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FINANCIAL FACTORS AND INVESTMENT IN BELGIUM, FRANCE, GERMANY AND THE UK: A COMPARISON USING COMPANY PANEL DATA

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ABSTRACT

We construct company panel datasets for manufacturing firms in Belgium, France, Germany and the UK, covering the period 1978-89. These datasets are used to estimate a range of empirical investment equations, and to investigate the role played by financial factors in each country. A robust finding is that cash flow or profits terms appear to be both statistically and quantitatively more significant in the UK than in the three continental European countries. This is consistent with the suggestion that financial constraints on investment may be relatively severe in the more market-oriented UK financial system.

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1. Introduction

There is now a large microeconometric literature that investigates the role of financial factors in company investment decisions. Most studies find that financial variables such as cash flow help to explain investment spending. For some econometric models of investment, this relationship should not occur under the null hypothesis that company investment spending is not affected by financial constraints, and the evidence of 'excess sensitivity to cash flow' is interpreted as suggesting the importance of such constraints. It is sometimes suggested that these financial constraints on investment may be the outcome of asymmetric information between firms and suppliers of finance. The excess sensitivity of investment to financial variables has been found to be less important for certain types of firms, such as those with close relationships to banks in Japan and Germany, and those which pay out high dividends in the UK and the US[1].

Once we move away from a model of perfect capital markets in which financial decisions and real investment decisions are separable, we raise the possibility that different financial systems may have different effects on company investment. Heterogeneity across countries has been well documented, for example in patterns of investment finance, corporate ownership patterns, corporate governance rules, the market for corporate control and the relative importance of different financial markets and institutions[2]. Differences between Anglo-American 'market-based' and German or Japanese 'bank-based' systems have received particular attention. It is sometimes suggested that the arms-length relation between firms and suppliers of finance that tends to characterise the market-oriented systems may be less effective at dealing with problems of asymmetric information. Perhaps surprisingly, there has been little investigation of whether these differences between financial systems may be related to differences in the impact of financial constraints on investment.

The aim of this paper is to begin an econometric investigation of this question. We construct company panel datasets for manufacturing firms in Belgium, France, Germany and the UK, covering the period 1978-1989. These datasets are used to estimate a range of empirical investment equations, and to investigate the role played by financial factors in each country. The main focus of the investigation is to compare results for the same investment model across different countries, rather than to compare 'competing' econometric specifications within each country. We therefore emphasise results that appear to be robust to the

[1]See *inter alia* Hoshi, Kashyap and Scharfstein (1991), Elston (1993), Bond and Meghir (1994) and Fazzari, Hubbard and Petersen (1988). See Mairesse and Dormont (1985) for an earlier comparative study.

[2]See *inter alia* Mayer (1988, 1990), and Edwards and Fischer (1994).

choice of model specification.

We estimate accelerator, error correction and Euler equation specifications, including additional cash flow and profits terms to investigate the role of financial variables. The models are estimated using GMM methods which control for biases due to unobserved firm-specific effects and lagged endogenous variables. Some OLS and Within Groups results are reported for comparison, and suggest the importance of controlling for these biases.

There are important differences between firms in these countries, and in the nature of the accounts data that were available for this study. The UK data refer to the consolidated accounts of company groups that are traded on the London Stock Exchange. The accounts data available for corporations in the other countries are generally not consolidated. The German data also refer only to stock market quoted firms. The data for France and Belgium cover a wider range of firms who report accounts in those countries, and include some unquoted companies as well as some subsidiaries of larger firms. As the proportion of corporate activity accounted for by firms quoted on national stock markets varies considerably across these countries, it would not necessarily be desirable to restrict attention only to quoted firms. However it would be desirable to have more comparable accounting data, on either a consolidated or unconsolidated basis. The impact of other differences between accounting rules in the four countries is minimised by using recorded cash flows wherever possible, and by estimating values for the capital stock from the investment flows on a standard basis for each sample.

Partly as a result of these differences in the data available, the UK and German companies we study tend to be much larger than the French and Belgian companies[3]. Nevertheless we find that simple time series descriptions of the investment process display a remarkable degree of uniformity across the four datasets. However the results of the econometric investment models reveal some interesting differences between the four countries. Financial variables are found to play an important role in France, Germany and the UK. However a robust finding across all specifications is that cash flow or profits terms appear to be both statistically and quantitatively more significant in the UK than in the continental European countries. This finding is consistent with the suggestion that financial constraints on investment may be relatively severe in the more market-oriented UK financial system.

The remainder of the paper is organised as follows. Section 2 briefly describes the three investment models that we estimate in this study; section 3 describes the four datasets we use; section 4 presents our empirical results; and section 5

[3]We use a sub-sample of the largest firms in France to investigate the sensitivity of our results to firm size. We also consider sub-samples of independent French firms, and of German companies for which consolidated data were available, to investigate the impact of accounting differences on our results.

concludes with a discussion of these findings.

2. Three empirical investment equations

We estimate three different econometric models of company investment, which allows us to consider the sensitivity of our empirical findings to the choice of model specification. The models we use are an accelerator model, an error correction model, and an Euler equation. These are described in the next three sections.

2.1. An accelerator specification

Accelerator models of investment can take many forms[4]. We start from the assumption that, in the absence of adjustment costs, the desired capital stock can be written as a log-linear function of output and the cost of capital. Letting k_{it} denote the (natural) log of the desired capital stock for firm i in period t, y_{it} denote the log of output and j_{it} denote the log of the real user cost of capital, we write the desired capital stock as

$$k_{it} = a + y_{it} - \sigma j_{it}. \tag{2.1}$$

This is consistent with profit maximisation subject to constant returns to scale and a CES production function, and nests the possibility of a fixed capital-output ratio ($\sigma = 0$). Taking first differences and using the approximation $\Delta k_{it} \approx I_{it}/K_{i,t-1} - \delta$, where I_{it} is investment and K_{it} is the capital stock at the end of period t, then gives the basic investment equation

$$\frac{I_{it}}{K_{i,t-1}} = \delta + \Delta y_{it} - \sigma \Delta j_{it}. \tag{2.2}$$

To account for slow adjustment of the actual capital stock to the desired capital stock, we nest this within a general dynamic regression model. We also assume that variation in the user cost of capital can be controlled for by including both time-specific and firm-specific effects. The model we estimate therefore has the form

$$\frac{I_{it}}{K_{i,t-1}} = \rho\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \beta_0 \Delta y_{it} + \beta_1 \Delta y_{i,t-1} + d_t + \eta_i + v_{it} \tag{2.3}$$

where d_t is a time dummy, η_i is an unobserved firm-specific effect and v_{it} is an error term. We consider adding current and lagged cash flow terms to test this basic specification.

Several points can be noted briefly about this model. The lagged dependent variable will be correlated with firm-specific effects. Growth in output may also

[4] See Jorgenson (1963) or Eisner and Nadiri (1968) for example.

be correlated with these effects, and the current change in output is likely to be correlated with shocks to investment via the production function. We allow for this endogeneity in estimation. If constant returns to scale is acceptable, the long run effect of output growth on the investment rate ($[\beta_0 + \beta_1]/[1 - \rho]$) should be unity, at least in the absence of financial constraints.

Perhaps more importantly, we emphasise that the interpretation of additional cash flow or profits terms added to the right-hand side of equation (2.3) is ambiguous. Whilst a significant cash flow effect could reflect the presence of financial constraints on investment, it is also possible that such terms would be significant in the absence of financial constraints. In the presence of adjustment costs, for example, current investment depends not only on current but also on expected future changes in the desired stock of capital[5]. It is possible that information on cash flow helps to forecast output, for example, in which case such information on cash flow would help to explain investment spending in such a reduced form model. By the presence of financial constraints on investment, we mean a situation where a windfall increase in profits, that conveyed no new information about future profitability or investment opportunities, would nevertheless be associated with a rise in investment spending. This concept of financial *constraints* on investment should be distinguished from the possibility of significant *effects* from financial variables in empirical investment models that do not otherwise control for expectational influences.

2.2. An error correction specification

An alternative approach, rather than taking first differences of equation (2.1), is to nest equation (2.1) itself within a dynamic regression model. This approach was used in the investment literature by Bean (1981), and has the advantage of retaining information in the levels of output and the capital stock.

Following Bean (1981), we consider an error correction specification which has equation (2.1) as its long-run solution. Again dropping terms in the user cost of capital, and using the approximation $\Delta k_{it} \approx I_{it}/K_{i,t-1} - \delta$, this gives an empirical model of the form

$$\frac{I_{it}}{K_{i,t-1}} = \rho\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \beta_0 \Delta y_{it} + \beta_1 \Delta y_{i,t-1} + \phi(k_{i,t-2} - y_{i,t-2}) + d_t + \eta_i + v_{it}. \quad (2.4)$$

It is noteworthy that this nests the accelerator model considered in the previous section. However the long-run properties of the two models are quite different. While the long-run properties of the accelerator model depend on the parameters β_0, β_1 and ρ, the long-run properties of this model depend only on the form of the error correction mechanism $(k_{i,t-2} - y_{i,t-2})$. The long-run proportionality imposed

[5]See Nickell (1978), chapter 11, for example.

in equation (2.4) depends on the assumption of constant returns to scale, which can be tested by including an additional levels term in $y_{i,t-2}$ (or $k_{i,t-2}$). 'Error correcting' behaviour requires that $\phi < 0$, so that a capital stock above its desired level is associated with lower future investment, and *vice versa.* The interpretation of additional financial variables as reflecting influences on expectations rather than financial constraints again remains a possibility with this type of model.

2.3. An Euler equation specification

The version of the Euler equation model we estimate is based on Bond and Meghir (1994). This is a relation between investment rates in successive periods, derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. Under these assumptions, and as long as we assume that expectations are formed accordingly, the Euler equation model has the advantage of controlling for all expectational influences on the investment decision. Evidence of misspecification associated with the role of financial variables in this model is less easily explained away as merely capturing an expectational influence[6].

The firm is assumed to maximise the present discounted value of current and future net cash flows. Letting L_{it} denote variable factor inputs, w_{it} the price of variable factors, p^I_{it} the price of investment goods, p_{it} the price of output, β^t_{t+j} the nominal discount factor between period t and period t+j, δ the rate of depreciation, $F(K_{it}, L_{it})$ the production function gross of adjustment costs, $G(I_{it}, K_{it})$ the adjustment cost function and $E_t(.)$ the expectations operator conditional on information available in period t, the firm solves

$$\max E_t \left[\sum_{j=0}^{\infty} \beta^t_{t+j} R(K_{i,t+j}, L_{i,t+j}, I_{i,t+j}) \right] \tag{2.5}$$

$$\text{s.t. } K_{it} = (1-\delta)K_{i,t-1} + I_{it}$$

$$\text{where } R_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it} - p^I_{it}I_{it}.$$

The Euler equation characterising the optimal investment path relates marginal adjustment costs in adjacent periods. This can be written as

$$-\left(\frac{\partial R}{\partial I}\right)_{it} = -(1-\delta)\beta^t_{t+1}E_t\left(\frac{\partial R}{\partial I}\right)_{i,t+1} + \left(\frac{\partial R}{\partial K}\right)_{it}. \tag{2.6}$$

[6]The same comment applies to the Q model. We do not consider a Q model here as we wish to include unquoted companies in our samples, and since stock market data was not available in all four countries.

Assuming competitive markets and that $F(K_{it}, L_{it})$ is constant returns to scale, and specifying $G(I_{it}, K_{it}) = \frac{b}{2}[(I/K)_{it} - c]^2 K_{it}$, this can be expressed as

$$\left(\frac{I}{K}\right)_{it} - \alpha_1 \left(\frac{I}{K}\right)^2_{it} = \alpha_2 E_t \left(\frac{I}{K}\right)_{i,t+1} + \alpha_3 \left[\left(\frac{\Pi}{K}\right)_{it} - J_{it}\right] + \alpha_0, \qquad (2.7)$$

$$\text{where } \Pi_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it}$$

is gross operating profit and J_{it} is the real user cost of capital. Current investment is positively related to expected investment and to the current average profits term (reflecting the marginal profitability of capital under constant returns), and negatively related to the user cost of capital. An attractive feature of the Euler equation model is that all relevant expectational influences are captured by the one-step ahead investment forecast.

To implement this model, we replace the unobserved $E_t\left(I/K\right)_{i,t+1}$ by the realised $(I/K)_{i,t+1}$ plus a forecast error, and take this $(I/K)_{i,t+1}$ term to the left-hand side to obtain an econometric model that is linear in variables[7]. We also replace the cost of capital term by time effects and firm-specific effects, and include a term in the output-capital ratio that may be introduced either by non-constant returns to scale or by monopolistic competition in the product market. The resulting empirical specification is

$$\left(\frac{I}{K}\right)_{i,t+1} = \beta_1 \left(\frac{I}{K}\right)_{it} - \beta_2 \left(\frac{I}{K}\right)^2_{it} - \beta_3 \left(\frac{\Pi}{K}\right)_{it} + \beta_4 \left(\frac{Y}{K}\right)_{it} + d_{t+1} + \eta_i + v_{i,t+1}. \qquad (2.8)$$

Unlike the previous two models, this Euler equation model should control for the influence of financial variables on expectations of future profitability. Under the null of no financial constraints, it can be shown[8] that $\beta_1 \geq 1$, $\beta_2 \geq 1$, $\beta_3 > 0$ and (under constant returns to scale) $\beta_4 \geq 0$. Under the alternative, investment spending is positively related to cash flow or profits through the effect of financial constraints. The basic Euler equation in (2.8) is then mis-specified. Since the gross operating profits term $(\Pi/K)_{it}$ in equation (2.8) will be highly correlated with cash flow, the prediction of a negative sign on this term may be expected to fail in the presence of financial constraints.

The main aim of our study is to investigate whether robust results are obtained across countries from each of these models, not to evaluate them as rival specifications. It would not make much sense to compare, in terms of goodness of

[7]Other normalizations are condidered by Johansen (1994) and Whited (1992).

[8]It is possible to show that $\beta_1 = (1 + c + 2c(\nu - 1))/\psi$, $\beta_2 = \nu/\psi$, $\beta_3 = \mu/(b\psi)$ and $\beta_4 = (\mu - \nu)/(b\psi)$, where $\psi = \beta^t_{t+1}(1 - \delta)(p_{t+1}/p_t)$ is treated as constant, μ is the mark-up coefficient in a monopolistic competition framework, and ν is the returns to scale.

fit, the largely empirically derived accelerator and error correction models to the more structural Euler equation. Moreover, the validity of these equations is not mutually exclusive. The Euler equation is not inconsistent with the CES assumption used to obtain the error correction model; and the error correction model is not incompatible with the assumption of symmetric, quadratic adjustment costs[9].

3. Data

We use panel data on company accounts covering the period 1978-89. All firms have their main activity in the manufacturing sector, and firms with fewer than 100 employees in their first year in our sample were excluded. Firms that had engaged in major merger or acquisition activity were also excluded wherever possible, as the standard models of investment may not characterise these discrete adjustments very well.

The UK sample comprises 571 firms quoted on the London Stock Exchange for which consolidated accounts data were available from Datastream. Some of these companies have branches and subsidiaries overseas whose activities will be included in this data. The French and Belgian samples comprise 1,365 firms and 361 firms respectively, for which unconsolidated accounts data have been collected by INSEE in France and the central bank in Belgium. These need not be stock market quoted companies, and may include subsidiaries of foreign companies[10]. The German sample comprises some 228 quoted Aktiengesellschaft (AG) corporations, for which unconsolidated accounts data were available from the Bonn Data Bank. This sample contains most of the quoted manufacturing AG firms in Germany for which sufficient years of data were available.

The main variables we use are flows of investment, sales and gross operating profits. Investment spending is obtained from the sources and uses of funds account, and not inferred from changes in the balance sheet. For Germany and the UK, we construct a measure of cash flow by adding back reported depreciation to reported profits net of interest and taxes. For Belgium and France, we obtain a similar measure of cash flow by substracting the wage bill, interest and taxes from value added. For all countries, we use real sales as a proxy for output, even though a measure of value added was available from the company accounts in the Belgian and French data. However experiments showed that very similar results were obtained for these countries when this measure was used instead of sales.

A measure of the stock of capital at current replacement cost was estimated from the flow data on investment using a standard perpetual inventory method for each sample. The starting value was based on the net book value of tangible

[9]See Nickell (1985) for further discussion of the links between adjustment costs and error correction models.

[10]In principle, the investment of French or Belgian subsidiaries of UK companies could appear in both samples, although this is unlikely to be very common.

fixed capital assets, adjusted for previous years inflation. Subsequent values were obtained using accounts data on investment and disposals, national price indices for investment goods prices, and a depreciation rate of 8% assumed to be common to all countries. Further details of this calculation can be found in the data appendix. We have also experimented with other measures of the capital stock based on the reported gross and net book values of tangible assets, but our results remained very similar when using these alternative measures.

Table 1 presents some basic features of these datasets. The size distribution of all the samples is highly skewed, with mean employment being 2-7 times higher than median employment. The UK and German firms are clearly much larger on average than those in our French and Belgian samples, and the former samples are also more skewed. The French and Belgian firms had similar employment levels on average in 1985, but the French sample contains some much larger firms than the Belgian sample.

Table 2 reports the mean values of the variables used in our econometric analysis between 1981 and 1989. The investment rates (I/K) appear very similar on average in these datasets. However the average growth of real sales (Δy) is larger on average for Belgium and the UK than for our French and German samples. The cash-flow rates (C/K) or gross operating profit rates (Π/K) are quite similar across the four samples. The output-capital ratio (Y/K) is smaller on average in our UK sample, which may reflect in part the average size of the firms in the samples and in part the netting out of intra-group sales in these consolidated accounts.

4. Empirical results

We begin our empirical investigation by reporting some simple time series descriptions of the investment process in each of our samples. Table 3 reports the results of estimating an AR(2) model for the investment rate ($I_{it}/K_{i,t-1}$). In each case we report the results from three estimators: OLS levels, Within Groups, and GMM first differences. OLS levels does not control for the possibility of unobserved firm-specific effects and may therefore result in upward-biased estimates of the autoregressive coefficients if firm-specific effects are important. Within Groups is OLS after transforming the data to deviations from firm means; this eliminates the firm-specific effects but is well known to result in downward-biased estimates of the autoregressive coefficients in panels with a small number of time periods[11]. GMM first differences eliminates the firm-specific effects by differencing the equations, and then uses lagged values of endogenous variables as instruments. If the error term in levels is serially uncorrelated, then the error term in first differences is MA(1), and instruments dated t-2 and earlier should be valid in the differenced

[11] See Nickell (1981).

equations. Under this assumption, consistent parameter estimates can be obtained. If the error term in levels is itself MA(1), then only instruments dated t-3 and earlier will be valid; and so on. We test the validity of the instruments used by reporting both a Sargan test of the over-identifying restrictions, and direct tests of serial correlation in the residuals[12].

Despite the differences between these samples discussed in the previous section, the investment dynamics display a striking degree of similarity. In all cases the OLS levels results appear to be significantly biased upwards relative to the GMM results, and the Within Groups results appear to be significantly biased downwards. This suggests the presence of significant firm-specific effects, so we focus on the GMM results. The instruments used were lagged values of (I/K) dated t-2, t-3, ... , t-6 (where available), and year dummies were included in the specification. The validity of these instruments is easily accepted for two of the four countries, though is marginal for Belgium and the UK[13]. The investment rate data seems to be described fairly well by this simple AR(2) process, with significant positive autocorrelation in all cases. The sum of the coefficients on the two lagged terms varies between 0.21 for the UK and 0.26 for Germany.

Table 4 reports GMM results for a basic accelerator model of the form outlined in equation (2.3), with additional terms in the ratio of cash flow to the beginning of period capital stock $(C_{it}/K_{i,t-1})$ included to test the basic specification. The instruments used were the lagged values of all right-hand side variables dated t-2, t-3, ..., t-6, which allows for contemporaneous correlation between these variables and shocks to the investment equation, as well as correlation with unobserved firm-specific effects[14]. In all cases, comparison to OLS and Within Groups estimates (not reported here) again suggested the presence of significant firm-specific effects. We find significant positive effects from the lagged dependent variable (except in the UK) and from the growth in sales (except in Germany). Perhaps more interestingly, we find a significant positive effect from either current or lagged cash flow in each of the four countries. However, the sensitivity of investment spending to cash flow appears to be much greater in the UK, and to a lesser extent in Germany, than it is in Belgium or France.

Table 5 reports corresponding GMM results for an error correction model of

[12] See Arellano and Bond (1991) for further details of these procedures, which were implemented using GAUSS and the DPD program (see Arellano and Bond, 1988). The GMM results reported are one-step estimates. All reported standard errors are asymptotically robust to heteroskedasticity.

[13] In the tables we report p-values for the Sargan test (i.e. the probability of generating the calculated Sargan statistic under the null of valid instruments), which is asymptotically distributed as χ^2. We report actual values for the tests of first order (m1) and second order (m2) serial correlation in the differenced residuals. These are asymptotically standard normal under the null of no serial correlation.

[14] i.e. both current sales and current cash flow are treated as potentially endogenous variables in the investment equation.

the form outlined in equation (2.4), without imposing the restriction of constant returns to scale. The inclusion of the error correction term greatly reduces the coefficients on the lagged dependent variable, which become statistically insignificant in each of the four countries. It also reduces the coefficients on the cash flow terms, which become statistically insignificant in the case of Belgium[15]. Again it is striking that the sensitivity of investment to cash flow appears to be much greater for the UK companies.

Table 6 reports GMM estimates for the Euler equation specification set out in equation (2.8). The instrument set used here includes instruments dated t-2, which were found to be invalid in UK data by Bond and Meghir (1994). The coefficients on the lagged investment terms are correctly signed, but much smaller in absolute value than suggested by the derivation of this model in the absence of financial constraints on investment. The coefficient on the gross operating profits term is positive in all four cases, and significantly different from zero for France and the UK, which is contrary to the theoretical prediction under the null of no financial constraints. This effect is again much stronger in the UK sample. Our results for the UK sample are very similar to those obtained using t-2 instruments by Bond and Meghir (1994).

In Table 7 we report GMM estimates of the Euler equation model using only instruments dated t-3 and earlier. The exclusion of instruments dated t-2 substantially reduces the precision of the parameter estimates. In our smallest sample, for Germany, we then fail to identify any significant investment dynamics. In the three other samples the coefficients on the lagged investment terms increase in absolute value towards the values that should characterise the adjustment of capital in the convex adjustment costs model. For Belgium and France, the coefficient on gross operating profits is not significantly positive in these results. For the UK, however, the positive coefficient on the profits term remains large and highly significant.

For each of the investment models we have considered, the cash flow or profits variables appear to play a much more important role in the sample of UK firms than in the remaining countries. Although the UK sample contains much larger firms than the French and Belgian samples, and some previous studies have found stronger evidence of financial effects on investment among larger firms[16], we can be reasonably confident that this finding is not driven by differences in firm size. First, the size distribution of firms in our German sample is quite similar to that in our UK sample (see Table 1), but we find much weaker effects from financial variables in our German results. Secondly, we used a sub-sample of large French companies to investigate the impact of firm size directly. This sub-sample consists of 234 firms which had at least 1000 employees in their first year. It is more

[15]It may not be unrelated that Belgium is the one country for which the constant returns to scale restriction is not rejected.

[16]See Devereux and Schiantarelli (1990).

comparable to our UK and German samples, with mean and median employment in 1985 of 3,819 and 1,794 respectively. The results of estimating each of the investment models for this sub-sample are reported in the Results Appendix. They show almost no significant differences from the results for the full French dataset, and there is no indication that the large French firms are more (or less) affected by financial constraints than the smaller French firms.

Finally we investigated the impact of using consolidated or unconsolidated accounts data on our results. Recall that our data for the UK - where we have found the strongest effects from cash flow - are consolidated accounts for company groups, whilst our data for the remaining countries are unconsolidated accounts for individual corporations. Clearly there is a possibility that the investment spending by a subsidiary is constrained by the cash flow of the company group as a whole, rather than by the cash flow of the subsidiary itself, and that this will not be detected by regressing the subsidiary's investment on its own cash flow using unconsolidated data. Notice that in this case we would be underestimating the impact of financial constraints in France, Germany and Belgium, rather than overestimating the importance of financial constraints in the UK.

To investigate this possibility, we used a sub-sample of 437 independent French firms that are not subsidiaries of larger companies[17], and a sub-sample of 87 German companies for which consolidated company accounts were also available in the Bonn Data Bank. The firms in the independent French sub-sample tend to be small, with mean and median employment in 1985 of 214 and 184 respectively. The firms in the consolidated German sample are much larger on average than in any of the other samples we have used, with mean and median employment in 1985 of 37,317 and 7,669 respectively.

The results of estimating our investment equations on these sub-samples are also reported in the Results Appendix. The results for the independent French sub-sample are mixed, with no significant cash flow effects found in the error correction model, but with less satisfactory results for the Euler equation than found for the large French firms. For the sub-sample of consolidated German accounts, the coefficient on cash flow is a little higher in the accelerator and error correction models, but remains well below the corresponding UK results[18]. Overall these comparisons do not suggest that the differences between our results for the UK and for Belgium, France and Germany are primarily driven by this difference in the level of aggregation at which the company data is available, although it would be interesting to investigate this issue further.

[17]These 'independent' firms are defined as not being a subsidiary of either a French or a foreign company during the sample period, and as not having subsidiaries themselves.

[18]Because the sample size is much smaller, these results for the consolidated German sub-sample do not use instruments dated t-5 or t-6.

5. Conclusion

A consistent pattern emerges from our results. Simple accelerator equations tend to exaggerate the importance of financial variables relative to richer dynamic specifications, suggesting that the cash flow variables proxy for the omitted error correction terms. Nevertheless we find the cash flow terms to be statistically significant even in the error correction model for all countries except Belgium; and the Euler equation models also suggest some evidence of excess sensitivity to profits, particularly for the UK. A robust result across all our specifications is that the sensitivity of investment to financial variables is both statistically and quantitatively more significant in the UK than in France, Germany or Belgium. This difference is not accounted for by differences in the size distribution of firms, or in the nature of the company accounts data available for the UK.

The significance of cash flow terms in the accelerator and error correction models could in principle reflect expectations-formation rather than financial constraints, although if this is the correct interpretation it is perhaps surprising that we observe substantial differences between countries. This interpretation is also less appealing in the context of the Euler equation model, where the model derived under the null of no financial constraints is rejected in all countries, and strongly rejected in the UK sample[19].

The availability of internal finance appears to have been a more important constraint on company investment in our sample of UK firms than in our samples of continental European firms over the period 1978-89. This finding is consistent with the suggestion that the market-oriented financial system in the UK performs less well in channelling investment funds to firms with profitable investment opportunities than do the continental European financial systems. However we would caution that we have not tested this hypothesis directly, and our results are doubtless consistent with other interpretations. The accounts data available for this study were not as consistent across countries as we would have liked. Moreover, models of financial constraints predict that investment is only constrained when desired investment exceeds the supply of internal finance; it may simply be that our results reflect transient differences in the frequency of this event within our samples, rather than deeper differences in the effects of different financial systems. Discriminating between these alternative interpretations will require more detailed comparative analyses of the investment behaviour of different types of companies across countries; we believe this to be an important challenge for future research.

[19] Previous research using UK data also indicates that this excess sensitivity of investment to cash flow is concentrated among observations on low-dividend paying companies, which is consistent with the presence of relatively severe financial constraints on investment spending for these firms. See Bond and Meghir (1994).

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Table 1: Some basic features of the datasets

	Belgium	**France**	**Germany**	**U.K.**
Size of the Samples (1981-1989)				
Firms	361	1 365	228	571
Observations	2 571	9 485	1 797	4 036
Obs. / Firm	7.12	6.95	7.88	7.07
Employment in 1985				
Mean	777	939	6 944	6 342
Std. Dev.	1 300	3 838	22 215	21 117
Q25	231	180	425	394
Median	399	332	980	983
Q75	732	659	2 991	3 261
Maximum	11 670	91 049	202 200	312 000

Table 2: Means (standard deviations) of variables used in estimation (Period : 1981-1989)

	Belgium	France	Germany	UK
$\left(\frac{I_t}{K_{t-1}}\right)$	0.125 (.107)	0.110 (.089)	0.122 (.079)	0.117 (.110)
Δy_t	0.027 (.145)	0.010 (.125)	0.005 (.143)	0.033 (.177)
$(k-y)_{t-2}$	-0.993 (.612)	-0.926 (.546)	-0.827 (.564)	-0.658 (.499)
$\left(\frac{C_t}{K_{t-1}}\right)$	0.178 (.144)	0.119 (.136)	0.160 (.093)	0.134 (.106)
$\left(\frac{I_{t-1}}{K_{t-1}}\right)$	0.111 (.076)	0.103 (.067)	0.117 (.061)	0.102 (.073)
$\left(\frac{I_{t-1}}{K_{t-1}}\right)^2$	0.018 (.027)	0.015 (.022)	0.017 (.020)	0.016 (.027)
$\left(\frac{\Pi_{t-1}}{K_{t-1}}\right)$	0.239 (.163)	0.222 (.176)	0.218 (.124)	0.198 (.134)
$\left(\frac{Y_{t-1}}{K_{t-1}}\right)$	3.247 (2.195)	2.868 (1.665)	2.578 (1.629)	2.186 (1.260)

Table 3: AR(2) models for I_t/K_{t-1}

OLS levels

	Belgium	France	Germany	UK
ρ_1	0.2994 (.0327)	0.3152 (.0176)	0.3713 (.0398)	0.3283 (.0279)
ρ_2	0.0488 (.0253)	0.1376 (.0126)	0.0511 (.0308)	0.1274 (.0213)

Within Groups

	Belgium	France	Germany	UK
ρ_1	0.1115 (.0333)	0.0998 (.0175)	0.1927 (.0406)	0.1032 (.0271)
ρ_2	-0.1344 (.0272)	-0.0672 (.0130)	-0.1197 (.0318)	-0.0911 (.0231)

GMM first differences, t-2 instruments
(42 moment conditions)

	Belgium	France	Germany	UK
ρ_1	0.2568 (.0467)	0.2043 (.0221)	0.2909 (.0575)	0.1979 (.0482)
ρ_2	-0.0139 (.0343)	0.0226 (.0156)	-0.0347 (.0493)	0.0158 (.0303)
m1	-7.41	-13.29	-6.92	-7.56
m2	0.60	-1.54	-1.07	-2.69
Sargan	0.048	0.691	0.767	0.038

Table 4: Accelerator models

GMM first differences, t-2 instruments
(110 moment conditions)

	Belgium	**France**	**Germany**	**UK**
$\left(\frac{I_{t-1}}{K_{t-2}}\right)$	0.2042	0.1592	0.2349	0.0585
	(.0397)	(.0212)	(.0671)	(.0416)
Δy_t	0.1111	0.1344	-0.0624	0.1456
	(.0718)	(.0501)	(.0411)	(.0658)
Δy_{t-1}	0.0509	0.0153	0.0058	-0.0052
	(.0190)	(.0092)	(.0150)	(.0127)
$\left(\frac{C_t}{K_{t-1}}\right)$	-0.0507	0.0045	0.3024	0.5431
	(.0987)	(.0748)	(.0896)	(.1909)
$\left(\frac{C_{t-1}}{K_{t-2}}\right)$	0.1566	0.1132	-0.0058	0.0654
	(.0612)	(.0334)	(.0461)	(.1395)
m1	-7.29	-13.30	-6.54	-8.16
m2	-0.13	-0.86	-1.87	-1.46
Sargan	0.612	0.298	0.809	0.089

Table 5: Error correction models

GMM first differences, t-2 instruments
(144 moment conditions)

	Belgium	France	Germany	UK
$\left(\frac{I_{t-1}}{K_{t-2}}\right)$	-0.0189	-0.0088	0.0225	-0.0745
	(.0557)	(.0335)	(.0822)	(.0541)
Δy_t	0.1706	0.0971	-0.0018	0.1212
	(.0780)	(.0489)	(.0360)	(.0611)
Δy_{t-1}	0.1972	0.0113	0.0667	-0.0160
	(.0611)	(.0431)	(.0386)	(.0356)
$(k-y)_{t-2}$	-0.2314	-0.1219	-0.1897	-0.1297
	(.0485)	(.0233)	(.0429)	(.0426)
y_{t-2}	-0.0525	-0.1096	-0.1091	-0.1187
	(.0523)	(.0365)	(.0408)	(.0324)
$\left(\frac{C_t}{K_{t-1}}\right)$	-0.0652	-0.0499	0.1301	0.4583
	(.0846)	(.0649)	(.0668)	(.1653)
$\left(\frac{C_{t-1}}{K_{t-2}}\right)$	0.0658	0.0742	-0.0507	-0.0502
	(.0523)	(.0274)	(.0425)	(.1160)
m1	-6.83	-11.66	-6.01	-7.55
m2	-0.09	-1.42	-1.83	-1.44
Sargan	0.488	0.074	0.320	0.386

Table 6: Euler equation models

GMM first differences, t-2 instruments
(149 moment conditions)

	Belgium	**France**	**Germany**	**UK**
$\left(\frac{I}{K}\right)_{t-1}$	0.4260	0.3665	0.3886	0.4344
	(.0920)	(.0399)	(.1112)	(.0790)
$\left(\frac{I}{K}\right)^2_{t-1}$	-0.4664	-0.4652	-0.3281	-0.7154
	(.2482)	(.1069)	(.3059)	(.1972)
$\left(\frac{\Pi}{K}\right)_{t-1}$	0.0084	0.0591	0.0243	0.2141
	(.0322)	(.0123)	(.0314)	(.0409)
$\left(\frac{Y}{K}\right)_{t-1}$	0.0249	0.0091	0.0130	0.0052
	(.0054)	(.0054)	(.0061)	(.0078)
m1	-9.77	-17.91	-8.16	-10.36
m2	0.22	-0.08	-1.71	-1.96
Sargan	0.398	0.349	0.387	0.031

Table 7: Euler equation models

GMM first differences, t-3 instruments
(113 moment conditions)

	Belgium	**France**	**Germany**	**UK**
$\left(\frac{I}{K}\right)_{t-1}$	0.5075	0.6007	0.1290	0.7675
	(.3115)	(.1391)	(.2592)	(.3119)
$\left(\frac{I}{K}\right)^2_{t-1}$	-1.0731	-1.3047	-0.3719	-1.8547
	(.9162)	(.4141)	(.7748)	(.6703)
$\left(\frac{\Pi}{K}\right)_{t-1}$	0.0577	0.0407	0.1025	0.1853
	(.0568)	(.0245)	(.0584)	(.0561)
$\left(\frac{Y}{K}\right)_{t-1}$	0.0249	0.0160	0.0061	0.0045
	(.0076)	(.0053)	(.0068)	(.0102)
m1	-4.78	-8.02	-3.24	-5.11
m2	-0.89	-0.47	-2.57	-1.85
Sargan	0.362	0.246	0.509	0.056

DATA APPENDIX

The company datasets for the four countries are obtained from different sources. For France, we obtain data on large and medium-sized firms from INSEE, which collects them from fiscal sources of the Ministry of Finance. Therefore these French data are the unconsolidated accounts of these corporations. For Belgium, we have access to the unconsolidated balance sheets and income accounts of a selected sample of large and medium-sized Belgian corporations. This sample has been built by the Banque National of Belgium, which collects the data from the Commerce Court. In fact, by law, all Belgian firms must register their annual accounts that are sent to the National Bank of Belgium. These French and Belgian companies need not be stock market quoted, and may include subsidiaries of foreign companies.

The UK sample comprises the consolidated accounts of companies quoted on the London Stock Exchange, which were obtained from Datastream. Finally, the German data has been collected at the University of Bonn. This contains basically all the quoted manufacturing Aktiengesellschaft (AG) corporations for which sufficient years of data were available. These are all quoted firms, but the data available are unconsolidated accounts for these corporations[20].

We use panel data on company accounts covering the period 1978-89, even though for the UK and Germany longer time series were available. All firms have their main activity in the manufacturing sector, and firms with fewer than 100 employees in the first year of observation were excluded. The initial samples of firms which satisfied these requirements were 1473 firms for France, 410 firms for Belgium, 600 firms for the UK and 287 firms for Germany.

We attempted to use variables that are reasonably comparable across countries, even though the national accounting definitions are not precisely the same. The French and Belgian accounts have very similar definitions of the main variables. The UK and German accounts provide more limited information on costs, and the UK accounts report commercial depreciation rather than fiscal depreciation.

The main variables we use are flows of investment, sales, gross operating profits, and cash flow. Investment spending is obtained from the sources and uses of funds account, and not inferred from changes in the balance sheet. We use sales as a proxy for output. For the French and Belgian data, a measure of value added was also available from the accounts. All the flow variables were deflated using output price indices at the sectoral level.

[20]For example Audi, which is an almost wholly owned subsidiary of Volkswagen, nevertheless has a separate listing.

A measure of the stock of capital at current replacement cost $p_t^I K_t$ was estimated from the flow data on investment $p_t^I I_t$ using a standard perpetual inventory method, in a similar way for each sample:

$$p_t^I K_t = (1-\delta)\, p_{t-1}^I K_{t-1} \left(\frac{p_t^I}{p_{t-1}^I}\right) + p_t^I I_t$$

$$\text{where : } \begin{cases} K_t & : \text{Capital Stock} \\ p_t^I & : \text{Price of Investment Goods} \\ I_t & : \text{Real Investment} \\ \delta & : \text{Depreciation rate (8\%)} \end{cases}$$

The starting value was based on the net book value of tangible fixed capital assets in the first observation within our sample period, adjusted for previous years inflation. For France, Belgium and Germany, where the reported net book value of assets subtracts the fiscal depreciation allowed for tax purposes rather than commercial depreciation, we have corrected this measure by taking into account accelerated fiscal depreciation. This correction lowers the value of accumulated depreciation, and thus increases the net book value of assets. Subsequent values were obtained using accounts data on investment and disposals, national price indices for investment goods prices, and a depreciation rate of 8% assumed to be common to all countries.

For France and Belgium, we construct a measure of gross operating profits Π by subtracting the total wage bill from value added. The measure of cash flow C is then computed from gross operating profits by subtracting payments of interest and taxes. This method was not possible for the UK and Germany, because we do not have data on value added. In these cases we computed cash flow by adding back reported depreciation to reported profits (net of interest and taxes). Gross operating profits were then obtained by adding back interest payments and taxes to this measure of cash flow.

After computing the main variables used in the investment models, we have excluded observations where the change in sales suggested that a major merger or acquisition (or disposal) had occurred, since it is not clear that such large adjustments would be well characterised by the usual investment models. We also excluded observations which appeared to contain substantial outliers. Specifically, observations were discarded if the investment rate exceeded one, if real sales increased or decreased by more than a factor of three, or if the observed ratio of either sales, gross operating profits or cash flow to the capital stock fell in the first or the last centile of the empirical distribution for each country. In these cases we retained the longest available time series of consecutive annual observations for the firms affected. We also required that at least six consecutive annual observations were available for the firms included in our final samples. These criteria resulted in a loss of respectively 7.3%, 11.9%, 5.0% and 21.3% of our initial observations for France, Belgium, the U.K. and Germany.

RESULTS APPENDIX

Table A1: Accelerator and error correction models

GMM first differences, t-2 instruments

	France Large Firms		France Independent		Germany Consolidated	
Firms	234		437		87	
Observations	1 440		2981		520	
$\left(\frac{I_{t-1}}{K_{t-2}}\right)$	0.1435	-0.0054	0.2003	-0.0994	0.0948	-0.1699
	(.0695)	(.0650)	(.0358)	(.0663)	(.0557)	(.1082)
Δy_t	0.1776	0.1593	0.1276	0.0749	-0.1260	-0.0545
	(.0528)	(.0613)	(.0575)	(.0477)	(.0556)	(.0609)
Δy_{t-1}	-0.0419	-0.0198	0.0468	0.0603	0.0307	0.0452
	(.0223)	(.0458)	(.0146)	(.0645)	(.0333)	(.0555)
$(k-y)_{t-2}$	-	-0.1141	-	-0.2176	-	-0.2457
		(.0322)		(.0488)		(.0989)
y_{t-2}	-	-0.0798	-	-0.1649	-	-0.1881
		(.0388)		(.0488)		(.0764)
$\left(\frac{C_t}{K_{t-1}}\right)$	-0.0260	-0.0423	-0.1076	-0.0700	0.4398	0.2874
	(.0706)	(.0678)	(.0919)	(.0691)	(.1632)	(.1605)
$\left(\frac{C_{t-1}}{K_{t-2}}\right)$	0.1194	0.1033	0.1489	0.0311	-0.1408	-0.1392
	(.0533)	(.0497)	(.0420)	(.0372)	(.0900)	(.0714)
m1	-4.98	-4.88	-8.11	-6.74	-4.08	-2.90
m2	0.79	0.75	0.03	-0.45	1.03	0.26
Sargan	0.571	0.266	0.443	0.375	0.573	0.763

Table A2: Euler equation models

GMM first differences

	France Large Firms		France Independent		Germany Consolidated	
	t-2 inst.	t-3 inst.	t-2 inst.	t-3 inst.	t-2 inst.	t-3 inst.
$\left(\frac{I}{K}\right)_{t-1}$	0.5671	0.8442	0.3111	0.2122	0.3154	0.2023
	(.0923)	(.2490)	(.0646)	(.2075)	(.1147)	(.2231)
$\left(\frac{I}{K}\right)^2_{t-1}$	-0.8531	-1.6807	-0.4056	-0.2488	-0.6039	-0.5380
	(.2476)	(.8020)	(.1907)	(.6583)	(.2350)	(.5919)
$\left(\frac{\Pi}{K}\right)_{t-1}$	0.0946	0.0551	0.0540	0.0701	-0.1063	-0.0808
	(.0246)	(.0371)	(.0193)	(.0426)	(.0605)	(.0768)
$\left(\frac{Y}{K}\right)_{t-1}$	-0.0056	-0.0010	0.0134	0.0165	0.0313	0.0391
	(.0046)	(.0086)	(.0053)	(.0089)	(.0111)	(.0122)
m1	-6.91	-4.63	-10.62	-5.51	-4.92	-3.65
m2	1.53	0.97	-0.36	-0.57	0.17	-0.28
Sargan	0.399	0.698	0.192	0.093	0.833	0.481