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# Financial frictions and the K/L ratio in UK manufacturing*

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**Abstract**

Using comprehensive financial data on UK unquoted firms, we investigate whether technological differences of UK manufacturing industries influence the response of firms' capital-labour ratio (K/L) to changes in financial indicators under capital market imperfections. Results reveal that the sensitivity of the K/L ratio to cash flow not only depends on firms' net worth and financial frictions, but also on technological factors.

*JEL classification*: E22, D92, E44

*Key words*: Financial frictions, Capital-labour ratio, Manufacturing industries

## 1 Introduction

Empirical and theoretical studies of firm investment and employment suggest that changes in net worth and consequently in firms' real decisions arise from financial frictions (see Bond and van Reenen (2006)). Guariglia (2008) and Nickell and Nicolitsas (1999) find significant effects of financial constraints on UK firms' fixed investment and employment choices. Recently, Spaliara (2009) considered the effects of financial indicators on both investment and hiring decisions to examine how financial constraints affect the allocation of funds between capital and labour when decisions on both inputs have to be taken simultaneously rather than

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independently. Results show that financially constrained firms face a greater sensitivity of the K/L ratio to financial characteristics compared with their unconstrained counterparts.

In this paper, we take a different angle by examining whether technological differences influence the response of the K/L ratio to changes in financial indicators in the presence of financial frictions. Suppose that firms operating in different industrial groups, experience a permanent increase in the demand for their products. Financially unconstrained firms should be able to expand capital and labour using external and internal funds, irrespective of their technology. Those firms can always achieve the K/L ratio consistent with cost minimization and thus, we would not expect the ratio to vary with changes in our measure of financial constraints. In contrast, financially constrained firms, for whom access to external finance is expensive, have to rely heavily on internal funds to partially satisfy demand. In particular, constrained firms that operate in capital intensive industries need to use their internal funds to invest in physical capital so as to bring the K/L ratio closer to its optimum level. Thus, we expect an increase in the K/L ratio. Yet, the same group of firms in labour intensive industries will use their internal funds to hire more labour, given that for those firms capital adjustment might be prohibitively costly. Therefore, we anticipate a decrease in the K/L ratio. Motivated by this consideration we argue that the sensitivity of the K/L ratio to financial variables might not only depend on firms' net worth and financial constraints, but also on technological factors.

An important feature of our analysis is that we have access to a large panel of financial data on UK firms, most of which are unquoted on the stock market. This is an appealing characteristic as it allows our measures of financial frictions to display a wide degree of variation across observations in our sample. Hence, we will be able to identify financially constrained firms and study their nexus with the K/L ratio across industries.

## 2 Data analysis

The data come from FAME, which is a UK financial database complemented by STAN, the source for industry-level data. Firm-specific and financial indicators for all UK manufacturing firms are taken from FAME. We also extract information on investment and output at the industry level from STAN database. Our data span the period 1994 to 2004. Following Blundell et al. (1992), firms are allocated to one of the following nine industrial groups: (1) food, drink and tobacco; (2) textiles, clothing, leather and footwear; (3) chemicals and man-made fibres; (4) other minerals and mineral products; (5) metal and metal goods; (6) electrical and instrument engineering; (7) motor vehicles and parts, other transport equipment; (8) mechanical engineering; and (9) others.

To account for financial frictions we distinguish our sample between financially constrained and unconstrained firms using size as a sorting device. Mizen and Vermeulen (2005), Bougheas et al. (2006) and Guariglia (2008) use size as a proxy for capital market access for firms in UK manufacturing. Small firms are associated with a higher degree of information asymmetry and therefore are more likely to be financially constrained. We construct the dummy $Small_{it}$, which is equal to one if the firm's real total assets are below the upper quartile of the size distribution and zero otherwise. We expect the response of the K/L ratio to changes in financial variables to be higher for small firms compared with their large counterparts across all nine manufacturing industries.

## 3 Econometric results

To estimate the differing impact of financial frictions across industries we specify the following equation:

$$y_{it} = F_{it} Small_{it} \beta + F_{it}(1 - Small_{it})\gamma + X_{it}\delta + e_{it} \tag{1}$$

where $y_{it}$ is the log of $(K/L)$ ratio, $K$ is the replacement value of capital stock and $L$ is the number of employees. $F_{it}$, is the vector of financial variables, which is made up of $COLLATERAL$, the ratio of tangible assets to total assets, $LEVERAGE$, the ratio of total liabilities to total assets, and $CASH\ FLOW$, the sum of after tax profit and depreciation normalised by total assets. Vector $F_{it}$ is interacted with $Small_{it}$ and $(1 - Small_{it})$ to gauge the extent to which the effects of the financial variables on the K/L ratio differ for constrained and unconstrained firms. $X_{it}$ consists of $PRICE$, the log of industry variable user cost of capital to average firm wages and $SALES$, the log of real sales. $e_{it}$, is the error term.

To estimate our specification we employ the First-Differenced GMM approach (see Arellano and Bond (1991)) which considers both the endogeneity bias and unobserved heterogeneity problems. To remove unobserved heterogeneity, the model is specified in first differences, whereas to control for endogeneity, covariates in the first-differenced equation are instrumented by using the levels of the series involved, lagged by two or more periods. To evaluate the choice of the instruments and the specification of the model we use the Sargan/Hansen test and the *m2* test.

Table 1 presents the estimated results. The K/L ratio is more responsive to fluctuations in financial indicators for small firms.[1] This finding is in line with previous evidence (see

[1] The coefficients on cash flow and leverage are statistically significant for small firms, whereas for large firms they are insignificant and quantitatively unimportant. Further, collateral exerts a significant impact on the K/L ratio for both small and large firms confirming the importance of collateralized assets for debt

Spaliara (2009)) which shows that more constrained firms exhibit greater sensitivities of the K/L ratio to financial variables.

Turning to the result of our main interest, we now focus on the differential effect of financial variables on the K/L ratio for small firms. Looking at the inter-industry differences of the coefficients on financial indicators, our attention is captured by the sign reversal in the cash flow variable (row 1). The coefficients on cash flow for industrial groups 6, 7 and 8 attain a positive sign, whilst the coefficients on cash flow for the remaining industries (1, 2, 3, 5 and 9) attract a negative sign, indicating the statistically significant impact of the internal funds variable on the K/L ratio. Cash flow appears to have an insignificant effect on the K/L ratio when we consider industry 4. The role of cash flow in firms' real decisions has been highlighted by recent studies (Bond and van Reenen (2006) and Guariglia (2008)). In particular, the positive effect of cash flow on investment and employment has been interpreted as evidence of financial constraints. In this paper, our aim is to disentangle the effect of cash flow on the K/L ratio taking into account technological factors.

The positive linkage between cash flow and the K/L ratio for constrained firms in capital intensive industries (groups 6, 7 and 8) implies that firms facing financial problems and having inadequate access to external debt use their cash flow to finance their inputs. Although financially constrained firms cannot invest optimally in capital due to some technological impediment to adjusting capital quickly, the capital intensive nature of firms operating mainly in high-technology industries[2] drives them to channel their internal funds on the investment of capital. On the other hand, the negative relation between cash flow and the K/L ratio for constrained firms that belong to low-technology industries (groups 1, 2, 3, 5 and 9), suggests that when those firms face difficulties in obtaining external finance they hire more labour. Constrained firms in labour intensive industries will satisfy demand using labour more intensively. Finally, leverage and collateral retain their negative and positive effect on the K/L ratio, respectively across all industries.

To ensure robustness we have conducted a number of additional tests, which are available upon request. First, we use bank dependency and collateral as alternative measures of financing constraints. Second, given the speed and the time of capital and labour adjustment we employ a dynamic approach. Third, we estimate the model in a dynamic setting using the aforementioned alternative measures of constraints. Finally, to test the consistency of our findings based on the industrial grouping, we estimate our model for two large groups

finance. Overall, the p-values for the equality of the coefficients on cash flow and leverage show significant differences between constrained and unconstrained firms but this is not the case for collateral.

[2]According to OECD's sectoral classification (Hatzichronoglou (1997)) industries 6, 7 and 8 are classified as medium-high tech and high-tech industries, while industries 1, 2, 3, 5 and 9 as low-tech and medium-low tech industries.

of firms, namely high-tech and low-tech industries based on Görg and Strobl (2003). In all cases the results are very similar both quantitatively and qualitatively. In summary, we confirm the existence of a positive (negative) nexus between the K/L ratio and cash flow for constrained firms operating in more capital (labour) intensive industries.

## 4 Conclusion

Net worth and financial frictions have been found in the literature to play a significant role in firms' real decisions. However, in this paper we show that the use of internal funds by financially constrained firms is not homogeneous but depends on their technology.

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Table 1: Intra-industry and inter-industry comparison of the K/L ratio under financial frictions

| | Industry 1<br>(1) | Industry 2<br>(2) | Industry 3<br>(3) | Industry 4<br>(4) | Industry 5<br>(5) | Industry 6<br>(6) | Industry 7<br>(7) | Industry 8<br>(8) | Industry 9<br>(9) |
|---|---|---|---|---|---|---|---|---|---|
| $CashFlow_{it} * Small_{it}$ | -0.386*** | -0.359** | -0.344** | -0.081 | -0.165* | 0.170** | 0.379** | 0.244** | -0.549** |
| | (-2.94) | (-2.56) | (-2.11) | (-0.29) | (-1.88) | (2.09) | (1.99) | (2.02) | (-2.08) |
| $CashFlow_{it} * (1 - Small_{it})$ | -0.203 | -0.178 | -0.194 | -0.056 | 0.033 | -0.181 | 0.204 | 0.187 | -0.048 |
| | (-1.02) | (-0.86) | (-0.44) | (-0.19) | (0.19) | (-0.48) | (0.59) | (0.98) | (-0.60) |
| $Leverage_{it} * Small_{it}$ | -0.160** | -0.165** | -0.097* | -0.146*** | -0.044** | -0.081** | -0.130** | -0.097** | -0.094*** |
| | (-2.29) | (-2.04) | (-1.82) | (-2.88) | (-2.38) | (-2.28) | (-2.00) | (-2.04) | (-3.13) |
| $Leverage_{it} * (1 - Small_{it})$ | -0.065 | -0.073 | 0.026 | 0.034 | 0.023 | -0.003 | 0.026 | -0.010 | -0.032 |
| | (-1.60) | (-1.27) | (0.55) | (0.70) | (0.80) | (-0.10) | (0.45) | (-0.17) | (-1.37) |
| $Collateral_{it} * Small_{it}$ | 0.265*** | 0.329*** | 0.290*** | 0.405*** | 0.272*** | 0.324*** | 0.377*** | 0.278*** | 0.326*** |
| | (9.85) | (5.71) | (4.89) | (9.73) | (3.15) | (14.66) | (5.01) | (3.39) | (19.69) |
| $Collateral_{it} * (1 - Small_{it})$ | 0.304*** | 0.383*** | 0.306*** | 0.391*** | 0.283*** | 0.388*** | 0.435*** | 0.391*** | 0.342*** |
| | (10.88) | (6.83) | (6.07) | (9.25) | (4.28) | (14.64) | (6.36) | (3.67) | (17.95) |
| $Price_{it}$ | -0.494*** | -0.829*** | -0.455*** | -0.394*** | -0.621*** | -0.523*** | -0.807*** | -0.649*** | -0.530*** |
| | (-6.16) | (-9.50) | (-5.42) | (-3.11) | (-9.12) | (-7.61) | (-5.62) | (-10.33) | (-12.38) |
| $Sales_{it}$ | -0.715*** | -0.664*** | -0.613*** | -0.691*** | -0.675*** | -0.586*** | -0.869*** | -0.703*** | -0.683*** |
| | (-9.60) | (-8.02) | (-6.29) | (-4.29) | (-12.49) | (-11.41) | (-9.24) | (-16.09) | (-18.15) |
| $JStatistic$ | 0.415 | 0.187 | 0.109 | 0.970 | 0.128 | 0.104 | 0.419 | 0.501 | 0.602 |
| $m2$ | 0.204 | 0.741 | 0.528 | 0.033 | 0.788 | 0.302 | 0.715 | 0.375 | 0.039 |
| $Observations$ | 1665 | 1239 | 2635 | 588 | 3501 | 2732 | 764 | 1535 | 5236 |
| $Instruments$ | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 | t-2; t-3; t-4 |

Notes: Dependent variable is log(capital/labour). The figures in parentheses are t-statistics. * significant at 10%; ** significant at 5%; *** significant at 1%. Time dummies and time dummies interacted with industry dummies were included in all specifications. $m2$ is a test for second-order serial correlation in the first-differenced residuals, and the $J$ statistic is a test of the overidentifying restrictions.