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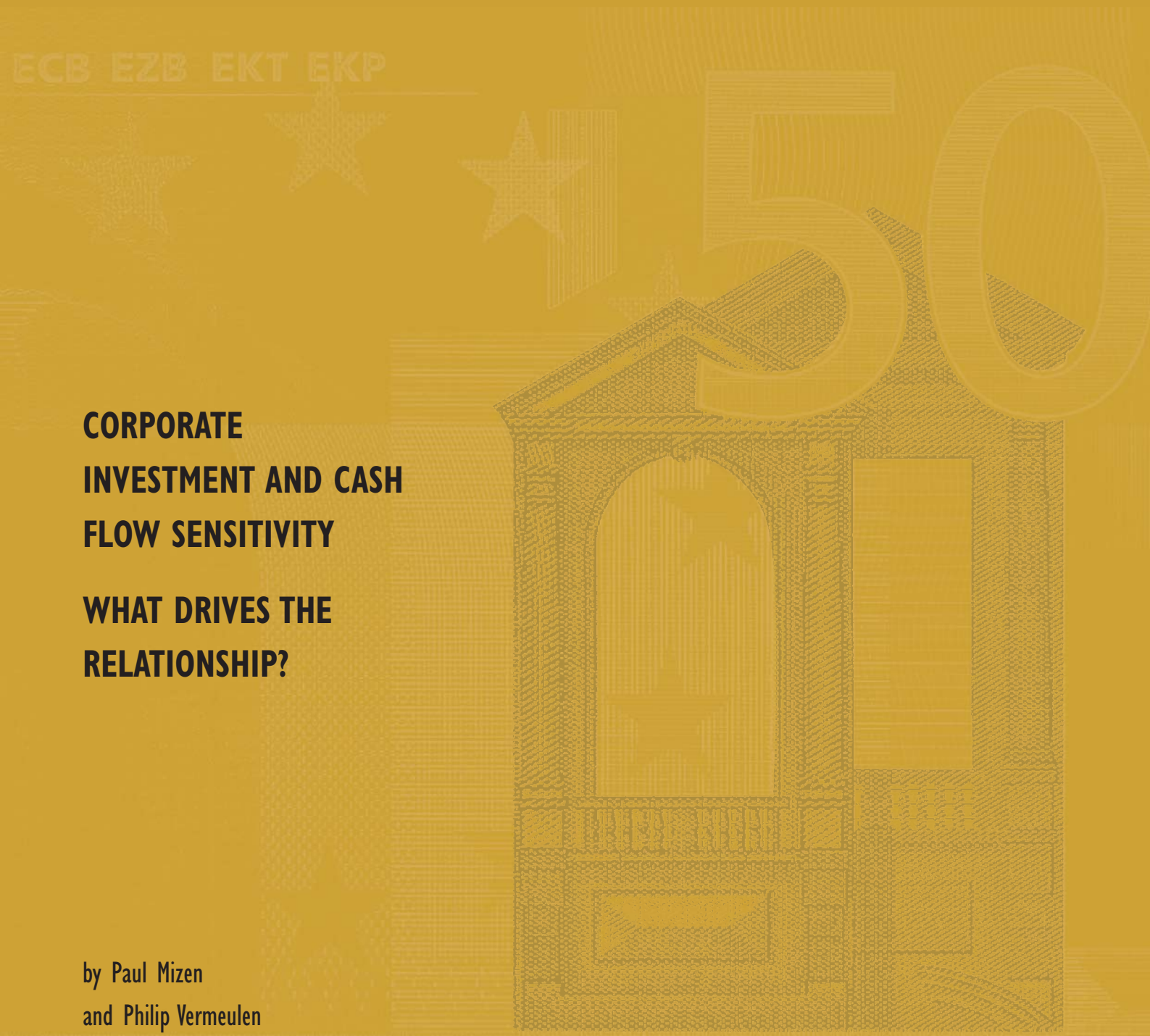

CORPORATE INVESTMENT AND CASH FLOW SENSITIVITY

WHAT DRIVES THE RELATIONSHIP?

by Paul Mizen

and Philip Vermeulen

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In 2005 all ECB publications will feature a motif taken from the €50 banknote.

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Abstract

The excess sensitivity of investment to cash flow has been demonstrated in numerous studies. Recent research has identified differences in the degree of sensitivity *across* countries, which it ascribes to the nature of the lender-borrower relationship in the financial systems of those countries. In this paper we offer new methods and results to determine whether differences are associated with structural explanations such as the nature of the financial system and industrial composition, or due to other firm-specific determinants such as size or creditworthiness. Unlike previous research we are able to systematically control for competing explanations in our data from more than one country and thereby isolate what drives the relationship. We find that creditworthiness is the main driving force of cash flow sensitivity.

Key words: corporate investment, cash flow sensitivity, cross-country investment studies

JEL: E22, D92

Non-technical summary

In the vast literature on the relationship between cash flow and investment all but a few papers are based on sample-splitting between constrained and unconstrained firms taken from a single country. Recent evidence provided in Bond et al. (2003) and Chatelain et al. (2003) does make a comparison between cash flow sensitivity of investment in a range of European countries. Bond et al. (2003) shows investment of UK firms to be *more* sensitive to cash flow fluctuations than the investment of firms in other European countries, but most notably Germany. This paper seeks to explain why the the degree of sensitivity in the UK appears to be greater than that of Germany. This paper extends the literature by examining from a number of perspectives the behaviour of firms in these two European countries that are regarded as polar cases of predominantly market-financed and bank-financed systems .

The paper proposes several hypotheses that are explored in turn. A first possible reason is that firms in market-oriented financial systems show greater sensitivity to cash flow because borrowers and lenders operate at arms length compared to those in relationship-oriented systems. A second possible cause for differences in response to cash flow across countries is that the samples of firms taken from each country might differ in composition with respect to particular characteristics, for instance size. Equally, the industrial type may be an important determinant of investment sensitivity to cash flow since industries differ considerably in terms of the size of firms, capital-intensity, borrowing capacity, openness and the durability of their output.

In this paper we use samples of firms derived from the AMADEUS database from Germany and the UK to investigate whether financial system, firm size, or industrial structure are possible driving determinants of the investment cash flow sensitivity. These can be seen as possible structural determinants of financing constraints but even if we find that one of these determinants is driving cash flow sensitivity it is not sufficient to infer that these are causal. A likely non-structural cause of responsiveness to cash flow is the general creditworthiness of firms and this might be correlated with size and industry. However this correlation will vary over time and between countries at a given point in time.

Our findings on the possible determinants are as follows. First, we confirm the result of Bond et al. (2003) where cash flow sensitivities are more pronounced in market-oriented financial systems, i.e. we find that in the full samples of corporate data for the UK and Germany, the UK firms are more sensitive. But these results are sensitive to sample composition, since the result obtained in the full sample is *not* found when the samples are closely-matched to ensure that firms have comparable size and industrial classifications. We conclude that financial system is not the determinant of cash flow sensitivity. Second, we do not find firms' size to be a determinant of cash flow sensitivity either in Germany or in the UK. Third, we find evidence that industrial characteristics are determinants of sensitivity in the UK but not in Germany. When investigating the economic performance we find that those industries with the weakest performance in the UK are most sensitive to cash flow. We conclude that the nature of the industry is important, but not in a purely structural sense, since it is the creditworthiness industry-by-industry that determines the availability of external finance and the sensitivity to cash flow. Ultimately we conclude that creditworthiness on a range of measurable criteria is the driving force of the investment cash flow sensitivity irrespective of the country of origin of the firms concerned .

1 Introduction

There is a large literature that identifies an influence of financial market imperfections on corporate investment and economic fluctuations. Beginning with Fazzari et al. (1988), this literature has documented the effects of asymmetric information on access to external finance, and has shown that firms that are identified *a priori* as financially constrained show greater sensitivity in investment to the availability of internal finance proxied by cash flow. The sensitivity of financially constrained firms to internal sources of finance offers support for the broad credit channel of monetary policy.

Most of these results are based on sample-splitting between constrained and unconstrained firms taken from the same country, but more recently evidence has been gathered on investment sensitivity to cash flow across a range of countries. For example, in a recent comparative study between firms in Belgium, France, Germany and the UK, Bond et al. (2003) present evidence that the investment of UK firms is *more* sensitive to cash flow fluctuations than the investment of firms in the three continental European countries. However, not all of these countries showed the same degree of sensitivity in corporate investment to cash flow variables (as we might have expected if the broad credit channel affected financially constrained firms in each of the countries in exactly the same way), so the focus of attention has necessarily shifted to ascertain the reason for the differences in the response to cash flow between countries.[1]

A first possible reason why the broad credit channel appears to be more powerful in some countries than in others is that the financial systems deal differently with the asymmetric information problem. It is possible that firms in market-oriented financial systems show greater sensitivity to cash flow because borrowers and lenders operate at arms length compared to relationship-oriented systems. For example, Allen and Gale (2000) indicate that Germany and the UK, which show different sensitivities to cash flow in the study by Bond et al. (2003), are on opposite sides of the financial spectrum. In the UK, equity market capitalisation as a percentage of GDP is far higher than in Germany, and corporate control is exercised by the financial markets rather than banks, in contrast to Germany. The financial system argument proposes that the arrangement of financial systems is responsible for the differences in the importance of the broad lending channel relationships across countries and this results in differences in the estimated relationships between investment and cash flow[2].

[1] Mairesse and Dormont (1985) provide a comparative investment analysis for the period 1970-79 using French, German and US large manufacturing firms. They find relatively similar investment behaviour in the different countries.

[2] While identifying the key differences between financial systems, Allen and Gale (2000) do not go so far as to assert that this is the reason for differences in cash flow sensitivity. In fact they argue that "*Given the importance of internal finance in most countries, it could be argued that institutional differences in the financial system are immaterial. This is one of the fundamental questions posed in comparing financial systems.* "

Bond et al. (2003) take the financial system to be an important consideration in explaining cross-country differences in cash flow sensitivity, although they are careful to state that other factors might be the cause of the differences, and state that more research is needed.

A second possible cause for differences in response to cash flow across countries is that the samples of firms taken from each country might differ in composition with respect to characteristics such as firm size. Firm size has been regarded as an important determinant of financial constraints in studies of the credit channel within countries (Gertler and Gilchrist, 1994, Oliner and Rudebusch, 1996, Vermeulen 2002) and may explain differences between countries. However it is not easy to determine whether firms are financially constrained because they are small, or small because they are financially constrained. Moreover, the ultimate cause of the differing sensitivities to monetary policy may reflect deeper underlying effects associated with, for example, the industrial type and its cyclical nature (Eichenbaum, 1994). Size is correlated with other characteristics that indicate firms are less likely to obtain external finance because small firms are often young, poorly collateralized and risky.

A third possible cause for sensitivity differences is that samples across countries might differ in industrial structure. A recent line of research suggests that differences in industry characteristics are important determinants of investment sensitivity to cash flow. Ganley and Salmon (1997), Hayo and Uhlenbrock (2000), Dedola and Lippi (2004), and Peersman and Smets (2004) have found that industries differ considerably in terms of the size of firms, capital-intensity, borrowing capacity (defined by leverage and size), openness and the durability of their output, and these have a significant effect on their financing and investment behavior. These differences between industries are powerful enough to dominate the differences between countries according to Dedola and Lippi (2004) and Peersman and Smets (2004).

In this paper we use samples of firms derived from the AMADEUS database from Germany and the UK to investigate whether financial system, firm size, or industrial structure are possible driving determinants of the investment cash flow sensitivity. These can be seen as possible structural determinants of financing constraints in the sense that they are semi-permanent features specific to each economy. However, even if we find that one (or possibly more than one) of these determinants is driving cash flow sensitivity it is not sufficient to infer that these are causal. A likely non-structural cause of responsiveness to cash flow is the creditworthiness of firms and this might be correlated with size and industry. However this correlation will vary over time and between countries at a given point in time. Some industries (firm size classes) might have healthy balance sheets at certain times, but weak ones at other times. A finding, in a given sample, that some industries are more sensitive than others is therefore not sufficient evidence in favor of industry as a determinant of financing constraints. The comparison between the UK and Germany gives us a means to identifying whether the true underlying cause of cash flow sensitivity is due to structural or non-structural determinants.

We first investigate whether the financial system is a determinant of financing constraints in the sense discussed above. If this is the case we should find that German firms are less sensitive than UK firms, *controlling* for size and industry. We then investigate whether size or industry are determinants, irrespective of creditworthiness. If these are determinants we should find that the cash flow sensitivity differences across size classes or across industry groupings are similar for Germany and the UK. Essentially, if size and industry characteristics are structural determinants of cash flow sensitivity then these properties should be found in *both* the UK and in Germany when comparing similar size and industry classes. We finally check if creditworthiness might be at the core of the differences we find.

Our findings on the possible determinants are as follows. First, we confirm the result of Bond et al. (2003) where cash flow sensitivities are more pronounced in market-oriented financial systems, i.e. we find that in the full samples of corporate data for the UK and Germany, the UK firms are more sensitive. But these results are sensitive to sample composition, since the result obtained in the full sample is *not* found when the samples are closely-matched to ensure that firms have comparable size and industrial classifications. We conclude that financial structure is not an important determinant of cash flow sensitivity. Second, we do not find firms' size to be a determinant of cash flow sensitivity either in Germany or in the UK. Third, we find evidence that industrial characteristics are determinants of sensitivity in the UK but not in Germany. When investigating the economic performance we find that those industries with the weakest performance in the UK are most sensitive to cash flow. We conclude that the nature of the industry is important, but not in a purely structural sense, since it is the creditworthiness industry-by-industry that determines the availability of external finance and the sensitivity to cash flow. Ultimately we conclude that creditworthiness is the driving force of the investment cash flow sensitivity.

The next section discusses the background issues in the literature. In section 3 we discuss our methodology for discriminating between the driving factors in the relationship between corporate investment and financial constraints. Section 4 describes our data sources and then the results are reported in section 5.

2 Literature

2.1 Investment and cash flow sensitivity

There is a large literature that estimates the impact of financial constraints on the investment behavior of firms beginning with the seminal article by Fazzari, Hubbard and Petersen (1988). They classify firms according to whether they were likely to be financially constrained on the basis of their size, dividend payouts and capital structure and this characteristic determines whether they are more sensitive to the supply of internal funds measured by cash flow. The highest sensitivities to cash flow are found for firms categorized as financially constrained, and this is taken to indicate that financial constraints are binding in this case. Many further studies have followed the same methodology including Chirinko and Schaller (1995), Hubbard et al. (1995), Calomiris and Hubbard (1995), as summarized by Hubbard (1998).

More recently the literature has raised several new objections to this approach. Kaplan and Zingales (1997, 2000) have argued that the classification adopted by Fazzari et al. (1988) tends to assign firms incorrectly. They make use of more detailed information in financial statements from annual reports to classify the same firms over an identical sample period into three categories 'financially constrained', 'possibly financially constrained' and 'not financially constrained'. Using this classification they find that financially constrained firms have the *lowest* sensitivity of investment to cash flow. On a larger dataset Cleary (1999) also finds that the most constrained firms have the lowest sensitivity. Recently, Allayannis and Mozumdar (2004) show that the findings of Kaplan and Zingales (1997) can be explained by a few influential observations whereas the results of Cleary (1999) can be explained by observations of firms with negative cash flows. One of the main messages of the work by Kaplan and Zingales and Clearly is that for firms under distress the cash flow sensitivity might be reduced, so that for severely constrained firms the usual relationship found in the literature might be reversed. We think that one of the more important reasons to be cautious in interpreting cash flow sensitivity as indicating financing constraints is that cash flow might forecast future profitability or sales growth. We check for this possibility, but as in Bond et al. (2003), our results indicate that it is not an important problem in our sample.

2.2 Cash flow sensitivity and the financial system

The financial system of a country dictates how the common problem of asymmetric information will be handled. The idea that the financial system has an important role to play in economic fluctuations, and investment in particular, is an old one. (See Gertler (1988) for an overview.) Market-oriented financial systems where arms-length lenders offer funds through commercial paper, corporate bond and equity markets are more likely to show greater sensitivity to cash flow. Relationship-oriented systems are likely to foster closer and more transparent arrangements that allow them to exercise greater scrutiny over borrowers, and as a result investors will be less sensitive to internal sources of funds. An excellent discussion of the principal differences between the two structures is given in Rajan and Zingales (2003). The evidence in Allen and Gale (2000) indicates that Germany and the UK, are good examples of the polar cases on the wide spectrum of financial systems in Europe. In the UK, market capitalisation as a percentage of GDP is some three times that of Germany, and corporate control is exercised by the financial markets rather than banks, in contrast to Germany. Nevertheless bond markets are much less well developed in Germany and the UK versus the US. Although firms in both countries rely heavily on internal funds, and the development of market finance has been significant in the period 1995- 2004 even in Germany (c.f. Rajan and Zingales, 2003), the impact of these systems could affect the sensitivity of investment to cash flow. Analysis of these economies to internal funds at the margin is expected to show investment will be more sensitive to internal funds (cash

flow) for countries where the financial system is relatively market-based, and vice versa, if the financial system is the driving force behind the importance of cash flow. Bond et al. (2003) offer one of the few comparative studies of the impact of cash flow on investment across several countries with different financial systems. Their results are based on estimates of investment equations for four European countries (Belgium, France, Germany, and the United Kingdom), and offer some support for differences between countries that are more market-oriented (United Kingdom) or relationship-oriented (Germany). They are quick to acknowledge, however, that other factors may have an important role to play.

2.3 Cash flow sensitivity and size

Firm size has been used as an indicator of access to external finance (Gertler and Gilchrist, 1994). In addition small firms are generally younger, with higher levels of firm-specific risk, and less collateral, making them less likely to attract external finance. The evidence suggests that small firms are more sensitive to monetary policy tightening than larger firms. Gertler and Gilchrist (1994) document that indicators of monetary tightening such as Romer dates are highly significant explanatory variables in time series estimates of small firms' sales, inventory accumulation and short-term debt, in direct contrast to estimates for large firms[3]. Gilchrist and Himmelberg (1995) find excess sensitivity for small firms, and those with out a bond rating or commercial paper issue in their sample. According to Schaller (1993) small firms and those that do not belong to a corporate group in Canada are more sensitive to cash flow than others. However not all evidence on size goes in the same direction. In their seminal study Fazzari, Hubbard and Petersen (1988) point out that when they split samples according to size, small firms have relatively low cash flow coefficients. Also, Hu and Schiantarelli (1998) find that larger firms are more likely to be financially constrained . They explain their result by arguing that (at least in their sample of listed firms) firm size may be inversely related to concentration of ownership, which tends to mitigate agency problems. On the basis of a formal framework that relates theory to empirical investment models, Chirinko (1997) argues that firm size (and retention behavior) are not appropriate criteria for identifying financially constrained firms.

One has to be careful in projecting the results obtained on US data to European firms. In the US studies, the larger firms are quite different from the small firms in that the large firms have access to bond markets and the commercial paper market. The split really selects firms into those that obtain external finance from banks versus those that obtain external finance from the markets. In contrast, in Germany and the UK, bond markets and commercial paper markets are much less developed than in the US implying that a large-small firm sample split is less likely to generate a partition between bank versus market financed firms. Rather both

[3] Although there are statistically significant differences in the response to monetary policy in relation to firm size, and this has been strongly associated with financial constraints, it is difficult to be sure about the direction of causation. (Eichenbaum, 1994)

small and large firms will be mostly (even exclusively) bank financed. In a cross country study of Germany, France, Italy and Spain, Chatelain et al. (2003) find a significant larger effect of cash flow for smaller firms only in the Italian case. So *a priori* from the above studies it is difficult to argue that small firms are necessarily more likely to face financing constraints in the UK and Germany compared to large firms.

2.4 Cash flow sensitivity and industrial structure

In a study of the regional effects of monetary policy, Carlino and DeFina (1998) show that there are some significant deviations from the average US response to monetary policy changes over the period 1958-1992 at the regional level. They argue that one potential explanation for the differences in regional response to the federal funds rate is the different industrial composition of the regions. Manufacturing industry intensive states are more sensitive to monetary policy shocks than states with a greater diversity of industries, and states with greater numbers of small firms also are marginally more sensitive.

A new literature has taken up this theme making use of industrial characteristics to determine whether these features are responsible for differences in the output response to monetary policy between countries. Barth and Ramey (2000) have linked the differential effects of monetary policy shocks to the impact of 'cost' and 'demand' influences in monetary transmission, which are connected to the exposure of particular types of industries to these influences.

Dedola and Lippi (2004) and Peersman and Smets (2004) have shown that industries with characteristics such as greater investment intensity, openness and more durable goods are more likely to show greater sensitivity to changing monetary policy because their 'cost side is more sensitive to the real cost of capital'. These industries are more interest sensitive than others, enhancing the impact of the interest channel of monetary policy on the output cycle. They also argue that industries that have greater difficulty in accessing financial markets, with higher working capital requirements and greater borrowing capacity (as measured by size and leverage) could be more prone to the broad credit channel effects of monetary transmission. The output response is reported from a structural VAR framework for 20 industries in five OECD countries by Dedola and Lippi (2004) and from a single-equation autoregression of output growth for 74 industries in the euro area countries by Peersman and Smets (2004). Differences in the policy effects by industry are shown to be explained primarily by particular industry characteristics such as durability, openness and capital intensity of production.

2.5 Cash flow sensitivity and creditworthiness

Differences in cash flow sensitivities by size and industry classes can ultimately be caused by differences in creditworthiness by firms. Hu and Schiantarelli (1998) find that firms with weaker balance sheets are more likely constrained. Clearly (1999) finds that profitability and

sales growth are the two most important variables in a discriminant analysis used to select firms that increase or decrease dividends (which he interprets as reflecting the absence or presence of financing constraints). We examine whether these indicators of creditworthiness are correlated with sensitivity to cash flow in our industry and size classes. In other words, we determine whether there are some industries or some firm classes that are more sensitive to cash flow than others (even if they are the same industries in different countries) because their poor performance on these criteria makes them more reliant on internal finance for investment at the margin.

We do not espouse any one model in this paper, rather we approach each literature from an agnostic point of view. The paper devises sample-splitting and sample-matching methods to determine whether the predictions of each literature can be supported empirically. By evaluating the models for more than one country and making comparisons between them we hope to shed more light on the underlying reasons for cash flow sensitivity in investment equations. The next section explains our methodology in detail.

3 Methodology

3.1 Investment equation

Mairesse et al. (1999) and Bond et al. (2003) are two recent cross-country investment studies. We follow their methodology[4] and model investment in a flexible error correction model. For a neoclassical profit-maximizing firm with a CES production function and no adjustment costs the capital stock is proportional to output,

$$k_{i,t} = \rho y_{i,t} + h_{it} \tag{1}$$

with $k_{i,t}$and $y_{i,t}$ the log of the capital stock and the log of output. h_{it} is a function of the user cost.

Assuming that the capital stock in the presence of adjustment costs evolves as an ADL(2,2) model, equation 1 can be embedded as the long run solution and can be re-written in an error correction format (see Bean, 1981) and assuming the change in the capital stock can be approximated by investment over previous capital stock less depreciation, $\Delta k_{i,t} \approx \frac{I_{i,t}}{K_{i,t-1}} - \delta$ we can write in panel data format:

$$\frac{I_{i,t}}{K_{i,t-1}} = \gamma_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \gamma_2 \Delta y_{i,t} + \gamma_3 \Delta y_{i,t-1} + \theta(k_{i,t-2} - y_{i,t-2}) + \phi_1 \frac{cf_{it}}{K_{it-1}} + \phi_2 \frac{cf_{it-1}}{K_{it-2}} + d_t + \eta_i + \nu_{i,t}. \tag{2}$$

[4]When estimating an Euler specification for data from a range of European countries, Bond et al. (2003) indicate that the model is 'seriously mispecified' and offer a distinctly lukewarm discussion of its performance. We therefore focus solely on the error correction model.

The adjustment costs reflect the sluggish adjustment of capital stock and rest on a proportional adjustment argument forwarded by Caballero, Engel and Haltiwanger (1995), which states that desired capital stock in the presence of adjustment costs is proportional to the desired capital stock in the absence of adjustment costs. The variation in the user cost is controlled for by firm specific effects and time dummies. The importance of financial constraints in this model can be ascertained by including cash flow scaled by capital, as a measure of the supply of internal funds, in the regression. We estimate the above equation using first-difference GMM (Arrelano and Bond, 1991). We use the lagged variables in levels as instruments for the first differences of the regressors. We use the Sargan-test of overidentifying restrictions as a joint test of model specification and instrument selection. We also report the m1 and m2 test of serial correlation of the first differenced residuals. Both the m1 and m2 test are asymptotically standard normal under the null of no serial correlation in $\nu_{i,t}$.

3.2 Sampling procedure

Comparisons between countries can reasonably be expected to give different magnitudes to the coefficients even if the investment behavior of firms in each country is driven by the same fundamental processes, but determining the root cause of these differences is not straightforward. The previous section has indicated that differences in financial systems, size and industrial structure are potential explanations for response to financial constraints across countries. Unless we use methods that can isolate a single explanation by controlling for the others it will be difficult (if not impossible) to resolve the question of what drives the relationship between financial constraints and corporate investment. In this section we propose two methods based on matching and sample-splitting to construct specially selected samples of data taken from corporate accounts in Germany and the United Kingdom to evaluate each of the competing explanations of the sensitivity of investment to cash flow.

The first method seeks to control for size and industrial features in the samples from each country that could be responsible for the different sensitivities to cash flow between countries. Comparisons of investment sensitivity to cash flow are typically drawn from the population of firms from each country without a designated sampling criterion. The samples are constructed by randomly drawing firms from the population of each country, but where there are size or industrial characteristics that differ between the populations of each country, random sampling will reflect these characteristics in the respective samples. It is possible that the different sensitivities to cash flow in investment equations are a reflection of these features in each country and not necessarily due to the influence of financial system. Only in the exceptional cases where the sample is very large or the composition uniform in both countries, could random sampling draw firm conclusions that differences in sensitivity are due to the financial system argument and not one of the competing views.

Conclusions drawn over the importance of financial system on investment may prove fragile if sample-specific features in the size of firms or industrial structure are responsible

for differences in the response of investment to financial constraints in each country. To draw robust conclusions about investment activity in different countries in relation to their financial structure we argue that steps should be taken to properly match firms in each country within the panel before making comparisons between them. While this will inevitably lead to a smaller panel of usable firms, the results are likely to be more reliable as a comparison of investment activity under financial constraints between countries.

Our first method recognizes the importance of matching the firms in the panel by selecting firm pairs from Germany and the UK to construct closely-matched samples. This ensures that our firms have common NACE codes for industrial classification and similar sizes. These closely-matched samples only include those German firms that have a close match with a UK firm and vice versa. We are able to determine whether the differences in the results between the UK and Germany in the random samples are an artefact of the composition by comparing them with the results of the closely-matched sample, and these results are reported in the next section. We then address the question whether investment is more or less sensitive to cash flow in the UK compared to Germany. If the financial structure argument is correct then the significance of the cash flow variable in 'market-oriented' as opposed to 'relationship-oriented' economies will indicate that financial constraints bind even when we control for the selection of firms. If the sample composition is responsible for the differences between the UK and Germany we should find no differences in sensitivity for the sample that has been closely-matched for firm type but clear differences between the random samples.

Our second method controls for sample characteristics - such as size and industrial structure - that might be responsible for differences in the sensitivity of investment to cash flow in each country. When we consider the influence of size we take into account factors such as absolute and relative size of the firm, where the level of sales indicates absolute size, and relative sales i.e. sales compared to the other firms in the same industry reflects relative size (because firms may be large in relation to the average for their industry without being large in an absolute sense). Small firms have long been regarded as more financially constrained than large firms (c.f. Gertler and Gilchrist, 1994, Gilchrist and Himmelberg, 1995) and by controlling for this characteristic we can determine whether it is the proportion of small firms versus large firms in each country sample that is responsible for the sensitivity to cash flow.

When we consider the influence of industrial structure we control for the nature of the industry that might cause the firms to be more sensitive to cash flow. The literature has indicated that intermediate producers might be more sensitive to cash flow than final goods producers due to the scale and duration of their investment projects. Likewise firms that operate in more closed industries that have less import competition or are more domestically oriented may also be more sensitive to financial constraints than firms in more open industries. We control for these features across countries to evaluate whether these criteria are responsible for the different sensitivities of investment to cash flow between countries.

If one of these features is responsible for the excess sensitivity of corporate investment to cash flow then samples selected to include and exclude these features should show the same degree of sensitivity irrespective of the country from which they were drawn. For example, if size or openness is the characteristic that determines excess sensitivity of investment to cash flow then both German and UK firms that are smaller than the average or less open should show excess sensitivity, and larger than average firms or those in more open industries should show less sensitivity. This may confirm that size or industrial grouping is responsible for the sensitivity to cash flow, as opposed to the nature of the financial system.

4 Results

4.1 Data

Our data are taken from the AMADEUS database. We only use variables that are comparable across countries such as the capital stock, investment, sales and cash flow and these are taken from balance sheets for manufacturing firms. The details of how these variables were constructed are described in the Appendix. From this database we first construct two full samples: a sample of German firms and a sample of UK firms. We clean by dropping the 1 % outliers from the investment to capital ratio, cash flow to capital ratio, and the error correction term. We have a consecutive run of at least five observations for each firm over the period 1993-99.

After cleaning, the full samples of British and the German firms contain 2103 firm-year observations from 378 UK firms and 804 firm-year observations from 145 German firms. The summary statistics are given in Table 1. The full German and UK samples do not differ much *between* countries in terms of average investment $(I_t/K_{t-1,})$, sales growth (Δy_t) and cash flow to capital ratio (CF_t/K_{t-1}). Although the average German firm in our sample is much larger than the average UK firm when measured by sales. There is a large dispersion within both samples in terms of size.[5]

As is quite usual with firm panel data, firms *within* each country tend to show more substantial differences compared to the averages across countries in terms of the level of investment, sales growth and the cash flow-to-capital ratio. The relative variation is of the same order in Germany as in the UK. On the basis of these summary statistics used in the investment regressions the two samples look very similar and it would be hard to predict that the investment regressions would differ across countries.

[5] The main reason for the smaller average of sales in the UK is the presence of many more smaller firms. Our use of consolidated accounts limits us in the selection of German firms. Consolidation is common in the UK among all firms, in Germany only the larger ones consolidate.

Table 1 - Summary statistics of full samples

	Germany			UK		
	mean (st.dev.)	min	max	mean (st.dev.)	min	max
I_t/K_{t-1}	0.16 (0.14)	-0.35	0.94	0.14 (0.17)	-0.83	0.99
Δy_t	0.04 (0.11)	-0.68	0.60	0.03 (0.16)	-1.01	0.95
CF_t/K_{t-1}	0.23 (0.23)	-0.24	2.04	0.22 (0.22)	-0.50	1.82
$(k-y)_{t-2}$	-1.05 (.49)	-2.57	0.13	-1.12 (.63)	-3.22	0.68
sales (£m)	1550 (4470)	15.6	44900	241 (814)	7.1	8720
N. Obs.	804			2103		
N. firms	145			378		

Sales are in millions of pounds sterling at 1995 prices.
German sales are converted to pounds sterling using DM2.63 = £1

4.2 Results from full sample of UK and German firms

In this section we report the estimates of an error correction model using full samples of data from the UK and Germany. These are reported in Table 2. The Sargan p-value and the m1 and m2 statistics indicate that the model is well specified both for Germany and the UK. There is a positive and significant influence from current and lagged sales growth in Germany and from current sales growth in the UK. The error correction term is significant and of the right sign in Germany, while it is insignificant in the UK. Cash flow has a positive and significant effect on investment in the UK, while in Germany cash flow is not significant. Interestingly, in a comparative study by the European System of Central Banks, using more than 5000 observation for Germany, Chatelain et al. (2003) find that none of the four cash flow terms is significant using an autoregressive distributed lag for investment. We find some similarities in the qualitative results between our error correction model for investment in the 1990s and the same model of Bond et al. (2003) for the 1980s, although the magnitude of the coefficients in the 1990s is substantially higher than the 1980s. Nevertheless, Bond et al. (2003) do find some small positive significant effect (albeit smaller than the UK) of cash flow in Germany.

Cummins et al. (1999) and Bond and Cummins (2001) show that the inclusion of earnings data from securities analysts as an indicator of returns to investment results in a much reduced correlation between investment and cash flow. This suggests that there is a possibility that cash flow is a proxy for information on earnings in the investment equation. Gilchrist and Himmelberg (1995) also indicate that if cash flow is a proxy for future earnings, sales or profitability we may not be measuring the sensitivity to internal finance at all. Since cash flow could be a proxy for other determinants of investment such as future sales growth or expected profitability that are not captured by current and past sales growth we investigate the possibility that cash flow may forecast future sales growth. The hypothesis that cash flow predicts future sales growth can be tested directly by creating forecast equations for sales. Bond et al. (2003) have found cash flow does help predict sales growth in three of their

four countries, but there are no noticeable differences in the explanatory power between the countries (as we would expect if the omitted variable argument were true). In our study, cash flow is marginally significant in the sales growth equation for Germany, but cash flow did not appear to be important to corporate investment in Germany. There is no evidence that cash flow helps predict future sales growth in the UK where cash flow was an important determinant of investment.[6]

Our results from the full sample indicate that there are systematic differences between cash flow sensitivity in Germany and the UK. One conclusion we could draw is that the UK financial system is less able to resolve asymmetric information problems and this creates greater sensitivity to cash flow as a result. There are however competing arguments that we would need to assess before we could draw this conclusion. The difference in cash flow sensitivity could be caused by differences in absolute or relative firm sizes across countries since UK firms are typically smaller on average than the German firms. If smaller firms are more financially constrained, then the UK firms would show higher cash flow sensitivity than larger German firms because of their size, irrespective of the fact that financial systems are different. Another possibility is that the difference could be a reflection of industrial structure, particularly if certain industrial sectors with greater investment intensity face more exposure to changes in monetary policy through interest and credit channels in the UK than in Germany. Just as size could be responsible for the increased sensitivity of firms in one country (the UK) compared to another (Germany), so industrial features could also be the driving force. Finally, the creditworthiness of (at least some firms in the UK sample) could cause a higher sensitivity for the UK sample. The next section tests these possible explanations of the cash flow sensitivity of investment discovered in the full samples. These are based on industrial structure and size using appropriately constructed samples drawn from the UK and Germany to control for the competing views.

[6] In all our subsequent regressions for matched samples and split-samples we ran regressions to determine whether cash flow was a predictor of future sales growth. We have not reported these results in the paper but in all cases we found that there was no explanatory power. Details are available from the authors on request.

Table 2 - Investment and cash flow sensitivity (full sample)

Dependent variable I_t/K_{t-1}	Full Sample	
	Germany	U.K.
I_{t-1}/K_{t-2}	-0.51 (0.13)**	-0.24 (0.11)*
Δy_t	0.60 (0.17)**	0.67 (0.17)**
Δy_{t-1}	0.62 (0.14)**	0.15 (0.12)
$(k-y)_{t-2}$	-0.59 (0.15)**	-0.16 (0.11)
CF_t/K_{t-1}	-0.15 (0.16)	-0.02 (0.16)
CF_{t-1}/K_{t-2}	-0.23 (0.12)	0.28 (0.09)**
$m1$	-3.98	-6.07
$m2$	-0.69	0.14
Sargan p-value	0.64	0.65
N obs	490	1230
N firms	145	378
Dependent variable Δy_t		
I_{t-1}/K_{t-2}	0.17 (0.43)**	0.17 (0.03)**
I_{t-2}/K_{t-3}	0.06 (0.04)	-0.02 (0.03)
Δy_{t-1}	0.07 (0.06)	0.18 (0.03)
Δy_{t-2}	-0.01 (0.05)	0.03 (0.03)
CF_{t-1}/K_{t-2}	0.12 (0.05)*	0.02 (0.03)
CF_{t-2}/K_{t-3}	-0.10 (0.05)*	-0.10 (0.03)

Notes: Parameter estimates and robust standard errors from one-step Arrelano-Bond; year-dummies and constant included. Significance reported at 1% (**), 5% (*) levels. Sargan test of over-identifying restrictions from two-step Arrelano and Bond estimates. Instruments set $\{\frac{I_{t-2}}{K_{t-3}}, \frac{I_{t-3}}{K_{t-4}}, \frac{I_{t-4}}{K_{t-5}}, \Delta y_{t-2}, \Delta y_{t-3}, \Delta y_{t-4}, (k-y)_{t-2}, (k-y)_{t-3}, (k-y)_{t-4}, CF_{t-2}/K_{t-3}, CF_{t-3}/K_{t-4}, CF_{t-4}/K_{t-5}, time\ dummies\}$.OLS sales regression.

4.3 Cash flow sensitivity and financial system

The results reported in this section are derived from samples that control for size and industrial activity by ensuring that the German and British firms are closely matched. The remaining differences between them should not result from differences in the size of firms or their area of industrial activity. Having controlled for these features, we should find that our earlier result that UK firms are more sensitive to cash flow than German firms is upheld in the matched samples if the nature of the financial system is the main determinant of cash flow sensitivity.

From the full samples, two matched samples are constructed. The matching process is as follows. The firms in each sample are divided into homogeneous industries (NACE - 3 digit) and are then sorted according to size. The largest German firm in a homogeneous industry is then matched with the largest UK firm in the same industry, the second largest is

then matched with the second largest, and so on. We also insure that the firms are observed during the same years. This matching process leads to a sample of 528 firm-year observations for both Germany and the UK and gives the closest matched sample that is possible while still maintaining a sufficiently large dataset to make inferences, given the specific definition of an industry that we employ.[7].

Table 3 shows the results for the matched German and UK samples. The results indicate that there are no differences in the response of investment to cash flow in the matched samples. This is a striking result because it reverses the result reported in the previous section for the full sample and suggests that there are not statistically significant differences in the response to cash flow once we have controlled for size and industrial activity. In all other respects the matched sample results appear stronger than the full sample results because the estimated coefficients on sales growth and the error correction term are larger in absolute value and have a higher level of statistical significance, cash flow excepted. The equations also seem well specified, since the error correction term is negative and significant for both samples, suggesting stabilizing feedback in investment dynamics for both countries. The most notable changes are to be found in the UK equation since far more UK firms were discarded on the grounds that they did not have a matching German company in the sample[8].

The main result from these equations is that the coefficient on the cash flow variable in the merged sample is now insignificant in *both* cases whereas previously it was a significant determinant of corporate investment for the UK. This finding is important because it suggests that the source of the difference between the German and British firms does not lie in the orientation of the financial systems because we do not find evidence for differences in sensitivity once we control for size and industrial structure.

Having found that we can eliminate the distinction between UK and German firms by controlling for firm-size and industry by matching, this suggests that differences between the two countries in one or both of these factors is potentially the source of the significance of cash flow for investment in the full samples of randomly-selected data from each country. The change in the significance of the cash flow coefficients between the full sample and the matched sample indicates that the full sample data set contains firms that *are* influenced by cash flow while the matched data set does not.

To confirm this fact, we can attempt to reinstate the cash flow sensitivity in the corporate investment equation for the UK by considering the firms that were unmatched[9]. These firms

[7]For our purpose we match on the third digit e.g. we have a matched UK and German firms in NACE 15 at the three digit level so that we pair firm in industry 151 (production, processing and preserving of meat and meat products) etc.

The summary statistics of the matched sample are in the appendix.

[8]The actual numbers indicate a reduction from 2103 firm-observations for the UK to 528, compared with a reduction from 804 firm-observations to 528 for Germany.

[9]Due to the fact that the German sample is smaller there are insufficient unmatched firms to examine this hypothesis in the German case, but with the larger sample of UK firms we are able to examine cash

do not have a German counterpart in terms of size or industrial activity. When we examine the sample of firms that could not be matched we find that the unmatched firms are sensitive to cash flow. Table 3 reports the responses to cash flow for the unmatched sample of UK firms in the final column and from these results we discover that cash flow is again important. In fact the cash flow variable is highly significant at the 1% level, and has a similar coefficient value to the full sample results for UK firms. We can infer from this that characteristics in the unmatched firms are responsible for the cash flow sensitivity in the full sample.

Table 3 - Investment and cash flow sensitivity on matched versus unmatched samples

Dep. var. I_t/K_{t-1}	Matched Sample		Unmatched Sample
I_t/K_{t-1}	Germany	U.K.	U.K.
I_{t-1}/K_{t-2}	-0.72 (0.15)**	-0.34 (0.15)*	-0.24 (0.13)
Δy_t	0.76 (0.20)**	0.63 (0.15)**	0.48 (0.18)**
Δy_{t-1}	0.72 (0.20)**	0.45 (0.15)**	0.11 (0.14)
$(k-y)_{t-2}$	-0.73 (0.20)**	-0.54 (0.17)**	-0.12 (0.12)
CF_t/K_{t-1}	-0.22 (0.14)	0.15 (0.13)	0.08 (0.15)
CF_{t-1}/K_{t-2}	-0.14 (0.10)	0.04 (0.15)	**0.29 (0.10)****
$m1$	-3.30	-3.19	-5.54
$m2$	0.38	0.14	-0.12
Sargan p-value	0.43	0.22	0.6127
N obs	314	314	916
N firms	97	97	281

Notes: Parameter estimates and robust standard errors from one-step Arrelano-Bond; year-dummies and constant included. Significance reported at 1% (**), 5% (*) levels. Sargan test of over-identifying restrictions from two-step Arrelano and Bond estimates. Instruments set $\{\frac{I_{t-2}}{K_{t-3}}, \frac{I_{t-3}}{K_{t-4}}, \frac{I_{t-4}}{K_{t-5}}, \Delta y_{t-2}, \Delta y_{t-3}, \Delta y_{t-4}, (k-y)_{t-2}, (k-y)_{t-3}, (k-y)_{t-4}, CF_{t-2}/K_{t-3}, CF_{t-3}/K_{t-4}, CF_{t-4}/K_{t-5}, time\ dummies\}$

While the evidence in Table 2 might have been interpreted as an indication that certain countries face more binding financial constraints than others, and these differences might also be associated with the different financial systems in those countries (the UK being relatively market-oriented and Germany being more relationship-oriented), our results in Table 3 rule out this interpretation. Based on a closely-matched sample of firms chosen to be directly comparable Table 3 shows that there are no differences in the response to cash flow in the investment equations across countries compared to the full sample. The reasons why cash flow is important for the full sample but not the closely-matched sample may lie in the composition of the samples for each country with particular reference to the size and

flow sensitivity of investment for the remaining sample of unmatched firms.

industrial structure. Systemic features like the prevalence of market- versus relationship-oriented financial systems are not responsible for the differences in the impact of financial constraints on investment.

In the next two sections we look at the varying responses of investment to cash flow when splitting sample according to size and industrial characteristics. If the response to cash flow varies with size and industry-specific features then it strenghtens the argument that it is these features rather than financial system that explain the different sensitivities of investment to cash flow between Germany and the UK.

4.4 Cash flow sensitivity and size

The papers by Gertler and Gilchrist (1994) and Gilchrist and Himmelberg (1995) illustrate that small firms are more sensitive to cash flow than larger firms. The theoretical argument to support these empirical results is that larger firms have greater access to external finance, and particularly non-bank external finance. In this section we split the sample of firms in the full sample on the basis of absolute and relative size to determine whether the responsiveness of corporate investment varies with that characteristic.

If there are differences in the sensitivity between the small and large firms *within* the UK or in Germany then it is most unlikely that the common financial system is responsible for the different responses to cash flow. It is much more likely that absolute or relative size is responsible for the differences in the sensitivity to cash flow. To the extent that differences exist between countries, such that one country has greater sensitivity to cash flow than another, this may arise from the dominance of sensitive types of firms e.g. smaller firms within the population of one country relative to another.

When we examine the behavior of firms that are larger or smaller than the median (on the basis of log real sales) for the UK and for Germany we discover that our earlier results are robust to sample splitting. In Table 4 the coefficient for cash flow in regressions for small and large firms in Germany is insignificant, giving a similar interpretation of no influence of cash flow on investment that we found before we split the sample on the basis of size[10]. For the UK the results indicate that cash flow has a positive and significant effect on investment for large *and* small firms, where the difference is not statistically significant, indicating that cash flow affects investment for *both* classes of firms as we found in the previous section.

This finding is robust to the redefinition of size based on the relative scale in the industry. Table 5 reports the results when we define size in a relative sense by the ranking of the firm within its industry. The results when we split the sample into relatively large and relatively small firms on this basis give the same qualitative results as Table 4. [11]

[10] In principal, size is also an endogenous characteristic of a firm. So strictly speaking it should be treated as a predetermined variable rather than a strict exogenous one on which one can do sample splits. However in most firm panels (as in ours) size of firms changes only little from year to year and is a semi-permanent feature of most firms.

[11] We do not report the results for the unmatched firms because we do not have a sufficiently large sample

Table 4 - Cash flow sensitivity and absolute size (full sample)

Dep. var. I_t/K_{t-1}	Germany		U.K.	
	Large Firms	Small Firms	Large Firms	Small Firms
I_{t-1}/K_{t-2}	-0.64 (0.17)**	-0.24(0.10)*	-0.37 (0.13)**	-0.18 (0.15)
Δy_t	0.49 (0.16)**	0.47 (0.15)**	0.67 (0.14)**	0.21 (0.13)
Δy_{t-1}	0.79 (0.18)**	0.28 (0.09)**	0.27 (0.14)	0.12 (0.16)
$(k-y)_{t-2}$	-0.64 (0.19)**	-0.37 (0.10)**	-0.32 (0.14)**	-0.14 (0.17)
CF_t/K_{t-1}	-0.21 (0.21)	-0.03 (0.18)	0.21 (0.18)	0.12 (0.12)
CF_{t-1}/K_{t-2}	-0.02 (0.16)	-0.19 (0.10)	**0.31 (0.13)***	**0.21 (0.09)***
m1	-3.08	-3.12	-3.95	-4.16
m2	-0.60	-1.68	0.34	0.52
Sargan	0.45	0.39	0.37	0.68
N obs	249	241	617	613
N firms	73	72	188	190

Notes: Parameter estimates and robust standard errors from one-step Arrelano-Bond; year-dummies and constant included. Significance reported at 1% (**), 5% (*) levels. Sargan test of over-identifying restrictions from two-step Arrelano and Bond estimates. Instruments set $\{\frac{I_{t-2}}{K_{t-3}}, \frac{I_{t-3}}{K_{t-4}}, \frac{I_{t-4}}{K_{t-5}}, \Delta y_{t-2}, \Delta y_{t-3}, \Delta y_{t-4}, (k-y)_{t-2}, (k-y)_{t-3}, (k-y)_{t-4}, CF_{t-2}/K_{t-3}, CF_{t-3}/K_{t-4}, CF_{t-4}/K_{t-5}, time\ dummies\}$.

Table 5 - Cash flow sensitivity and relative size (full sample)

Dep. var.	Germany		U.K.	
I_t/K_{t-1}	Large Firms	Small Firms	Large Firms	Small Firms
I_{t-1}/K_{t-2}	-0.51 (0.22)*	-0.53(0.15)**	-0.30 (0.15)*	-0.28 (0.13)*
Δy_t	0.69 (0.20)**	0.70 (0.12)**	0.45 (0.16)**	0.53 (0.15)**
Δy_{t-1}	0.51 (0.23)*	0.69 (0.16)**	0.27 (0.15)	0.24 (0.15)
$(k-y)_{t-2}$	-0.56 (0.22)**	-0.58 (0.19)**	-0.26 (0.15)**	-0.27 (0.15)
CF_t/K_{t-1}	-0.14 (0.20)	-0.23 (0.16)	0.01 (0.16)	0.10 (0.16)
CF_{t-1}/K_{t-2}	-0.20 (0.17)	-0.10 (0.11)	**0.19 (0.09)***	**0.28 (0.12)***
m1	-3.33	-2.78	-3.88	-3.98
m2	-1.21	1.37	-0.17	-0.49
Sargan	0.50	0.75	0.61	0.55
N obs	295	195	675	555
N firms	89	56	203	175

Notes: Parameter estimates and robust standard errors from one-step Arrelano-Bond; year-dummies and constant included. Significance reported at 1% (**), 5% (*) levels. Sargan test of over-identifying restrictions from two-step Arrelano and Bond estimates. Instruments set $\{\frac{I_{t-2}}{K_{t-3}}, \frac{I_{t-3}}{K_{t-4}}, \frac{I_{t-4}}{K_{t-5}},$

of German firms to give meaningful results, but the results for the UK unmatched firms have a similar response to Tables 4 and 5 i.e. *both* small and large firms are cash flow sensitive.

$\Delta y_{t-2}, \Delta y_{t-3}, \Delta y_{t-4}, (k-y)_{t-2}, (k-y)_{t-3}, (k-y)_{t-4}, CF_{t-2}/K_{t-3}, CF_{t-3}/K_{t-4}, CF_{t-4}/K_{t-5}, time\ dummies\}$.

A known feature of our two country samples is that German firms are typically larger than their UK counterparts. It is possible therefore that size could be the characteristic that accounts for the difference in the sensitivity to cash flow reported in the previous section between the full sample and the matched sample. However, the fact that even large firms in the UK are sensitive to cash flow indicates that size is not likely important. The results in this section are in line with the results in Chatelain et al (2003), von Kalckreuth (2003) and Devereux and Schiantarelli (1990). In comparing results from Austria, Belgium, France, Germany, Italy and Luxembourg Chatelain et al. (2003) state that size in itself does not seem to be sufficient to capture the presence of differences in external finance premia. Similarly von Kalckreuth (2003) finds no differences in cash flow effects when comparing large and small German firms and argues that "being small is something essentially different from being badly rated and credit constrained in Germany ". Devereux and Schiantarelli (1990) using a UK sample and splitting the sample also according to absolute and relative size find no statistical difference in cash flow sensitivity between large and small firms (although they argue that based on the point estimates cash flow "appears " to play a more important role for larger firms). Size is likely to be correlated with industrial structure (Gertler and Gilchrist, 1994). In the next section we look at industrial structure.

4.5 Cash flow sensitivity and industrial structure

There is a growing body of evidence that shows monetary policy has different effects on separate industries (c.f. Ganley and Salmon (1997) for the UK and Hayo and Uhlenbrock (1999) for Germany) and on regions within countries (see Carlino and DeFina (1998) and Peersman and Smets, (2004)). Since industries may be concentrated within particular regions or countries, the literature that documents industry and regional effects may have discovered a potential cause of country differences. Country effects may be one reflection of industrial composition. However, Dedola and Lippi (2004) have shown that when examining differing elasticities of output in response to monetary policy by group effects for industries and countries, industry effects dominate the country effects. If the explanation for the differences between countries was due to industrial compositions, then industry-effects should not be more important than country-effects, but this does not rule out that *some* of the differences between countries may reflect composition effects due to industrial structure. Some industries may face different financing constraints than others due to the scale of their investment projects, the competition within their industry or usefulness (resale value) of their collateral, but this is could be an important part of the puzzle over the role of cash flow on investment across countries. In what follows we investigate these lines of inquiry.

As before we rely on sample-splitting strategy to determine whether industrial structure is the factor that determines cash flow sensitivity. We identify several respects in which the industrial classifications of our samples differ and evaluate in this section whether sample-

splitting on the basis of these features gives rise to differences in response to cash flow. We expect on the basis of the papers discussed above that firms that are final goods producers or in more open export-oriented or import-competing industries should not maintain the original findings (i.e. they should have less cash flow sensitivity *even though we draw the firms from the full and the unmatched samples that previously demonstrated cash flow sensitivity).*

First we split the full UK and German samples into intermediate goods producers and final goods producers. We then compare the response of the cash flow sensitivity in the investment equations for each sample. The calculation of the extent to which firms are producers of intermediate or final goods is based on the share of total industry output that is an intermediate input by industry using the input-output tables for each country. We are able to do this at the NACE 3 level for the UK, and at the NACE 2 level for Germany. After ranking the industries by the proportion of the output that is an intermediate input to another industry we can identify the industries where final goods production exceeds intermediate goods production by separating the industries at the 50% mark.[12] The investment equations for final goods producers and intermediate goods producers are reported in Table 6.

For UK industries, there is no difference between intermediate and final goods producers' sensitivity to cash flow in investment equations - both are sensitive to cash flow - while for German industries, both intermediate goods and final producers are not sensitive to cash flow, confirming the full sample result. While there are clear differences in the sensitivity to cash flow between countries, as before, the sensitivity does not alter according to this industrial characteristic. This is despite the fact that many of our intermediate goods producers are found in the durable and heavy industrial goods category that were more investment intensive and were expected to show greater sensitivity than the lighter industries (Ganley and Salmon (1997), Dedola and Lippi (2004), Hayo and Uhlenbrock (2000) and Peersman and Smets (2004)). Our cross-country evidence does not pick up a consistent pattern of sensitivities for these types of industries

[12] We want to be able to make inferences on the split samples. The constraints we face is to have enough observations in all 4 subsamples. We also want to use the sample split-off point for both the UK and Germany. Therefore the 50% mark is chosen so that we approximately split the German and UK samples, simultaneously, into two equally sized samples.

Table 6 - Cash flow sensitivity for intermediate versus final goods producers (full sample)

	Germany		UK	
	inter. goods	final goods	inter. goods	final goods
I_{t-1}/K_{t-2}	-0.38 (0.15)*	-0.25 (0.16)	-0.32 (0.12)*	-0.27 (0.17)
Δy_t	0.41 (0.17)*	0.06 (0.18)	0.54 (0.17)**	0.28 (0.15)
Δy_{t-1}	0.42 (0.15)**	0.32 (0.17)	0.28 (0.13)*	0.20 (0.22)
$(k-y)_{t-2}$	-0.32 (0.18)	0.35 (0.18)	-0.26 (0.13)*	-0.28 (0.20)
CF_t/K_{t-1}	-0.22 (0.13)	-0.09 (0.19)	0.07 (0.15)	0.22 (0.17)
CF_{t-1}/K_{t-2}	-0.15 (0.12)	-0.04 (0.11)	**0.21 (0.10)***	**0.23 (0.10)***
N obs	205	285	746	484
N firms	63	82	228	150
m1	-3.61	-3.07	-4.64	-4.08
m2	-0.47	-0.13	-0.8	1.01
Sargan p value	0.53	0.15	0.78	0.09

Notes: Parameter estimates and robust standard errors from one-step Arrelano-Bond; year-dummies and constant included. Significance reported at 1% (**), 5% (*) levels. Sargan test of over-identifying restrictions from two-step Arrelano and Bond estimates. Instruments set $\{\frac{I_{t-2}}{K_{t-3}}, \frac{I_{t-3}}{K_{t-4}}, \frac{I_{t-4}}{K_{t-5}}, \Delta y_{t-2,}\Delta y_{t-3,}\Delta y_{t-4,}(k-y)_{t-2,}(k-y)_{t-3,}(k-y)_{t-4,}CF_{t-2}/K_{t-3}, CF_{t-3}/K_{t-4}, CF_{t-4}/K_{t-5}, time\ dummies\}$.

Table 7 -Cash flow sensitivity for open versus closed industries (full samples)

	Germany		UK	
Imports	import -competing	non import -competing	import -competing	non import -competing
I_{t-1}/K_{t-2}	-0.50 (0.8)**	-0.38 (0.15)**	-0.35 (0.11)**	-0.33 (0.13) *
Δy_t	0.53 (0.18)**	0.39 (0.16)*	0.63 (0.14)**	0.42 (0.12)**
Δy_{t-1}	0.25 (0.12)*	0.55 (0.15)**	0.37 (0.13)**	0.12 (0.16)
$(k-y)_{t-2}$	0.28 (0.15)	–	-0.34 (0.12) **	-0.24 (0.17)
CF_t/K_{t-1}	-0.16 (0.15)	0.15 (0.21)	0.01 (0.12)	0.20 (0.16)
CF_{t-1}/K_{t-2}	0.05 (0.15)	-0.28 (0.14)*	0.12 (0.08)	**0.32 (0.12)****
m1	-3.49	-2.99	-3.97	-4.65
m2	-0.74	-0.32	0.15	-0.48
Sargan	0.79	0.54	0.47	0.15
N obs	177	313	662	568
N firms	55	90	203	175
Exports	export -oriented	domestic -oriented	export -oriented	domestic -oriented
I_{t-1}/K_{t-2}	-0.49 (0.12)**	-0.35 (0.14)*	-0.42 (0.12)**	-0.36 (0.13)**
Δy_t	0.47 (0.13)**	0.31 (0.16)	0.58 (0.15)**	0.46 (0.12) **
Δy_{t-1}	0.52 (0.14)**	0.40 (0.14)**	0.45 (0.14)**	0.19 (0.16)
$(k-y)_{t-2}$	-0.41 (0.15)**	-0.50 (0.14)**	-0.47 (0.13)**	-0.26 (0.15)
CF_t/K_{t-1}	-0.17 (0.10)	-0.08 (0.25)	-0.09 (0.15)	0.17 (0.12)
CF_{t-1}/K_{t-2}	0.04 (0.12)	-0.01 (0.13)	0.12 (0.08)	**0.27 (0.12)***
m1	-3.70	-2.73	-3.43	-4.45
m2	-0.61	-0.37	0.24	-0.47
Sargan	0.66	0.96	0.48	0.19
N obs	319	171	578	652
N firms	95	50	176	202

Notes: Parameter estimates and robust standard errors from one-step Arrelano-Bond; year-dummies and constant included. Significance reported at 1% (**), 5% (*) levels. Sargan test of over-identifying restrictions from two-step Arrelano and Bond estimates. Instruments set $\{\frac{I_{t-2}}{K_{t-3}}, \frac{I_{t-3}}{K_{t-4}}, \frac{I_{t-4}}{K_{t-5}}, \Delta y_{t-2}, \Delta y_{t-3}, \Delta y_{t-4}, (k-y)_{t-2}, (k-y)_{t-3}, (k-y)_{t-4}, CF_{t-2}/K_{t-3}, CF_{t-3}/K_{t-4}, CF_{t-4}/K_{t-5}, time\ dummies\}$.

Second, we compare the impact of openness using a similar sample-splitting strategy, ranking industries by the share of total production derived from imports (import-competing industries versus non-import-competing industries) and exports (export-oriented versus domestically-oriented industries). We again use the input-output tables to calculate these shares and take our cut-off levels at 25% to define import intensive industries and export intensive industries. We expect that firms in more closed industries that are less

dependent on demand from foreign countries are more tied to the domestic cycle than firms in more open industries. These industries should be more sensitive to domestic monetary policy through the interest channel, and through the financial accelerator effect may become more sensitive to cash flow as their eligibility for external finance deteriorates.

We find support for this argument for the UK. The non-import-competing and domestically-oriented industries are more sensitive to cash flow. However in Germany, again none of the four subsamples shows sensitivity to cash flow (with a strange exception of a negative sensitivity for the non-import-competing industry.) Thus we do find results that are consistent with the idea that openness to imports or orientation towards exports has some importance for the sensitivity of cash flow in investment equations at least in the UK.

Taking into account the industrial features that might predispose investment in an industry to be more responsive to cash flow does not reveal the consistent results we would expect across countries if these characteristics were the driving process for the investment-cash flow relationship. Instead what we find is that the intermediate-final goods producer distinction hardly matters at all, and that German industry exhibits a consistent insensitivity to cash flow across any split in the sample that is undertaken on industrial grounds. This downgrades much of the evidence that these industrial features are responsible for the differences in the response to cash flow.

4.6 Cash flow sensitivity and creditworthiness

The sample splits according to structural features (size and industry characteristics) did no show consistent results across Germany and the UK. This casts doubt on the thesis that structural features are determinants of cash flow sensitivity and hence financing constraints. In this section we check whether the previous sample splits were implicitely dividing firms along the dimension of creditworthiness. Cleary (1999) shows that on the basis of a discriminant analysis two indicators of creditworthiness, namely sales growth and net profit margin, were the most significant. Following Cleary (1999), we use sales growth and operating profits (as a percentage of the capital stock) as indicators of creditworthiness for sub-samples of firms such as small versus large firms, intermediate versus final goods producing industries etc. Due to the endogenous nature of sales growth and net profit margin we cannot use the same sample splitting methodology to compare the responses to cash flow in sub-samples. Instead we calculate the average performance in terms of these creditworthiness variables for our previous sub-samples i.e. small versus large firms, intermediate versus final goods producers etc. We then perform a t-test of the significance of the difference in average sales growth and operating profits within countries across sample splits. If creditworthiness by industry is the key driver of the relationship between investment and financial constraints then there will be noticeable differences in the significance of coefficients across sample splits within countries indicating that sensitivities to cash flow are the result of balance sheet considerations. We would expect that these results would be consistent irrespective of the

indicator of creditworthiness that we use. Table 8 reports the results.

Table 8 -Tests of significant differences in creditworthiness

	Germany		UK	
	Sales growth	oper. profits ^	Sales growth	oper. profits ^
Large vs. small (absolute)	0.02 (0.01)	-0.01 (0.02)	0.00 (0.01)	0.01 (0 .01)
Large vs. small (relative)	-0.01 (0.01)	0.01 (0.02)	0.00 (0.01)	-0.01 (0.01)
interm vs. final	-0.01 (0.01)	-0.05 (0.02)**	0.00 (0.01)	0.00 (0.01)
import-comp vs. non import comp	0.01 (0 .01)	-0.03 (0.02)	0.01 (0 .01)	0.03 (0.01)**
export-oriented vs. dom. oriented	0.03 (0.01)**	-0.07 (0.02)**	0.02 (0.01)**	0.04 (0.01)**

^Operating profits as a percentage of the capital stock.

The table reports the difference in average sales growth and operating profits with standard errors in brackets

For Germany, when splitting samples, none of the sub-samples of industries or size classes has a better performance on *both* average sales growth and average profits relative to the counterpart sub-sample. For instance, large versus small firms show the same performance. The export-oriented industry has a better performance on sales growth but a worse performance on operating profits. Insignificant differences and absence of cash flow sensitivity in Germany across sample splits are consistent with the absence of significant creditworthiness differences.

In the UK however, the finding on the lower sensitivity of export oriented industries is confirmed with better performance on both average sales growth and operating profits. The finding on the lower sensitivity of the import-competing industries is confirmed by the better performance on the operating profits (but the average sales growth is not significantly different)

A consistent pattern emerges across countries and across industries that identifies those industries with higher proportions of firms with lower sales growth and lower levels of operating profits (i.e. worse performance on *both* measures of creditworthiness at the same time) to be more sensitive to cash flow. While there is more robust evidence to support creditworthiness arguments elsewhere, we demonstrate here that while the structural interpretations of different cash flow sensitivities can be rejected using our panels of British and German firms, the creditworthiness interpretation cannot be dismissed so easily [13]. We conclude from this that the balance sheet channel proposed by Bernanke and Gertler (1989) and Bernanke at al. (1996, 1999) receives some support, since ultimately indicators of creditworthiness at the industry level is associated with the extent to which a firm depends on internal finance to fund investment.

[13]Our results contrasts with the results of Clearly who finds that firms with high financial health were more sensitive to the available funds than less creditworthy firms. However, it is possible that Cleary result can be explained by firms in financial distress. These firms are restricted to use cash flow for investment purposes by debt covenant imposed by bond holders or banks, implying a lower sensitivity of investment to cash flow. This critique has also been given by Fazzari et al (2000) to the Kaplan and Zingales results (1997)

5 Conclusions

Much of the puzzle over the driving forces behind the relationship between cash flow and investment arises from the correlation between indicators of financial structure, industrial structure, size and creditworthiness. Many of these indicators are good proxies for the others and therefore can easily be confused empirically as drivers of the investment-cash flow relationship. The purpose of this paper is to suggest one means of discriminating between them by underscoring the importance of appropriate sample selection when doing comparative studies of corporate investment and financial constraints across countries. We take pains to ensure we make fair comparisons across countries by controlling for differences between countries and within samples.

Some samples of our data can provide evidence that is consistent with the idea that firms in more market-oriented financial systems such as the UK have greater cash flow sensitivity than firms in more relationship-oriented systems such as Germany. But this evidence is drawn from samples where no particular attention is given to selecting firms on the basis that they are comparable in terms of size and industrial activity. When we select our sample to ensure comparability we can show that this is a sample-specific result; and one that can be overturned by taking samples that control for industry and size to ensure that the firms drawn from each country are as similar as possible. In this case we find there is no difference in sensitivity to cash flow in each country, so that once comparability is made the basis for selection there is no difference in the sensitivity of German or British firms to cash flow and therefore no reason to suppose that the financial systems of each country are responsible for the differences in cash flow sensitivity of investment.

The same argument is taken further to explore other potential drivers such as firm size or industrial structure. We find, after controlling for other determinants of cash flow sensitivity, that neither absolute or relative size, nor the type of industrial structure under which the firms operate, such as openness to import competition or orientation to export markets, or production of final versus intermediary goods drives the investment-cash flow relationship. Instead we present new results to demonstrate that industries in which a higher proportion of firms with high sales growth and operating profits (i.e. those with observable high performance) are insensitive to cash flow, while industries where a higher proportion of firms are observably performing less well are more sensitive to cash flow. It is reasonable to suppose that firms in industries with healthy financial performance have less difficulty obtaining external funds and therefore are relatively less sensitive to the availability of internal finance when undertaking investment. We conclude that it is the performance of certain types of industries, in terms of sales and profits, that opens up access for firms in those industries to external finance, and this in turn reduces dependence of investment on cash flow.

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6 Appendix

6.1 Data Sources

The primary source of the data is the AMADEUS database from Bureau Van Dijk. We use the following two releases: the CD-rom June 2001 and the CD-rom September 1997. The database includes firm balance sheet and profit and loss information. We only select firms that have consolidated data; this means that data are all on the group level (capital stock, assets, turnover, etc.) This makes our study more comparable with US studies based on Compustat, which also reports consolidated data. In addition unconsolidated accounts can give a very misleading picture of the true nature of the firm. It is customary that the output of a large firm is usually produced over multiple plants, each (or a few taken together) with own legal identity and own unconsolidated account. For instance, BASF AG, has a consolidated turnover of around 30 billion euro, where it has an unconsolidated one of around 11 billion euro. Second, the true financial boundaries of the firms are the group not the individual plants. For instance for investment purposes, cash flow generated by one plant can easily be transferred to other plants. For each firm and each year, we extract from the database turnover, profit/loss, operating results, deprecation and book value of fixed capital and nace-2 and 3 digit code. We define nominal cash flow as profit/loss plus depreciation.

6.2 Variable Construction

We define nominal operating profits as operating results + depreciation. We deflate turnover, nominal cash flow and nominal operating profits by the industry output deflator. The industry output deflators at the 2 digit NACE level are obtained from the UK Office for National Statistics and Statistisch Bundesambt Deutschland. (The UK series are: PP Indices MM22, Table 2: Price indices of UK output all manufacturing and selected industries- SIC (92). The German series are Segment 3783 Index der Erzeugerpreise gewerblicher Produkte(1995=100) : insgesamt, nach Gütergruppen, -Zweigen, -Klassen und-Arten des GP, Ausgabe 1995(Deutschland) (1994 bis 2002).

Nominal investment $NI_{t+1}$of year t+1 is constructed as the difference between book value of fixed capital of (end of) year t+1 and end of year t adding depreciation of year t+1. Deflators of nominal investment are constructed from current and constant prices investment series at the industry level (for the UK: Business investment (release of the UK statistical office), revised results-2nd quarter 2002) (For Germany: Segment 7721 Bruttoanlageinvestitionen(in jeweiligen Preisen), Segment 7724 Bruttoanlageinvestitionen(in Preisen von 1995).

The real capital stock K_t is constructed using the traditional perpetual inventory method. Since the book values of fixed capital for the first year of observation for each firm are at historical prices we multiply the initial book value of fixed capital by a factor to account for historical inflation to get replacement values (i.e. price at time t) for the initial value of the capital stock. The capital (end of period) of future years is then obtained by the perpetual inventory formula

$K_{t+1} = (1 - \delta)K_t + \frac{NI_{t+1}}{P_{it+1}}$

Intermediate goods versus final goods industries. For the UK industries we refer to the NACE 3 level of industrial classification. The demand for industry output by other industries (ID) is calculated less the demand from the same industry (OD), hence total demand for the output by other industries is calculated by subtracting own demand on the diagnonal of the input-output table (ID-OD). This intermediate demand is divided by total domestic output (DY) taken from the UK 1995 input-output table. All figures are in 1995 basic prices in sterling millions. The figures are converted to a percentage and are ranked. The industries with the largest share of intermediate demand to total output are regarded as intermediate good producing industries, and those with the smallest share are the final good producing industries. The cut off value is 50% to reflect the fact that for firms below the cut off the majority of the firms' output is destined for intermediate consumption, and for those above the majority is destined for final consumption. Hence

100*(M/Y)> 50% final good producing industries

100*(M/Y)<= 50% intermediate good producing industries

For the German industries the same procedure is followed at the NACE 2 level of industrial classification (NACE 3 being unavailable). The data for intermediate demand is taken from the use 1995 table and domestic output is taken from the domestic 1995 table of the input-output table for 1995. Figures are in 1995 basic prices in euro millions.

Recalculations using total output (Y), which is the sum of domestic output (DY) plus imports (M = MEU+MNEU) did not significantly alter the rank orderings and the divide between intermediate and final goods producing industries was unchanged for both countries.

Import-intensive versus non-import intensive industries. For the UK industries we refer to the NACE 3 level of industrial classification. The data on import-intensity are derived by summing the imports (M) from the EU (MEU) and non-EU (MNUE) countries. Imports are divided by the total output of the industry (Y) which is the sum of total domestic output (DY) plus imports (M = MEU+MNEU) taken from the UK 1995 input-output table. All figures are in 1995 basic prices in sterling millions. The figures are converted to a percentage and are ranked. The industries with the largest share of imports to total output are regarded as import-intensive industries, and those with the smallest share are the non-import intensive industries. The measure of import-intensive and non-import-intensive industries is a relative measure, and to capture this fact we set the cut off value at 25% to split the sample with an indication of relative exposure to imports. Hence

100*(M/Y)> 25% import intensive

100*(M/Y)<= 25% non import intensive

For the German industries the same procedure is followed at the NACE 2 level of industrial classification (NACE 3 being unavailable). The data for imports and output are taken from the supply95 table of the input-output table for 1995. Figures are in 1995 basic prices in euro millions. Imports are calculated on a carriage, insurance and freight (c.i.f.) basis.

Export-oriented versus domestically-oriented industries.For UK industries we refer to the NACE 3 level of industrial classification. The data on orientation of sales are derived by calculating the exports (X) as the sum of the EU (XEU) and non-EU (XNUE) exports taken from

the UK input-output table for 1995. The total export figure is divided by the total output of the industry (Y), which is the sum of domestic output (DY) plus imports (M = MEU+MNEU). All figures are in 1995 basic prices in sterling millions. The figures are converted to a percentage and are ranked. The industries with the largest share of exports to total output are regarded as export-oriented industries, and those with the smallest share are the domestic-oriented industries. As above, the measure of export-oriented and domestic-oriented is a relative measure, and to capture this fact we set the cut off value at 25% to split the sample with an indication of relative orientation to exports. Hence

100*(X/Y)> 25% export-oriented
100*(X/Y)<= 25% domestic-oriented

For the German industries the same procedure is followed at the NACE 2 level of industrial classification(NACE 3 being unavailable). The data for output is taken from the supply95 table and data for exports is taken from the use1995 table of the input-output table for 1995. Figures are in 1995 basic prices in euro millions. Exports are calcualted on a free on board (f.o.b.) basis

6.3 Summary Statistics of Matched and Unmatched Samples

The summary statistics of the matched samples are given in Table A.1. Again the matched German and the matched UK sample are very much alike, and the matched sample statistics do not seem to be particularly different from the full sample statistics. A potential problem of matching could be that one incurs a big loss in terms of the numbers of sub-industries in manufacturing. This does not happen in our sample because Germany and the UK both have a broad base of manufacturing. The matched sample is diverse in terms of number of different 3-digit NACE industries since the matched sample contains firms from 41 different NACE three digit industries, where no single industry dominates the sample[14]. Table A.1 also provides the summary statistics of the firms without a match. Again the summary statistics of the unmatched samples are relatively similar across countries and relatively similar to the full sample statistics.We conclude that, the full, matched and unmatched samples look very much alike in terms of the levels and standard deviations of the variables. If we find differences accross sample in the estimation results, it has to be due to other reasons than the level of the variables themselves.

[14]The largest number of firm-year observations are from the manufacture of beverages industry (NACE 159), 8.9 %, the second largest is the manufacture of other special purpose machinery (NACE 295) 7.6%, the third largest is the manufacturing of machinery for the production and use of mechanical power (NACE 291) 7%.

Table A.1 - Summary statistics of matched and unmatched samples

Matched	Germany			UK		
	mean (s.d.)	min	max	mean (s.d.)	min	max
I_t/K_{t-1}	0.16 (0.15)	-0.260	0.94	0.14 (.16)	-0.56	0.94
Δy_t	0.04 (0.10)	-0.50	0.60	0.03 (.15)	-0.73	0.79
CF_t/K_{t-1}	0.25 (0.27)	-0.24	2.04	0.23 (.23)	-0.39	1.82
$(k-y)_{t-2}$	1.01 (0.47)	-0.13	2.57	1.06 (.59)	-0.68	2.81
N. Obs.	528			528		
N. firms	97			97		
Unmatched	Germany			UK		
	mean (s.d.)	min	max	mean (s.d.)	min	max
I_t/K_{t-1}	0.15 (0.13)	-0.35	0.70	0.14 (0.17)	-0.83	0.99
Δy_t	0.03 (0.13)	-0.68	0.49	0.04 (0.16)	-1.02	0.95
CF_t/K_{t-1}	0.20 (0.12)	-0.20	0.60	0.22 (0.21)	-0.50	1.76
$(k-y)_{t-2}$	1.12 (0.51)	-0.10	2.29	1.14 (0.65)	-0.55	3.22
N. Obs.	276			1575		
N. firms	48			281		

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