples of financially constrained and unconstrained firm-years defined on the basis of traditional criteria; columns 8 to 11 to the sub-samples defined on the basis of the global engagement criteria[15].

We can see that on average 74.4% of the firm-years in our sample participate in export markets, and that 46.2% of them are foreign owned: this indicates that global engagement is quite pervasive in our sample.

It appears that firm-years with large sales and older firm-years are also larger in terms of asset size and employment. Similarly, firm-years characterized by positive exports are typically larger than firm-years that do not export. Relatively risky and relatively safe, and foreign owned versus non foreign owned firm-years do not differ too much in terms of asset size and number of employees.

Focusing on our financial variables, we can see that the average values of *MIX1*, *MIX2*, and *LEV* are respectively equal to 0.51, 0.39, and 0.23. The former two numbers indicate that bank lending constitutes a very large part of the firm's current liabilities. All financial variables are typically higher for more risky, larger, as well as for globally engaged firm-years. The difference in the average values of these financial variables is particularly pronounced between relatively risky and safe firm-years. This suggests that highly bank-dependent, or highly indebted firms are more at risk from bankruptcy compared to other firms: these firms are therefore more likely to face financial constraints. Yet, the fact that all our leverage variables are higher for larger firms suggests that a high leverage can also be associated with good financial health.

4. Empirical results

The estimates of Equation (1) are reported in Table 2. The financial variables used in columns 1, 2, and 3 are respectively *MIX1*, *MIX2*, and *LEV*. In all specifications, lagged inventory investment attracts a negative and precisely determined coefficient; both current and lagged sales growth affect inventory investment positively; and the coefficient on the

[15]Note that the global engagement variables are characterized by a number of missing values. In the case of exports, this can be justified by the fact that not all firms are required to report their export turnover (see Greenaway et al., 2005, for a discussion of this issue).

error correction term is negative and precisely determined. Moreover, in all three columns, the coefficient on the relevant financial variable is positive and statistically significant. Focusing on columns 1 and 2, this indicates that the higher the proportion of bank credit used by firms relative to other forms of credit, the more the firm can invest in inventories. More specifically, if *MIX1* (*MIX2*) increased by one standard deviation, inventory investment would rise by 5.2% (4.8%). These effects, which are consistent with the findings in Kashyap et al. (1993), are economically significant.

Column 3 suggests that the higher its financial leverage, the more inventories the firm will be able to accumulate. In particular, a 1% rise in *LEV* leads to a rise in inventory investment of 3.8 percentage points. This supports the interpretation that a higher financial leverage indicates a higher indebtedness capacity of firms, and leads to the possibility of obtaining loans at better terms[16]. In all three columns, neither the Sargan test nor the *m2* test indicate any problems with the choice of instruments or the general specification of the model.

We next estimate a specification of the following type, in which the effects of the financial variables are differentiated across firm-years more and less likely to face financial constraints in a traditional sense:

$$\Delta I_{it} = \alpha + \beta_0 \Delta I_{i,t-1} + \beta_1 \Delta S_{it} + \beta_2 \Delta S_{i,t-1} + \beta_3 (I_{i,t-1} - S_{i,t-1}) + \\ + \beta_{41} * FIN_{it} * CONS_{it} + \beta_{42} * FIN_{it} * (1 - CONS_{it}) + v_i + v_t + v_{jt} + e_{it} \tag{2}$$

The variable $CONS_{it}$ is a dummy variable equal to 1 if firm *i* is financially constrained at time *t*, and equal to 0, otherwise[17]. As discussed in the previous section, traditional financial constraints are measured on the basis of the firms' sales, age, and credit riskiness.

Table 3 presents the estimates of Equation (2). In columns 1 to 3, sales is used as our sample splitting criterion, whereas in columns 4 to 6; and 7 to 9, age and the firm's quiscore are respectively used. We can see that in all cases, the financial variables are

---

[16] Benito (2005); Bagliano and Sembenelli (2004); and Huang (2003) find that leverage negatively affects the inventory investment of UK firms. Their different results could be due to the fact that their data are mainly made up of quoted firms, whereas our data contains a majority of unlisted firms. This explanation is supported by the fact that Campa and Shaver (2002), who use a panel of Spanish firms, a large number of which are unquoted, also find a positive coefficient on the debt to assets ratio in their investment regressions.

[17] Instead of using interaction terms, we could estimate our Equations separately on various sub-samples of firms. Our chosen approach is preferable as it allows us to avoid problems of endogenous sample selection; to gain degrees of freedom; and to take into consideration the fact that firms can transit between groups. See Kaplan and Zingales (1997), Guariglia (2000), and Guariglia and Mateut (2004) for a similar approach.

statistically significant only for constrained firm-years. Moreover, the coefficients on *MIX1*, *MIX2*, and *LEV* for the constrained firm-years are generally higher than those reported in Table 2 for the full sample. This is in line with studies such as Carpenter et al. (1994, 1998); Guariglia (1999); Small (2000); Bagliano and Sembenelli (2004); and Guariglia and Mateut (2004) who estimated similar inventory investment equations.

Our next specification looks at whether, compared to their purely domestic counterparts, globally engaged firms display lower sensitivities of investment to financial variables. The Equation that we estimate for this purpose takes the following form:

$$\begin{aligned}\Delta I_{it} &= \alpha + \beta_0 \Delta I_{i,t-1} + \beta_1 \Delta S_{it} + \beta_2 \Delta S_{i,t-1} + \beta_3 (I_{i,t-1} - S_{i,t-1}) + \\ &+ \beta_{41} * FIN_{it} * (1 - GE_{it}) + \beta_{42} * FIN_{it} * GE_{it} + v_i + v_t + v_{jt} + e_{it}\end{aligned} \qquad (3)$$

where GE_{it} is a dummy variable equal to 1 if firm *i* has positive exports in year *t* and/or is foreign owned in year *t*, and 0 otherwise.

Our estimates of Equation (3) are presented in Table 4. Columns 1 to 3 refer to the case in which global engagement is measured on the basis of whether the firm exports or not; and columns 4 to 6, to the case in which it is measured on the basis of whether the firm is foreign owned or not. It appears that the financial variables are only significant for purely domestic firms. These results are in line with Arbeláez and Echavarría (2002), Campa and Shaver (2002), Harrison and McMillan (2003), and Mickiewicz et al. (2004), and suggest that both exporting and being foreign owned play an important role in alleviating firms' financial constraints.

Finally, we propose a direct test for whether global engagement reduces the severity of the liquidity constraints that firms might face. More specifically, we test whether the sensitivity of inventory investment to financial variables is lower for those financially constrained firms that are globally engaged compared to their domestic counterparts. We estimate the following equation:

$$\Delta I_{it} = \alpha + \beta_0 \Delta I_{i,t-1} + \beta_1 \Delta S_{it} + \beta_2 \Delta S_{i,t-1} + \beta_3 (I_{i,t-1} - S_{i,t-1}) +$$

$$+\beta_{411} * FIN_{it} * CONS_{it} * (1 - GE_{it}) + \beta_{412} * FIN_{it} * CONS_{it} * GE_{it} + \tag{4}$$

$$+ \beta_{42} * FIN_{it} * (1 - CONS_{it}) + v_i + v_t + v_{jt} + e_{it}$$

Tables 5 and 6 present the estimates of Equation (4). In Table 5, global engagement is measured in terms of export behavior. In columns 1 to 3, firm-years are split into financially constrained and unconstrained in a traditional sense, using sales as a sorting criterion; in columns 4 to 6, age is used as a sorting criterion; and in columns 7 to 9, the firms' quiscore. We can see that all three financial variables only affect inventory investment at those financially constrained firm-years that do not export, suggesting therefore that serving foreign as well as domestic markets plays an important role in dampening the effects of liquidity constraints for small, young, and more risky firms.

Table 6 performs a similar exercise using foreign ownership as a measure of global engagement. It appears that only those financially constrained firm-years that are not foreign owned display a positive sensitivity of inventory investment to financial variables. So, just like serving foreign markets through exports, being foreign owned reduces the severity of the financial constraints that a firm faces.

In both Tables 5 and 6, the coefficients associated with the financial variables for those financially constrained firm-years that are not globally engaged are always higher than the corresponding coefficients reported in Table 3 for the financially constrained firm-years. This suggests that not being globally engaged actually worsens the financial constraints faced by firms. Finally, the *J* and *m2* tests do not indicate any problems with the specification of the model and the choice of the instruments.

The implications of our findings are significant: they suggest that export promotion policies can be beneficial to the economy, not only through the well-known growth-enhancing role played by exports, but also because they are likely to reduce the level of financial constraints faced by firms, and consequently to indirectly enhance their investment spending and productivity. The latter effect is likely to be particularly relevant for small and medium-sized enterprises (SMEs), whose investment is often constrained by the lack of finance.

5. Conclusions

In this paper, we have used a panel of 9,381 UK firms over the period 1993-2003 to study the links between firms' global engagement status and their financial health. We have estimated error-correction inventory investment equations augmented with three different financial variables, and analyzed the differential effects of the latter on the inventory accumulation of firms more and less likely to face financial constraints in a traditional sense, on the one hand; and of globally engaged versus purely domestic firms, on the other.

In line with previous studies, our results suggest that financial variables only affect inventory investment at firms that are financially constrained in a traditional sense (i.e. small, young, and risky firms). Moving beyond existing literature, we also found that inventory accumulation at globally engaged firms is not sensitive to financial variables, whereas inventory investment at purely domestic firms is. This suggests that global engagement is associated with a lower degree of financial constraints.

Finally, we have directly tested whether global engagement plays a role in attenuating the liquidity constraints faced by smaller, younger, and more risky firms. For this purpose we analysed the effects of the financial variables on the inventory investment of purely domestic financially constrained firms; globally engaged financially constrained firms; and financially healthy firms. We found that the financial variables have a statistically significant effect only on the inventory investment of the former category. We interpreted this as evidence that global engagement can shield firms from liquidity constraints.

Using the same dataset, Greenaway et al. (2005) show that financially constrained firms are less likely to export, and that balance sheet variables are significant determinants of firms' decisions to enter foreign markets. This happens because a healthier balance sheet makes it easier for firms to meet the sunk export-market entry costs. Together with our results in this paper, this suggests that the relationship between financial constraints and exporting decisions is bi-directional: only firms that are relatively financially healthy can afford to enter the export markets; and participating in foreign markets allows firms to dampen the financial constraints that they face.

Two policy implications follow. First, export promotion policies can be beneficial to the economy because they are likely to reduce the level of financial constraints faced by firms, and consequently to indirectly enhance their investment spending and productivity. Second, policies ensuring that there is efficient intermediation of funds to the small, financially constrained firms might be beneficial in allowing these firms to enter the export markets. Governments should therefore aim at finding the right mix of the two policies.

Appendix 1: The error-correction inventory model

The baseline error-correction specification which is estimated (Equation 1) can be seen as a generalization of Lovell's target adjustment model (1961). The target-adjustment model is based on the hypothesis that each firm has a desired target level of inventories, and that a firm finding its actual level of inventories not equal to its target level attempts only a partial adjustment towards the target level within any one period. As discussed in Lovel (1961, pp. 295-296), this partial adjustment could be due to the fact that there are costs involved in changing the level of stocks. Moreover, there could be problems related with the heterogeneous nature of stocks and/or the infrequent intervals at which certain articles are ordered.

We assume that the target stock of inventories of firm i at time t (I_{it}^{*}) is related to the volume of sales in that period (S_{it}) via the following Equation, where the variables are expressed in logarithms:

$$I_{it}^{*} = \alpha + \beta S_{it} \tag{A1}$$

β is the marginal desired stock coefficient, which can also be seen as an accelerator effect: if sales are expected to increase, then the target stock of inventories will also increase.

Denoting the logarithm of the actual stock of inventories of firm i at time t with I_{it}, and assuming that the actual inventory investment ΔI_{it} is a fraction δ of the required investment necessary for the firm to adjust its stocks to the equilibrium level, we can write

$$\Delta I_{it} = I_{it} - I_{i,t-1} = \delta (I_{it}^{*} - I_{i,t-1}) = \delta\alpha + \delta\beta S_{it} - \delta I_{i,t-1} \tag{A2}$$

This yields:

$$I_{it} = \delta\alpha + \delta\beta S_{it} + (1-\delta) I_{i,t-1} \tag{A3}$$

We then nest Equation (A3) within a general dynamic regression model, which accounts for the slow adjustment of the actual stock of inventories to the desired stock. We consider an autoregressive distributed lag specification with up to second-order dynamics (i.e. an ADL(2,2) model). This leads to:

$$I_{it} = \beta_1 I_{i,t-1} + \beta_2 I_{i,t-2} + \beta_3 S_{it} + \beta_4 S_{i,t-1} + \beta_5 S_{i,t-2} + v_i + v_{jt} + v_t + e_{it} \tag{A4}$$

The presence of lagged variables makes allowance for the fact that data are not observed in a state of equilibrium. We include a firm-specific effect (v_i), an industry-specific time effect (v_{jt}), and a regular time-specific effect (v_t). Together with the idiosyncratic component, e_{it}, these make up the error term of Equation (A4). We also impose the parameter restriction $(\beta_3 + \beta_4 + \beta_5)/(1 - \beta_1 - \beta_2) = 1$, aimed at ensuring a long-run equilibrium behavior of the stock of inventories relative to sales.

Imposing this long-run unit elasticity and reparameterizing the ADL model we can express Equation (A4) in an error-correction format:

$$\Delta I_{it} = -\beta_2 \Delta I_{i,t-1} + \beta_3 \Delta S_{it} - \beta_5 \Delta S_{i,t-1} - (1-\beta_1-\beta_2)(I_{i,t-1} - S_{i,t-1}) + v_i + v_{jt} + v_t + e_{it} \qquad \text{(A5)}$$

where $(I_{i,t-1}-S_{i,t-1})$ represents the error-correction term. According to this equation, inventories are partially adjusted to current and past changes in sales, but in the long-run, they are kept approximately in line with sales. To be consistent with error-correction behavior, the coefficient associated with the $(I_{i,t-1} - S_{i,t-1})$ term should be negative: if the stock of inventories moves further from (closer to) its desired level, future inventory investment should be higher (lower).

We further augment our model with financial variables, which aim at picking up financial effects on inventory investment. This yields Equation (1) in the paper.

Appendix 2: Data

Structure of the unbalanced panel:

Number of obs. per firm	Number of firms	Percent	Cumulative
3	21	0.22	0.22
4	259	2.76	2.98
5	449	4.79	7.77
6	561	5.98	13.75
7	655	6.98	20.73
8	962	10.25	30.99
9	2,212	23.58	54.57
10	4,258	45.39	99.96
11	4	0.04	100.00
Total	9,381	100.00	

Definitions of the variables used:

Inventories: includes finished goods and work-in-process inventories.

Sales: includes both UK and overseas turnover.

Total assets: the sum of the firm's fixed and current assets.

Export: dummy variable equal to 1 if the firm exports a positive amount.

Foreign: dummy equal to 1 if the firm is foreign owned, and 0 otherwise. This variable is only available in the last year of observations available for each firm. We therefore assume that a firm which was foreign owned in its last available year was foreign owned throughout the period in which it was observed.

MIX1: the firm's ratio of short-term debt to short-term debt plus trade credit. Short-term debt includes the following items: bank overdrafts, short-term group and director loans, hire purchase, leasing, and other short-term loans, but it is predominantly bank finance.

MIX2: the firm's ratio of short-term debt to current liabilities. Current liabilities are defined as the sum of short-term debt, trade credit, and other current liabilities that include some forms of finance resembling commercial paper or bonds.

LEV: the firm's short-term debt to total assets ratio.

Quiscore: an indicator produced by Qui Credit Assessment Ltd, which measures the likelihood of company failure in the twelve months following the date of calculation. Quiscore is given as a number in the range from 0 to 100. The lower its quiscore the more risky a firm is likely to be.

Deflators: all variables are deflated using the aggregate GDP deflator.

Table 1: Summary statistics of the key variables

	Total	$CONS_{it}$ =1	$CONS_{it}$ =0	$CONS_{it}$ =1	$CONS_{it}$ =0	$CONS_{it}$ =1	$CONS_{it}$ =0	GE_{it} =1	GE_{it} =0	GE_{it} =1	GE_{it} =0
		$CONS_{it}= f\,(Sales_{it})$		$CONS_{it} = f\,(Age_{it})$		$CONS_{it}=f(Quiscore_{it})$		$GE_{it}=f(Export_{it})$		$GE_{it}=f(Foreign_{it})$	
Assets (th)	39.5	6.16	139.8	27.4	76.9	37.8	46.3	45.8	26.9	55.7	45.9
	(428)	(8.4)	(849.2)	(185.2)	(800.4)	(228.9)	(778.2)	(438.9)	(172.8)	(217.6)	(644.6)
Sales (th)	47.9	8.7	165.8	36.3	83.7	49.7	44.1	54.5	34.5	72.9	49.8
	(306.8)	(7.8)	(598.9)	(213.9)	(491.5)	(274.3)	(399.3)	(325.8)	(176.8)	(302.3)	(393.0)
Employees	388.5	110.2	1158.9	302.9	640.1	408.1	335.0	424.0	284.7	465.8	452.8
	(2008.8)	(103.8)	(3790.5)	(1504.6)	(3026.6)	(2021.8)	(2035.3)	(1873.8)	(958.4)	(1576.8)	(2735.2)
ΔI_{it}	-0.0101	-0.006	-0.0234	-0.0026	-0.0335	-0.0017	-0.0303	-0.0164	-0.0088	-0.0225	-0.0095
	(0.325)	(0.329)	(0.310)	(0.335)	(0.288)	(0.329)	(0.295)	(0.311)	(0.345)	(0.331)	(0.318)
ΔS_{it}	0.0008	-0.004	0.0160	0.0077	-0.0207	0.0075	-0.0117	-0.008	0.016	-0.0033	0.00001
	(0.215)	(0.216)	(0.212)	(0.220)	(0.197)	(0.217)	(0.193)	(0.220)	(0.197)	(0.225)	(0.214)
$I_{i,\,t-1} - S_{i,\,t-1}$	-2.365	-2.378	-2.326	-2.401	-2.253	-2.359	-2.397	-2.180	-2.844	-2.248	-2.376
	(0.830)	(0.850)	(0.768)	(0.842)	(0.783)	(0.825)	(0.839)	(0.687)	(0.957)	(0.755)	(0.837)
$MIX1_{it}$	0.506	0.493	0.5488	0.5058	0.510	0.534	0.407	0.517	0.485	0.592	0.495
	(0.270)	(0.266)	(0.278)	(0.2698)	(0.271)	(0.262)	(0.267)	(0.271)	(0.269)	(0.270)	(0.263)
$MIX2_{it}$	0.386	0.375	0.418	0.3868	0.384	0.422	0.258	0.396	0.370	0.451	0.382
	(0.247)	(0.242)	(0.258)	(0.247)	(0.247)	(0.243)	(0.205)	(0.250)	(0.245)	(0.258)	(0.242)
LEV_{it}	0.230	0.224	0.247	0.235	0.213	0.267	0.081	0.236	0.224	0.266	0.238
	(0.217)	(0.216)	(0.222)	(0.220)	(0.208)	(0.211)	(0.080)	(0.222)	(0.215)	(0.239)	(0.220)
$Quiscore_{it}$	55.03	55.03	55.04	53.98	58.26	45.43	84.73	55.07	54.07	55.73	54.54
	(21.89)	(22.04)	(21.44)	(21.79)	(21.90)	(15.29)	(8.41)	(22.13)	(21.15)	(23.43)	(21.46)
Age_{it}	30.57	28.18	37.74	19.21	65.58	29.37	34.86	32.04	28.37	29.69	33.14
	(24.03)	(21.97)	(28.19)	(10.77)	(19.38)	(23.35)	(25.71)	(24.6)	(23.22)	(24.55)	(24.83)
$Export_{it}$	0.744	0.712	0.832	0.730	0.786	0.740	0.758			0.841	0.727
	(0.436)	(0.453)	(0.373)	(0.444)	(0.410)	(0.439)	(0.428)			(0.365)	(0.445)
$Foreign_{it}$	0.462	0.414	0.569	0.473	0.431	0.447	0.505	0.500	0.334		
	(0.499)	(0.493)	(0.496)	(0.499)	(0.495)	(0.497)	(0.500)	(0.500)	(0.472)		
Observations	40949	30735	10214	30914	10030	30161	9755	21766	7471	14083	16399

Notes: The Table reports sample means. Standard deviations are presented in parentheses. The subscript *i* indexes firms, and the subscript *t*, time, where *t*=1993-2003. *MIX1*: the firm's ratio of short-term debt to short-term debt plus trade credit. *MIX2*: the firm's ratio of short-term debt to current liabilities. *LEV*: the firm's short-term debt to total assets ratio. *Quiscore*: indicator which measures the likelihood of company failure in the twelve months following the date of calculation. The lower its quiscore value, the more risky the firm is likely to be. *Export*: dummy variable equal to 1 if the firm exports a positive amount. *Foreign*: dummy equal to 1 if the firm is foreign owned, and 0 otherwise. The dummy variable $CONS_{it}$ takes value 1 for firm *i* in year *t* if firm *i*'s sales, age or quiscore are in the lowest 75% of the distribution of the sales, age, or quiscore of all the firms in firm *i*'s industry in year *t*. GE_{it} is a dummy variable equal to 1 if firm *i* has positive exports in year *t* and/or is foreign owned in year *t*, and 0 otherwise.

Table 2: Inventory investment and financial variables

	(1)	(2)	(3)
	$MIX1_{it}$	$MIX2_{it}$	LEV_{it}
ΔI_{it-1}	-0.084***	-0.083***	-0.088***
	(0.020)	(0.019)	(0.020)
ΔS_{it}	0.801***	0.792***	0.826***
	(0.178)	(0.172)	(0.180)
$\Delta S_{i,t-1}$	0.040***	0.041***	0.042***
	(0.013)	(0.013)	(0.013)
$I_{i,\,t-1} - S_{i,\,t-1}$	-0.506***	-0.497***	-0.497***
	(0.053)	(0.051)	(0.050)
$MIX1_{it}$	0.191***		
	(0.058)		
$MIX2_{it}$		0.193***	
		(0.055)	
LEV_{it}			0.179***
			(0.063)
Observations	40417	40949	40949
Number of firms	9289	9381	9381
m1 (p)	0.00	0.00	0.00
m2 (p)	0.57	0.54	0.63
Sargan (p)	0.19	0.25	0.16

Notes: All specifications were estimated using a GMM first-difference specification. Test statistics and standard errors (in parentheses) 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 include $\Delta I_{i,t-2}$; $\Delta S_{i,t-2}$; ($I_{i,t-2}$ - $S_{i,t-2}$); $FIN_{i,t-2}$; and further lags, where $FIN_{i,t-2}$ indicates in turn $MIX1_{i,t-2}$, $MIX2_{i,t-2}$, and $LEV_{i,t-2}$. Time dummies and time dummies interacted with industry dummies were always included as regressors and as instruments. 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: Inventory investment and financial variables: distinguishing firm-years on the basis of whether they are more or less likely to face financial constraints in a traditional sense

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$CONS_{it} = f\,(Sales_{it})$			$CONS_{it} = f\,(Age_{it})$			$CONS_{it} = f\,(Quiscore_{it})$		
ΔI_{it-1}	-0.061***	-0.064***	-0.084***	-0.079***	-0.081***	-0.084***	-0.059***	-0.058***	-0.075***
	(0.023)	(0.023)	(0.019)	(0.017)	(0.017)	(0.018)	(0.017)	(0.016)	(0.016)
ΔS_{it}	0.501**	0.554**	0.771***	0.779***	0.801***	0.807***	0.546***	0.534***	0.733***
	(0.224)	(0.217)	(0.162)	(0.146)	(0.143)	(0.151)	(0.131)	(0.127)	(0.137)
$\Delta S_{i,t-1}$	0.034**	0.035**	0.041***	0.038***	0.040***	0.040***	0.028**	0.028**	0.034***
	(0.015)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
$I_{i,\,t-1} - S_{i,\,t-1}$	-0.425***	-0.439***	-0.480***	-0.511***	-0.510***	-0.501***	-0.473***	-0.466***	-0.503***
	(0.059)	(0.056)	(0.047)	(0.050)	(0.049)	(0.048)	(0.047)	(0.046)	(0.046)
$MIX1_{it}*CONS_{it}$	0.349**			0.243***			0.148***		
	(0.163)			(0.090)			(0.053)		
$MIX1_{it}*(1-CONS_{it})$	-0.379			0.035			0.196*		
	(0.348)			(0.174)			(0.119)		
$MIX2_{it}*CONS_{it}$		0.390**			0.271***			0.162***	
		(0.173)			(0.090)			(0.053)	
$MIX2_{it}*(1-CONS_{it})$		-0.426			-0.016			0.273	
		(0.348)			(0.173)			(0.174)	
$LEV_{it}*CONS_{it}$			0.264**			0.239***			0.207***
			(0.131)			(0.091)			(0.065)
$LEV_{it}*(1-CONS_{it})$			-0.041			-0.027			0.721
			(0.305)			(0.241)			(0.444)

Observations	40417	40949	40949	40412	40944	40944	38868	39374	39374
Number of firms	9289	9381	9381	9288	9380	9380	9040	9131	9131
m1 (p)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m2 (p)	0.71	0.90	0.69	0.57	0.50	0.61	0.64	0.59	0.63
Sargan (p)	0.27	0.35	0.19	0.23	0.28	0.18	0.31	0.59	0.51

Notes: The dummy variable $CONS_{it}$ takes value 1 for firm *i* in year *t* if firm *i*'s sales, age or quiscore are in the lowest 75% of the distribution of the sales, age, or quiscore of all the firms in firm *i*'s industry in year *t*. Instruments include $\Delta I_{i,t-2}$; $\Delta S_{i,t-2}$; $(I_{i,t-2} - S_{i,t-2})$; $FIN_{i,t-2}$; $Sales_{i,(t-2)}$ / $Age_{i,(t-2)}$ / $Quiscore_{i,(t-2)}$ and further lags, where $FIN_{i,t-2}$ indicates in turn $MIX1_{i,t-2}$, $MIX2_{i,t-2}$, and $LEV_{i,t-2}$. Time dummies and time dummies interacted with industry dummies were always included as regressors and as instruments. 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 4: Inventory investment and financial variables: distinguishing firm-years on the basis of their global engagement status

	(1)	(2)	(3)	(4)	(5)	(6)
	$GE_{it} = f\,(Export_{it})$			*$GE_{it} = f\,(Foreign_{it})$*		
ΔI_{it-1}	-0.054**	-0.047**	-0.054**	-0.073***	-0.067***	-0.056***
	(0.021)	(0.020)	(0.022)	(0.018)	(0.018)	(0.018)
ΔS_{it}	0.771***	0.688***	0.736***	0.717***	0.630***	0.544***
	(0.163)	(0.156)	(0.168)	(0.147)	(0.147)	(0.137)
$\Delta S_{i,t-1}$	0.028*	0.028*	0.030*	0.036***	0.034**	0.030**
	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)
$I_{i,\,t-1} - S_{i,\,t-1}$	-0.553***	-0.526***	-0.524***	-0.496***	-0.468***	-0.457***
	(0.059)	(0.056)	(0.055)	(0.056)	(0.054)	(0.050)
$MIX1_{it}*GE_{it}$	0.468***			0.229**		
	(0.149)			(0.115)		
$MIX1_{it}*(1-GE_{t})$	0.040			0.107		
	(0.081)			(0.104)		
$MIX2_{it}*GE_{it}$		0.459***			0.191*	
		(0.170)			(0.115)	
$MIX2_{it}*(1-GE_{it})$		0.051			0.144	
		(0.090)			(0.097)	
$LEV_{it}*GE_{it}$			0.502**			0.281**
			(0.226)			(0.137)
$LEV_{it}*(1-GE_{it})$			-0.062			0.028
			(0.132)			(0.117)
Observations	26921	27287	27287	30064	30482	30482
Number of firms	6927	7001	7001	6605	6670	6670
m1 (p)	0.00	0.00	0.00	0.00	0.00	0.00
m2 (p)	0.85	0.78	0.79	0.29	0.27	0.31
Sargan (p)	0.19	0.22	0.20	0.15	0.13	0.10

Notes: GE_{it} is a dummy variable equal to 1 if firm *i* has positive exports in year *t* and/or is foreign owned in year *t*, and 0 otherwise. Instruments include $\Delta I_{i,t-2}$; $\Delta S_{i,t-2}$; $(I_{i,t-2} - S_{i,t-2})$; $FIN_{i,t-2}$; $Export_{i,(t-2)}$ / $Foreign_{i,(t-2)}$ and further lags, where $FIN_{i,t-2}$ indicates in turn $MIX1_{i,t-2}$, $MIX2_{i,t-2}$, and $LEV_{i,t-2}$. Time dummies and time dummies interacted with industry dummies were always included as regressors and as instruments. 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 5: Inventory investment and financial variables: distinguishing firm-years on the basis of whether they are more or less likely to face financial constraints in a traditional sense, and on the basis of their degree of global engagement measured in terms of export behavior

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$CONS_{it} = f\,(Sales_{it})$ $GE_{it} = f\,(Export_{it})$			$CONS_{it} = f\,(Age_{it})$ $GE_{it} = f\,(Export_{it})$			$CONS_{it} = f\,(Quiscore_{it})$ $GE_{it} = f\,(Export_{it})$		
ΔI_{it-1}	-0.050**	-0.029	-0.036	-0.056***	-0.051***	-0.058***	-0.042**	-0.039**	-0.044**
	(0.020)	(0.021)	(0.022)	(0.019)	(0.018)	(0.019)	(0.018)	(0.017)	(0.017)
ΔS_{it}	0.672***	0.448***	0.499***	0.787***	0.731***	0.761***	0.695***	0.650***	0.686***
	(0.148)	(0.163)	(0.175)	(0.142)	(0.134)	(0.142)	(0.129)	(0.124)	(0.125)
$\Delta S_{i,t-1}$	0.030**	0.025	0.027*	0.029*	0.030**	0.032**	0.022	0.023	0.024*
	(0.015)	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)
$I_{i,\,t-1} - S_{i,\,t-1}$	-0.509***	-0.464***	-0.459***	-0.551***	-0.533***	-0.523***	-0.553***	-0.536***	-0.536***
	(0.055)	(0.057)	(0.056)	(0.056)	(0.054)	(0.052)	(0.056)	(0.055)	(0.052)
$MIX1_{it}*CONS_{it}*$	0.378**			0.478***			0.447***		
$(1\text{-}GE_{it})$	(0.188)			(0.180)			(0.151)		
$MIX1_{it}*CONS_{it}*$	0.005			0.075			0.041		
GE_{it}	(0.129)			(0.104)			(0.076)		

$MIX1_{it}*$	0.113			0.041			0.209		
$(1-CONS_{it})$	(0.211)			(0.197)			(0.128)		
$MIX2*CONS_{it}*$		0.504**			0.474**			0.422**	
$(1-GE_{it})$		(0.235)			(0.208)			(0.169)	
$MIX2*CONS_{it}*$		0.031			0.110			0.068	
GE_{it}		(0.154)			(0.111)			(0.084)	
$MIX2*(1-CONS_{it})$		-0.034			0.058			0.257	
		(0.259)			(0.195)			(0.191)	
$LEV*CONS_{it}*$			0.558**			0.457*			0.467**
$(1-GE_{it})$			(0.273)			(0.271)			(0.192)
$LEV_{it}*CONS_{it}*$			0.071			0.040			-0.008
GE_{it}			(0.187)			(0.139)			(0.122)
$LEV_{it}*(1-CONS_{it})$			-0.240			-0.031			0.038
			(0.291)			(0.272)			(0.494)

Observations	26921	27287	27287	26916	27282	27282	25840	26187	26187
Number of firms	6927	7001	7001	6926	7000	7000	6726	6799	6799
m1 (p)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m2 (p)	0.93	0.74	0.81	0.84	0.70	0.73	0.92	0.68	0.63
Sargan (p)	0.33	0.70	0.72	0.22	0.25	0.21	0.14	0.25	0.22

Notes: $CONS_{it}$ takes value 1 for firm *i* in year *t* if firm *i*'s sales, age or quiscore are in the lowest 75% of the distribution of the sales, age, or quiscore of all the firms in firm *i*'s industry in year *t*. GE_{it} is a dummy variable equal to 1 if firm *i* has positive exports in year *t*, and 0 otherwise. Instruments include $\Delta I_{i,t-2}$; $\Delta S_{i,t-2}$; $(I_{i,t-2} - S_{i,t-2})$; $FIN_{i,t-2}$; $Sales_{i,(t-2)}$ / $Age_{i,(t-2)}$ / $Quiscore_{i,(t-2)}$; $Export_{i,(t-2)}$ and further lags, where $FIN_{i,t-2}$ indicates in turn $MIX1_{i,t-2}$, $MIX2_{i,t-2}$, and $LEV_{i,t-2}$. Time dummies and time dummies interacted with industry dummies were always included as regressors and as instruments. Also see Notes to Tables 1 and 2. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 6: Inventory investment and financial variables: distinguishing firm-years on the basis of whether they are more or less likely to face financial constraints in a traditional sense, and on the basis of their degree of global engagement measured in terms of foreign ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$CONS_{it} = f\,(Sales_{it})$ $GE_{it} = f\,(Foreign_{it})$			$CONS_{it} = f\,(Age_{it})$ $GE_{it} = f\,(Foreign_{it})$			$CONS_{it} = f\,(Quiscore_{it})$ $GE_{it} = f\,(Foreign_{it})$	
ΔI_{it-1}	-0.077***	-0.051***	-0.074***	-0.070***	-0.068***	-0.072***	-0.049***	-0.050***
	(0.018)	(0.018)	(0.019)	(0.017)	(0.017)	(0.018)	(0.015)	(0.015)
ΔS_{it}	0.724***	0.458***	0.664***	0.719***	0.678***	0.685***	0.590***	0.554***
	(0.149)	(0.132)	(0.142)	(0.128)	(0.131)	(0.135)	(0.084)	(0.088)
$\Delta S_{i,t-1}$	0.041***	0.031**	0.040***	0.038***	0.037***	0.038***	0.023*	0.024*
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.013)
$I_{i,t-1} – S_{i,t-1}$	-0.476***	-0.427***	-0.457***	-0.505***	-0.489***	-0.476***	-0.531***	-0.507***
	(0.057)	(0.051)	(0.050)	(0.054)	(0.053)	(0.051)	(0.046)	(0.046)
$MIX1_{it}*CONS_{it}*(1-GE_{it})$	0.507*			0.627**			0.243***	
	(0.259)			(0.243)			(0.083)	
$MIX1_{it}*CONS_{it}*GE_{it}$	-0.041			-0.080			0.090	
	(0.306)			(0.203)			(0.075)	
$MIX1_{it}*(1-CONS_{it})$	-0.010			-0.049			0.142	
	(0.245)			(0.167)			(0.089)	
$MIX2*CONS_{it}*(1-GE_{it})$		0.409*			0.457**			0.230**
		(0.228)			(0.225)			(0.094)
$MIX2*CONS_{it}*GE_{it}$		0.158			0.053			0.093
		(0.233)			(0.176)			(0.082)
$MIX2*(1-CONS_{it})$		-0.173			0.002			0.215
		(0.219)			(0.164)			(0.134)

*LEV*CONS$_{it}$**			0.507**			0.574**		
(1-GE$_{it}$)			(0.245)			(0.250)		
*LEV$_{it}$*CONS$_{it}$**			-0.133			-0.082		
GE$_{it}$			(0.232)			(0.187)		
LEV$_{it}$(1-CONS$_{it}$)*			0.133			-0.009		
			(0.254)			(0.232)		
Observations	30064	30482	30482	30059	30477	30477	28838	29233
Number of firms	6605	6670	6670	6604	6669	6669	6426	6490
m1 (p)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m2 (p)	0.26	0.32	0.31	0.39	0.24	0.33	0.29	0.26
Sargan (p)	0.16	0.15	0.20	0.27	0.17	0.18	0.16	0.16

Notes: $CONS_{it}$ takes value 1 for firm *i* in year *t* if firm *i*'s sales, age or quiscore are in the lowest 75% of the distribution of the sales, age, or quiscore of all the firms in firm *i*'s industry in year *t*. GE_{it} is a dummy variable equal to 1 if firm *i* is foreign owned in year *t*, and 0 otherwise. Instruments include $\Delta I_{i,t-2}$; $\Delta S_{i,t-2}$; $(I_{i,t-2} - S_{i,t-2})$; $FIN_{i,t-2}$; $Sales_{i,(t-2)}$ / $Age_{i,(t-2)}$ / $Quiscore_{i,(t-2)}$; $Foreign_{i,(t-2)}$ and further lags, where $FIN_{i,t-2}$ indicates in turn $MIX1_{i,t-2}$, $MIX2_{i,t-2}$, and $LEV_{i,t-2}$. Time dummies and time dummies interacted with industry dummies were always included as regressors and as instruments. Also see Notes to Tables 1 and 2. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

References

Abel, A. and J. Eberly (2002). "Q for the Long Run." *Mimeograph*, Kellogg School of Management and the Wharton School of the University of Pennsylvania.

Abel, A. and J. Eberly (2004). "Q Theory without Adjustment Costs & Cash Flow Effects without Financing Constraints." *Mimeograph*, Kellogg School of Management and the Wharton School of the University of Pennsylvania.

Alti, A. (2003). "How Sensitive is Investment to Cash Flow when Financing is Frictionless?" *Journal of Finance,* 58 (2), 707-722.

Arbeláez, M., and J. Echavarría (2002). "Credit, Financial Liberalization and Manufacturing Investment in Colombia." Latin American Research Network Working Paper No. R-450. Washington, DC, United States: Inter-American Development Bank, Research Department.

Arellano, M. and S. Bond (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies,* 58, 277-97.

Blalock, G, Gertler, P., and D. Levine (2004). "Investment Following a Financial Crisis: Does Foreign Ownership matter?" *Mimeograph*, Cornell University.

Bagliano, F. and A. Sembenelli (2004). "The Cyclical Behavior of Inventories: European Cross-Country Evidence from the early 1990s Recession." *Applied Economics*, 36, 2031-44.

Benito, A. (2005). "Financial Pressure, Monetary Policy Effects and Inventories: Firm-level Evidence from a Market-based and a Bank-based Financial System." *Economica,* 72, 201-224.

Bernanke, B. and M. Gertler (1995). "Inside the Black Box: the Credit Channel of Monetary Policy Transmission." *Journal of Economic Perspectives*, 9 (4), 27-48.

Blinder, A. and L. Maccini (1991). "Taking Stock: a Critical Assessment of Recent Research on Inventories." *Journal of Economic Perspectives*, 5, 73-96.

Blundell, R. and S. Bond (1998). "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics*, 87, 115-43.

Blundell, R., Bond, S., Devereux, M., and F. Schiantarelli (1992). "Investment and Tobin's Q: Evidence from Company Panel Data." *Journal of Econometrics,* 51, 233-57.

Bo, H., Kuper, G., Lensink, R., and E. Sterken (2002). "Dutch Inventory Investment: are Capital Market Imperfections Relevant?" *Applied Economics,* 34, 15-22.

Bond, S. and J. Cummins (2001). "Noisy Share Prices and the *Q* Model of Investment." Institute for Fiscal Studies, Discussion Paper, No. 22.

Bond, S., Klemm, A., Newton-Smith, R., Syed, M., and G. Vlieghe (2004). "The Roles of Expected Profitability, Tobin's *Q* and Cash Flow in Econometric Models of Company Investment." Institute for Fiscal Studies, Working Paper No. 04/12.

Campa J-M. and J-M. Shaver (2002). "Exporting and Capital Investment: On the Strategic Behavior of Exporters". IESE Business School, University of Navarra, Discussion Paper No. 469.

Carpenter, R., Fazzari, S., and B. Petersen (1994). "Inventory (Dis)investment, Internal Finance Fluctuations, and the Business Cycle." *Brookings Papers in Economic Activity*, 2, 75-122.

Carpenter, R., Fazzari, S., and B. Petersen (1998). "Financing Constraints and Inventory Investment: a Comparative Study with High-Frequency Panel Data." *Review of Economics and Statistics*, 80 (4), 513-19.

Carpenter, R. and Guariglia, A. (2003). "Cash Flow, Investment, and Investment Opportunities: New Tests Using UK Panel Data." University of Nottingham Discussion Paper No. 03/24.

Carpenter, R. and B. Petersen (2002). "Is the Growth of Small Firms Constrained by Internal Finance?" *Review of Economics and Statistics*, 84 (2), 298-309.

Castañeda, G. (2002). "Internal capital markets and financing choices of Mexican firms Before and during the financial Paralysis of 1995-2000." Latin American Research Network Working Paper No. R-469. Washington, DC, United States: Inter-American Development Bank, Research Department.

Choi, W. G. and Y. Kim (2001). "Has Inventory Investment been Liquidity-Constrained? Evidence from US Panel Data." International Monetary Fund Working Paper No. 01/122.

Cleary, S. (1999). "The Relationship between Firm Investment and Financial Status." *Journal of Finance*, 54 (2), 673-92.

Colombo, E. (2001). "Determinants of Corporate Capital Structure; Evidence from Hungarian Firms." *Applied Economics*, 33, 1689-1701.

Cooper, R. and J. Ejarque (2001). "Exhuming *Q*: Market Power vs. Capital Market Imperfections", National Bureau of Economic Research Working Paper No. 8182.

Cooper, R. and J. Ejarque (2003). "Financial Frictions and Investment: Requiem in *Q*". *Review of Economic Dynamics*, 6, 710-28.

Cummins, J., K. Hasset, and S. Oliner (2005). “Investment Behavior, Observable Expectations, and Internal Funds.” *American Economic Review*, (forthcoming).

De Brun, J., N. Gandelman and E. Barbieri (2002). “Investment Equations and Financial Restrictions at Firm Level: the Case of Uruguay.” Latin American Research Network Working Paper No. R-462. Washington, DC, United States: Inter-American Development Bank, Research Department.

Dedola, L and F. Lippi (2005). “The Monetary Transmission mechanism: Evidence from the Industries of five OECD Countries.” *European Economic Review,* 49 (6), 1543-69.

Desai, M., Foley, F., and Forbes, K. (2004a). “Financial constraints and growth: multinational and local firm responses to currency crises.” National Bureau of Economic Research Working Paper No. 10545.

Desai, M., Foley, F., and J. Hines (2004b). “A Multinational Perspective on Capital Structure Choice and Internal Capital Markets.” *Journal of Finance,* 59 (6), 2451-87.

Erickson, T. and T. Whited (2000). “Measurement Error and the Relationship between Investment and *Q*.” *Journal of Political Economy,* 108 (6), 1027-57.

Fazzari, S., Hubbard, G., and B. Petersen (1988). “Financing Constraints and Corporate Investment.” *Brookings Papers on Economic Activity,* 1, 141-95.

Gomes, J. (2001). “Financing Investment.” *American Economic Review,* 91 (5), 1263-1285.

Greenaway, D., Guariglia, A., and R. Kneller (2005). “Do Financial Factors Affect Exporting Decisions?” *Mimeograph,* University of Nottingham. (forthcoming as a *GEP Research Paper,* Leverhulme Centre for Research on Globalization and Economic Policy, University of Nottingham).

Guariglia, A. (1999). “The Effects of Financial Constraints on Inventory Investment: Evidence from a Panel of UK Firms.” *Economica,* 66, 43-62.

Guariglia, A. (2000). “Inventory Investment and Capital Market Imperfections: A Generalization of the Linear Quadratic Inventory Model.” *Oxford Bulletin of Economics and Statistics*, 62 (2), 223-42.

Guariglia, A. (2005). “Internal Financial Constraints, External Financial Constraints, and Investment Choice: Evidence from a Panel of UK Firms.” *Mimeograph*, University of Nottingham.

Guariglia, A., and S. Mateut (2004). “Credit Channel, Trade Credit Channel, and Inventory Investment: Evidence from a Panel of UK Firms.” *Mimeograph*, University of Nottingham.

Harrison, A., Love, I., and M. McMillan (2004). “Global Capital Flows and Financing Constraints.” *Journal of Development Economics,* 75, 269-301.

Harrison, A. and M. McMillan (2003). “Does Direct Foreign Investment Affect Domestic Firms Credit Constraints?” *Journal of International Economics,* 61 (1), 73-100.

Hoshi, T, Kashyap, A, and D. Scharfstein (1991). “Corporate Capital Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups.” *Quarterly Journal of Economics,* 106 (1), 33-60.

Huang, Z. (2003). “Evidence of a Bank Lending Channel in the UK,” *Journal of Banking and Finance,* 27, 491-510.

Hubbard, G. (1998). “Capital Market Imperfections and Investment.” *Journal of Economic Literature,* 35, 193-225.

Kaplan, S. and L. Zingales (1997). “Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?” *Quarterly Journal of Economics,* 112 (1), 169-215.

Kashyap, A. and J. Stein (1994). “Monetary Policy and Bank Lending.” In: Mankiw, N. G. (Ed.), Monetary Policy. Chicago University Press, Chicago, 221-56.

Kashyap, A., Stein, J., and W. Wilcox. (1993). “Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance.” *American Economic Review*, 83 (1), 78-98.

Lovell, M. (1961). “Manufacturers’ Inventories, Sales Expectations and the Acceleration Principle.” *Econometrica,* 29, 293-314.

Mickiewicz, T., Bishop, K., and U. Varblane (2004). “Financial Constraints in Investment – Foreign Versus Domestic Firms. Panel Data Results from Estonia, 1955-1999”. William Davidson Institute Working Paper No. 649.

Mishkin, F. (1995). “Symposium on the Monetary Transmission Mechanism.” *Journal of Economic Perspectives*, 9 (4), 3-10.

Moyen, N. (2004). “Investment-Cash Flow Sensitivities: Constrained versus Unconstrained Firms.” *Journal of Finance,* 69, 2061-92

Nickell, S. (1981). “Biases in Dynamic Models with Fixed Effects.” *Econometrica*, 49, 1417-26

Ng, S. and H. Schaller (1996). "The Risky Spread, Investment, and Monetary Policy Transmission: Evidence on the Role of asymmetric Information." *Review of Economics and Statistics,* 78 (3), 375-383.

Oliner, S. and S. Rudebusch (1996). "Monetary policy and credit conditions: evidence from the composition of external finance: comment." *American Economic Review,* 86 (1), 300-309.

Peersman, G. and F. Smets (2005). "The Industry Effects of Monetary Policy in the Euro Area." *Economic Journal*, 115, 319-42.

Petersen, M. and R. Rajan (1997). "Trade credit: theories and evidence." *Review of Financial Studies*, 10, 661-691.

Schaller, H. (1993). "Asymmetric Information, Liquidity Constraints and Canadian Investment." *Canadian Journal of Economics*, 26, 552–74.

Small, I. (2000). "Inventory Investment and Cash Flow." Bank of England Working Paper No. 112.

Whited, T. (1992). "Debt, Liquidity Constraints and Corporate Investment: Evidence from Panel Data." *Journal of Finance*, 4, 1425-60.