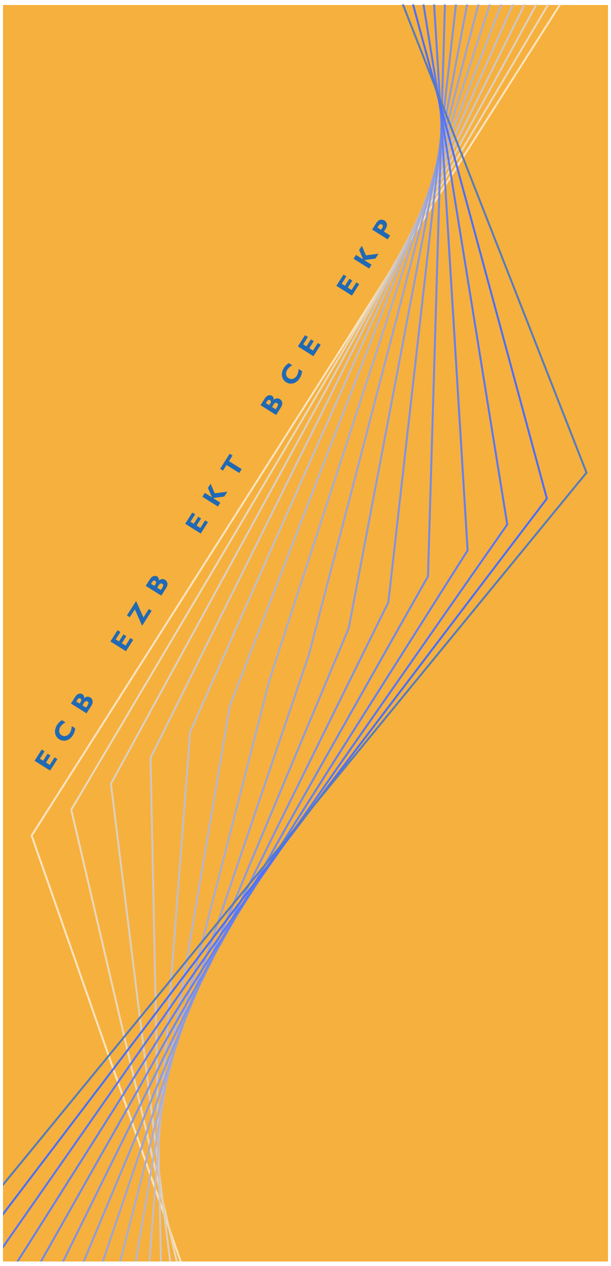
EUROPEAN CENTRAL BANK

WORKING PAPER SERIES



EUROSYSTEM MONETARY TRANSMISSION NETWORK

WORKING PAPER NO. 112

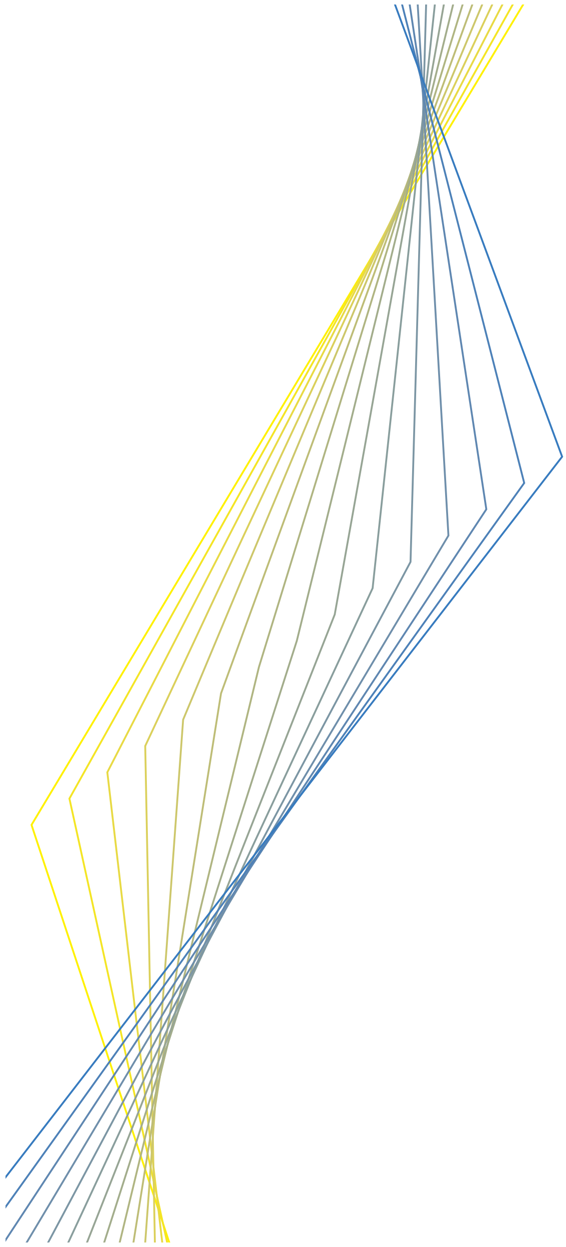
FIRM INVESTMENT AND MONETARY TRANSMISSION IN THE EURO AREA

BY J. B. CHATELAIN, A. GENERALE, I. HERNANDO, U. VON KALCKREUTH AND P. VERMEULEN

December 2001

EUROPEAN CENTRAL BANK

WORKING PAPER SERIES



EUROSYSTEM MONETARY TRANSMISSION NETWORK

WORKING PAPER NO. 112

FIRM INVESTMENT AND MONETARY TRANSMISSION IN THE EURO AREA

BY J. B. CHATELAIN[1], A. GENERALE[2], I. HERNANDO[3], U. VON KALCKREUTH[4] AND P. VERMEULEN[5]

December 2001

1 Banque de France; E-mail: jean-bernard.chatelain@banque-France.fr.
2 Banca d'Italia; E-mail: generale.andrea@insedia.interbusiness.it.
3 Banco de España; E-mail: hernando@bde.es.
4 Deutsche Bundesbank; E-mail: ulf.von-kalckreuth@bundesbank.de.
5 European Central Bank; E-mail: philip.vermeulen@ecb.int. This paper represents the authors' personal opinions and does not necessarily reflect the views of the institutions they are affiliated to. We would like to thank the members of the Eurosystem's Monetary Transmission Network and the participants of the monetary economics workshop at the NBER Summer Institute 2001 for helpful discussions and feedback, and especially Daniele Terlizzese for his very helpful comments.

The Eurosystem Monetary Transmission Network

This issue of the ECB Working Paper Series contains research presented at a conference on "Monetary Policy Transmission in the Euro Area" held at the European Central Bank on 18 and 19 December 2001. This research was conducted within the Monetary Transmission Network, a group of economists affiliated with the ECB and the National Central Banks of the Eurosystem chaired by Ignazio Angeloni. Anil Kashyap (University of Chicago) acted as external consultant and Benoît Mojon as secretary to the Network.

The papers presented at the conference examine the euro area monetary transmission process using different data and methodologies: structural and VAR macro-models for the euro area and the national economies, panel micro data analyses of the investment behaviour of non-financial firms and panel micro data analyses of the behaviour of commercial banks.

Editorial support on all papers was provided by Briony Rose and Susana Sommaggio.

Address	**Kaiserstrasse 29**
	D-60311 Frankfurt am Main
	Germany
Postal address	**Postfach 16 03 19**
	D-60066 Frankfurt am Main
	Germany
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

ISSN 1561-0810

Contents

Abstract

We present a comparable set of results on the monetary transmission channels on firm investment for the four largest countries of the euro area (Germany, France, Italy and Spain). With particularly rich micro datasets for each country containing over 215,000 observations from 1985 to 1999, we explore what can be learned on the interest channel and broad credit channel. For each of those countries we estimate neo-classical investment relationships, explaining investment by its user cost, sales and cash flow. We find investment to be sensitive to user cost changes in all those four countries. This implies an operative interest channel in these euro area countries. We also find investment in all those countries to be quite sensitive to cash flow movements. However we find that only in Italy smaller firms react more to cash flow movements, implying that a broad credit channel might not be as pervasive in all countries.

JEL classification: E22, E50

Keywords: investment, monetary transmission channels, user cost of capital

Non-Technical summary

Monetary policy is thought to work through different channels. An understanding of the strength of different channels of monetary policy transmissions is crucial for an optimal single monetary policy in the euro area. In this paper we focus on two different channels which affect investment. The interest channel is operative when market interest fluctuations change the user cost of capital and hence investment. The broad credit channel is operative when market interest fluctuations change the balance sheet condition and the available cash flow of firms and through this investment.

This paper provides an investigation of those two channels, based on results from a unique comparative study on the four largest euro area countries (Germany, France, Italy and Spain). While a large literature exists investigating those channels using macro-economic data, much less work is available using micro-panel data. We use large firm databases for each country, containing in total over 215,000 observations from 1985 to 1999. The use of micro-data has the advantage of reducing simultaneity problems that could bias the estimates and allows to analyse differences in behaviour by taking advantage of cross-sectional variability.

We run standardised neo-classical investment regressions using as much as possible harmonised definitions of the variables; this allows comparisons across countries. In these neo-classical investment regressions, investment is a function of sales, cash flow and the user cost of capital. We find investment to be sensitive to user cost changes in all those four countries. Most of the effect of user cost changes are born within the first two years. This implies an operative interest channel in these euro area countries. We also find investment in all those countries to be quite sensitive to sales and cash flow movements.

We further investigate whether significant differences exist between large and small firms in investment behaviour. We find that only in Italy smaller firms react more to cash flow movements. We argue that size might not be the right indicator in all countries to investigate the broad credit channel.

Finally, by calculating the response of the main investment determinants (user cost and cash flow) to market interest rates, we are able to present a first assessment of the way in which monetary impulses are transmitted to investment spending.

I. Introduction

Monetary policy is generally thought to be able to affect business investment through multiple channels. First, a traditional interest rate channel is identified, whereby changes in market interest rates imply changes in the cost of capital, which in turn affect investment. It is however well known that on aggregate data it is difficult to find clear evidence of this channel. Second, changes in market interest rates have an effect on the net cash flow (i.e. cash flow after interest payments) available to a firm. In the presence of imperfect capital markets, the availability of net cash flow will have an effect on investment. This is generally referred to as the broad credit channel.

This paper provides an investigation of those two channels, based on results from a unique comparative study on the four largest euro area countries.[2] Using rich firm databases for each country, standardised regressions were run to make comparison across countries feasible. Although, for confidentiality reasons, individual data could not be pooled – so that no formal statistical testing is possible – the standardisation of the analysis should still allow to detect possible asymmetries in the working of the above channels. In particular, reliance on firm data should make it possible to identify whether there are differences in the behaviour of firms with otherwise similar characteristics. This is a distinct advantage, relative to the inference based on aggregate data in which "true" differences in behaviour are potentially confounded by differences due to composition of the firms in the aggregate.

The rest of the paper is structured as follows. In section 2 we motivate the research and spell out the relevant questions that could be answered by comparing the results across countries. In section 3 we describe the theoretical framework. In section 4 we present the data we use. In section 5 we present the regression results. In section 6 we test whether a broad credit channel is operative in the euro area. In section 7 we investigate the link between monetary policy, user cost and cash flow.

II. Motivation of the analysis

Since the beginning of monetary unification in Europe, a large body of empirical analysis has been devoted to the transmission mechanism of monetary policy. These

[2] Mojon, Smets and Vermeulen (2001) investigate the elasticity of investment w.r.t its user cost using industry data on the same four countries. The MTN project has lead to a number of complementary companion papers on investment and monetary policy: Butzen, Fuss and Vermeulen (2001), Chatelain and Tiomo (2001), Gaiotti and Generale (2001), von Kalckreuth (2001), Lünneman and Mathä (2001) and Valderrama (2001).

analyses are usually justified by the observation that a common monetary policy affects economies characterized by a high degree of heterogeneity.

This paper is a contribution on the issue of monetary policy transmission in the euro area; it focuses on the four major euro area countries by using data collected at the national level. Our perspective is at the same time wider and narrower to the one motivating previous research. It is narrower since we limit our attention to a specific channel of monetary policy, that on firms' investment spending. It is wider since, by using micro data, we try to take into account the relevance of firms' balance sheet conditions in the transmission of monetary policy. The contribution of the paper consists mainly in an assessment of the main determinants of investment spending in each of the countries.

The interest in the transmission mechanism is motivated by a variety of reasons that also can have policy implications. First, to assess carefully the monetary stance in the area it is important to know if the pure interest channel is the only channel at work. If agents' financial conditions are shown to be important, then knowing these same conditions proves to be important for the policy maker; at the same time this knowledge helps to better forecast the likely effects of a monetary decision.

As it is well known, the main channels of monetary policy transmission have been thoroughly examined mainly using macro information (see the survey in Guiso, Kashyap, Panetta and Terlizzese, 1999). These kind of analyses on the one hand permitted to uncover regularities and differences across the countries of the euro area; on the other hand showed to be limited in many respects. First of all, it is known that aggregation can blur the differences in the transmission of monetary policy and impede the identification of important parts of the transmission mechanism. Hence the recourse to micro data is often motivated in the literature by the recognition of the limits of aggregate studies. As an example for the US, Chirinko, Fazzari and Meyer (1999) motivate the use of micro data, in their analysis on the relationship between investment spending and user cost of capital, exactly because studies at the aggregate level often failed to find an economically significant relation between these two variables. As the authors note, this failure could have been due "*to biased estimates due to problems of simultaneity, capital markets frictions, or firm heterogeneity that may be better addressed with micro data*".

Moreover micro data are needed also because of the "*extensive variation* [in micro data that] *will likely provide better instruments* [for instrumental variable estimation] *than can be obtained at the aggregate level*." The motivation for employing micro data can be generally ascribed to the advantages of panel data estimation versus time series estimation, often reckoned in the econometric literature. "*By utilizing information on both the intertemporal dynamics and the individuality of entities being investigated, one is better able to control in a more natural way for the effects of missing or unobserved* *variables*"(Hsiao, 1995). Moreover, in our analysis on the determinants of investment, the use of micro data permits to have firm level measures of the user cost, sales and cash flow, thus taking into account that the transmission of monetary impulses occurs at the firm-level.

In fact, as it is well known and indeed very well explained by Chirinko, Fazzari and Meyer (1999) one of the difficulties found in the empirical analysis on the relation between investment and the user cost is that these estimates turned out to be too low. As they report, this is maybe due to simultaneity bias. As they argue "*investment comprises a volatile component of aggregate demand, positively correlated with the business cycle, and business cycle movements correlate with interest rates. Positive investment shocks, for example, can cause positive movements in output and the demand for credit that affect the required rates of return on debt and equity. Conventional wisdom suggests that simultaneity between investment shocks and interest rates biases the user cost elasticity towards zero*." In this respect, the cross-sectional variation coming from the tax component in the user cost variable that we use in estimation can be regarded as an exogenous source of variation, thus allowing to identify the effects of the cost of capital on investment. Moreover, simultaneity problems are reduced by IV or GMM estimation. Hence the combination of instrumental variable estimation and the exogenous source of variability ensured by tax variations should permit to better identify user cost effects properly.[3]

As a last point, that is relevant for preferring micro data, it is worth mentioning Hsiao (1995) again: "*longitudinal data allow a researcher to analyze a number of important economic questions that cannot be addressed using cross-sectional or time-series data sets*." This is the case if one wants to precisely identify the existence of a broad credit channel, that is the second channel of monetary transmission.

The literature on the broad credit channel of monetary policy has emphasised the relevance of information asymmetries in the transmission of monetary policy. In particular, the difficulty faced by borrowers in monitoring the projects of "opaque" firms implies that firms' financial conditions are important for the availability and cost of external finance. The result that in the presence of information asymmetries the Modigliani Miller theorem does not hold implies also that firms that are likely to be more exposed to problems of asymmetric information should react more to a monetary tightening, which has the effect of reducing their net worth (Gilchrist and Zakrajsek, 1995). The analysis of the reaction to a common shock of groups of firms characterised by

[3] It has to be clarified that we do not pursue the strategy of research adopted by Cummins et al. (1994, 1996) that stretched this line of identification as far as to measure investment elasticities to the user cost in years of major tax reform. It is anyway important for us to be sure of having a sufficient amount of variability in the data due to this tax component.

weaker balance sheets and the comparison with other firms that are in a better financial position solves the identification problems encountered with the use of macro-data. In particular, whereas aggregate data are able to identify the relevance of the interest rate channel, it is only by analysing the different behaviour of different groups of agent that we are able to robustly identify the presence of a broad credit channel.

There are also drawbacks in using micro data. They mainly consist in the difficulty of recovering aggregate effects from micro estimations, the main reasons being that usually shorter time periods are available in panels, thus implying that variation in the monetary policy stance can be more limited than with time series data, and that samples are often biased towards specific types of firms. We are aware of these difficulties: as documented in the data set description we are confident that the sample chosen are quite representative of the firms' characteristics in each country; moreover, also with respect to other contributions on panel analysis we have panels that are quite long.

After motivating the scope of the paper, it is necessary to give a picture of the main real and financial characteristics of these countries. The observation of significant heterogeneities has often motivated the analysis of the transmission mechanism with the aim of uncovering the presence of asymmetries in the reaction observed across countries. In effect, a high degree of heterogeneity seems to characterise these economies in particular as regards firms' financial structure, the availability of external funds and the industrial structure. Table 1a illustrates some of these differences.

On the real side the distribution of firms by size turns out to be quite dissimilar: in Germany only 48 per cent of total turnover of non financial firms pertained to firms with less than 250 employees, whereas, at the other extreme, in Italy accounted for 71 per cent.

As to financial structure, firms differ markedly both for the availability of external funds and in the composition of their financial debt. Data collected by the Monetary Transmission Network show for example that the reliance on bank credit is the highest in Italy, partly reflecting the more limited role of equity in firm financing; it is much more limited in the other countries. Spain, a country in an intermediate position as to dependence on bank debt, shows also a high share of equity financing, both looking at the share of capital and reserves on firms' total liabilities and to stock market capitalisation in percentage of GDP. More importantly for the transmission of monetary policy impulses the share of short-term debt differs markedly across countries, with higher values in Italy and Spain. Looking at recent transaction data, flows in bank loans have substantially exceeded flows in shares and other equity in Germany, Italy and Spain. France is the exception to this pattern. It seems to be the country with a lower dependence on bank debt, as it is corroborated by its relatively high stock market capitalisation.

One obvious question that arises when looking at cross-country differences is then if these broad institutional characteristics are conducive to a different reaction to monetary policy. It has to be clarified that the research strategy adopted in this paper is only able to address partially the issue of asymmetries across countries. We are in fact mainly interested in documenting the importance of the different transmission mechanisms in each country. Our research strategy is the following: we first estimate investment equations for each country; this gives us the sensitivity of investment to its main determinants: the user cost, sales and cash flow. This permits an assessment of the relative importance of the different channels in each country. Moreover, by calculating the response of investment determinants to monetary policy we obtain a measure of the elasticity of investment to monetary policy. The comparison of the results obtained across countries is needed to understand how the transmission of monetary impulses takes place at the country level. Moreover, it gives a rough indication of the presence/absence of asymmetries, since cross-country comparisons are not performed on a pooled data set, thus impeding a test on the significance of the differences.

We believe though that examining the main channels of transmission in each country is only a first step for the assessment of the relevance of asymmetries. Consider the case of the broad credit channel: if financial variables prove to be important in some country, then there is evidence that the differences in the access to financial markets in this country play a role. But, at the stage of country by country analysis, finding larger effects of financial variables in one country does not mean that a broad credit channel is at work. One way to partly address this issue consists in performing a test of the differences in reaction to investment determinants for firms that are more likely to be subject to information asymmetries. The detection of significant differences in each country permits to highlight how widespread heterogeneous behaviour is in the countries we examine. What future research in the field should try to do is to carefully assess the quantitative importance of the eventual differences found and try to trace back the differences observed to the presence of heterogeneity in behaviour or in the composition of the firms in the economy.

Table 1a: Financial structure, capital markets and real indicators in the euro area

	Germany	France	Italy	Spain
Financial structure of manufacturing firms (1) *as a % of total liabilities; 1997*				
Bank credit	6.2	7.2	21.2	11.0
Of which:				
Maturity of less than 1 year	3.7	3.3	14.3	6.6
Maturity of more than 1 year	2.5	3.9	6.9	4.4
Bonds	0.2	1.9	0.9	0.1
Capital and reserves	32.9	38.0	28.1	45.7
External financing transactions of non-financial corporations (2) *as a % of nominal GDP; Average 1996-1999*				
Loans	4.5	2.0	2.0	5.4
Securities other than shares	-0.1	0.6	0.0	-0.1
Shares and other equity	1.5	3.4	1.3	2.7
Other liabilities	0.8	0.7	1.2	6.3
Capital markets (2) *As a % of nominal GDP; 1997*				
Total financial liabilities of non financial firms	128.8	268.4	135.0	209.6
Stock-market capitalisation	39.9	49.5	30.6	56.2
Bonds of non financial firms	0.1	..	1.6	2.7
Real indicators				
Investment/GDP % *average 1996-2000* **(3)**	22.2	19.0	19.4	23.3
Share of total non financial firms turnover attributable to firms with less than 250 employees *1997* **(2)**	48.0	56.0	71.0	62.0

(1) Source: BACH data set (European Commission)
(2) Source: Eurostat.
(3) Source: OECD and Eurostat.

III. The theoretical framework

The investment model we use is derived from the neo-classical demand for capital. It is estimated recently on panel data by, among others, Bond, Elston, Mairesse and Mulkay (1997), Chirinko, Fazzari and Meyer (1999), and Mairesse, Hall and Mulkay (1999, 2001). Abstracting from irreversibility, uncertainty, delivery lags, costs of adjustment, the first order condition for a firm's optimisation problem leads to the equality between the marginal product of capital and the user cost of capital UC_{it}:

$$F_K\left(K_{it}, L_{it}\right) = UC_{it}\,, \qquad (1)$$

where i stands for firm i and t stands for time.

Following Auerbach (1983) and Hayashi (2000), we obtain a weighted-average definition of the user cost of capital where the cost of debt is weighted by its share of the liabilities and the cost of equity is weighted by its share of the liabilities. We use the accounting proportions of debt or of equity which matters for taxation (the denominator for leverage is accounting debt and equity instead of the stock of capital computed by the perpetual inventory method):

$$UC_{it} = \frac{p_{st}^{\ I}}{p_{st}} \frac{(1 - itc_t - \tau_t z_s)}{(1 - \tau_t)} [AI_{it}(\frac{D_{it}}{D_{it} + E_{it}})(1 - \tau_t) + (LD_t)(\frac{E_{it}}{D_{it} + E_{it}}) - (1 - \delta_s) \frac{\Delta P_{st+1}^{\ I}}{P^I_{\ st}} + \delta_s]$$

(2)

with s sector-specific index, p_{st} is the price of final goods, p^I_{st} is the sectorial price of capital goods; τ_t is the corporate income tax rate, against which interest payments and depreciation are assumed to be deductible, z present value of depreciation allowances, *itc* the investment tax credit. AI is the apparent interest rate, measured as interest payment over gross debt, LD is the long term debt rate used as a proxy for the opportunity cost of equity and E book value of equity and δ_s is the industry rate of economic depreciation.

By contrast with the King and Fullerton's (1984) approach, as used by Harhoff and Ramb (2001) and von Kalckreuth (2001), this user cost of capital does not take into account the differences for dividends and retained earnings for households income tax and the distinction between different capital goods for the computation of the net present value of depreciation allowances.[4]

Following Eisner and Nadiri (1968), we parameterise the production function by a constant elasticity of substitution production function:

$$F(K_{it}, L_{it}) = TFP_i A_t \left[\beta_i L_{it}^{\frac{\sigma-1}{\sigma}} + \alpha_i K_{it}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}\nu}, \qquad \alpha_i + \beta_i = 1, \qquad (3)$$

where σ is the elasticity of substitution between capital and labour, ν represents returns to scale, $TFP_i A_t$ is total factor productivity which we assumed to have two components: a firm specific one and a year specific one. Substituting the marginal productivity of capital in equation (1) yields:

$$\log K_{it} = \theta \log Y_{it} - \sigma \log UC_{it} + \log H_{it}, \qquad (4)$$

with $$\theta = \left(\sigma + \frac{1-\sigma}{\nu} \right) \text{ and } H_t = (TFP_i A_t)^{\frac{\sigma-1}{\nu}} \cdot (\nu \alpha_i)^{\sigma}. \qquad (5)$$

Y_{it} represents sales. The variable H_{it} depends on the time varying term A_t and the firm specific term TFP_i. The elasticity of capital to sales is unity ($\theta = 1$), if the production function has constant returns to scale ($\nu = 1$), or if its elasticity of substitution is unity ($\sigma = 1$), that is, in the Cobb-Douglas case.

[4] The user cost variable used in von Kalckreuth (2001) takes better into account the specificities of the German taxation system. However results in this paper are qualitative very similar with results presented here.

We don't assume that (4) always holds, rather we assume (6), with K* the long run target value of the capital stock:

$$\log K^{*}_{it} = \theta \log Y_{it} - \sigma \log UC_{it} + \log H_{it}, \qquad (6)$$

The long run target value for capital, K^{*} is not observable, so that to go from (6) to an empirical specification, we need to specify an adjustment process. We specify an auto-regressive distributed lag model (ADL(3,3)) similar to the one used in Bond, Elston, Mairesse and Mulkay (1997):

$$k_{it} = \omega_1 k_{it-1} + \omega_2 k_{it-2} + \omega_3 k_{it-3} + \theta_0 y_{it} + \theta_1 y_{it-1} + \theta_2 y_{it-2} + \theta_3 y_{it-3} - \sigma_0 uc_{it} - \sigma_1 uc_{it-1} - \sigma_2 uc_{it-2} - \sigma_3 uc_{it-3} + \phi_0 h_{it} + \phi_1 h_{it-1} + \phi_2 h_{it-2} + \phi_3 h_{it-3} \qquad (7)$$

where we have used lower case letters to refer to the corresponding level variables in logs. At this stage, the literature on panel data splits in two models. A first strategy consists of transforming the ADL model as an error correction model, as done in the macro-economic time series literature (e.g. Hall, Mairesse and Mulkay (1999)). A second strategy consists of first differencing the ADL model (e.g. Chirinko, Fazzari and Meyer (1999)). The possibility of firm specific effect not only on the level of productivity, but also on its growth rate may justify this second strategy on panel data. For simplicity, we will only use the second strategy. We leave the possible comparison between the two approaches to companion country papers of the Monetary Transmission Network. First-differencing and using the approximation $\log K_t - \log K_{t-1} = I_t / K_{t-1} - \delta$, and replacing productivity by time dummies, a firm-specific effect *f* and a random term ε, yields:

$$\frac{I_{it}}{K_{it-1}} = \omega_1 \frac{I_{it-1}}{K_{it-2}} + \omega_2 \frac{I_{it-2}}{K_{it-3}} + \omega_3 \frac{I_{it-3}}{K_{it-4}} + \theta_0 \Delta y_{it} + \theta_1 \Delta y_{it-1} + \theta_2 \Delta y_{it-2} + \theta_3 \Delta y_{it-3} - \sigma_0 \Delta uc_{it} - \sigma_1 \Delta uc_{it-1} - \sigma_2 \Delta uc_{it-2} - \sigma_3 \Delta uc_{it-3} + time\ dummies + \varepsilon_{it} + f_i \qquad (8)$$

We estimate this equation (8). The long run user cost elasticity with respect to the stock of capital is given by $\sigma_{LT} = (\sigma_0 + \sigma_1 + \sigma_2 + \sigma_3)/(1 - \omega_1 - \omega_2 - \omega_3)$ and the long run sales elasticity with respect to the stock of capital is $\theta_{LT} = (\theta_0 + \theta_1 + \theta_2 + \theta_3)/(1 - \omega_1 - \omega_2 - \omega_3)$.

In addition, we consider an important extension of equation (8). It has been frequently argued that a measure of liquidity related to the credit channel of monetary policy should enter the model to account for access to internal funds that affect investment. In this model, liquidity is measured as cash-flow (CF). For comparison with the existing literature and, to avoid unit problems, cash flow enters relative to the existing capital stock.

$$\frac{I_{it}}{K_{it-1}} = \omega_1 \frac{I_{it-1}}{K_{it-2}} + \omega_2 \frac{I_{it-2}}{K_{it-3}} + \omega_3 \frac{I_{it-3}}{K_{it-4}} + \theta_0 \Delta y_{it} + \theta_1 \Delta y_{it-1} + \theta_2 \Delta y_{it-2} + \theta_3 \Delta y_{it-3}$$
$$- \sigma_0 \Delta uc_{it} - \sigma_1 \Delta uc_{it-1} - \sigma_2 \Delta uc_{it-2} - \sigma_3 \Delta uc_{it-3} + time\ \ dummies\ \ + \varepsilon_{it} + f_i$$
$$+ \theta_0 \frac{CF_{it}}{p^I_{st} K_{i,t-1}} + \theta_1 \frac{CF_{i,t-1}}{p^I_{s,t-1} K_{i,t-2}} + \theta_2 \frac{CF_{i,t-2}}{p^I_{s,t-2} K_{i,t-3}} + \theta_3 \frac{CF_{i,t-3}}{p^I_{s,t-3} K_{i,t-4}} \qquad (9)$$

One has to note that in this case the parameters θ are no longer elasticities with respect to the stock of capital but investment cash-flow sensitivities with obviously a constant elasticity of cash-flow with respect to investment. This specification has the following drawbacks: (i) the long run elasticity of the stock of capital with respect to cash-flow is implicitly constrained to one, (ii) the elasticities of capital with respect to user cost and sales are affected by the presence of the cash-flow term, particularly in the medium and long run, so that the formulas for long run elasticities holding for equation (8) do not exactly hold for equation (9). These issues are dealt with in the simulations provided in section VII of this paper.

IV. Data set description

In this section an overview is given of the individual country data used in the regressions. Definitions of the variables used were made as comparable as possible between the different countries.

National data sets do differ in many respects. First of all the way in which data are collected in each country is not the same. The fact that the prerequisites for entering in the sample are different implies that the representativeness of each sample differs across countries. In general, the samples are skewed towards larger firms. Moreover, since all the samples are open they differ in the degree of firm turnover.

In Germany, the Bundesbank's corporate balance sheet database constitutes the largest collection of accounting data for German non-financial firms[7]; the collection of financial statements originated from the Bundesbank's function of performing credit

[5] Where the sectors correspond to an aggregation of the NACE93 branch classification of the manufacturing sector.

[7] A detailed description is contained in Deutsche Bundesbank (1998), see also Friderichs and Sauvé (1999), and Stöss (2001).

assessments within the scope of its rediscount operations. On the whole, every year around 70,000 annual accounts were collected, on a strictly confidential basis, by the Bundesbank's branch offices. The German data-set is probably skewed towards large firms since, according to the turnover tax statistics, these firms represented roughly 75% of the total turnover of the West German manufacturing sector, albeit only 8% of the total number of firms.

In France, the data source consists of compulsory accounting tax forms[8] and of additional information taken from surveys collected by the Banque de France (the database "Centrale des Bilans"'). Since these data are collected only from firms who are willing to provide them, also French data are skewed towards large firms.[9]

Data for Italy are drawn from the Italian Company Accounts Data Service (Centrale dei bilanci), that, considering the whole period 1983-1999 and all non financial enterprises contains 692,000 observations, with more or less than 40,000 firms per year. Also for Italy there exists a bias towards large firms, since firms are not randomly drawn: in fact, the prerequisite for entering the sample is that each firm has to be indebted with a bank; moreover preference is given to firms with multiple lending relationships.[10]

The Spanish data were obtained from the Central Balance Sheet Office of the Banco de España (CBBE), and, in particular from the Annual Central Balance Sheet Database (CBA); this database is compiled through the voluntary collaboration of non-financial firms and is edited by means of contacts with them. Thus, it only covers those firms that voluntarily complete the questionnaire and it is biased towards large and manufacturing firms. The initial database included 115,980 observations corresponding to 22,014 firms over the 1983-1999 period. In 1994, its coverage of the non-financial firms sector, in terms of value added, was around 35 %.[11]

For the econometric analysis a smaller data set was used in each country. The loss in observations was due to the following reasons. Firstly, we concentrated the analysis on the manufacturing sector, for which data for the calculation of the capital stock at replacement cost appeared to be more reliable. Second, applying the perpetual inventory formula and using investment over lagged capital as a regressor meant dropping the first year-firm observations. Third, trimming (see appendix) and selecting firms which are consecutively present in the sample at least during five years in order to use a sufficient number of lags as explanatory variables led to the final sample in each country.

[8] They are collected by the Banque de France in the database FIBEN.
[9] Small firms of less than 20 employees are under-represented. No statistical sampling procedure has been used to correct this bias.
[10] Moreover, since the information collected is meant to be a service for banks in deciding their credit policies, the sample is biased towards firms that are creditworthy.
[11] For a more detailed description of this database, see Banco de España (2000).

Some specificities in each country are worth to be mentioned: for the German sample, that originally contained also unincorporated businesses, we excluded sole proprietorships and unincorporated partnerships because of differences in accounting rules[12]; this permits a higher degree of comparability with the other countries. Again for reasons of comparability, we only consider West German manufacturing firms, and we confine ourselves to the years 1988 - 1997.[13] In Italy, we discarded the firms for which information to construct the user cost (i. e. fiscal data) was not available.

In general, we ended up with samples, that though skewed towards larger firms are still representative of the manufacturing sector of each economy. Moreover, very often, balance sheet data only contain large and listed firms, whereas in our sample the median number of employees is 118 in Germany, 31 in Italy, 50 in Spain, and 55 in France. This means also that the data-set covers quite well unlisted companies, which are probably the best candidates to test for balance sheet effects: listed companies represent less than 4 per cent of the sample in Spain, less than 2 in Italy, and less than 6 in Germany and France. Moreover, firms are spread throughout the sectors of manufacturing[14].

In each country, the period covered by the samples used in estimation is 1985-1999, with the exception of Germany for which the time period available for estimation is 1988-1997. The total number of observations and the number of years available are comparable to or higher than those of the sample used by Chirinko et al. (1999) for US firms.[15]For the European samples, coverage, calculated on the total number of employees in the manufacturing sector, ranges from 19 per cent for Spain to 45 per cent for Germany[16].

Table 1b shows the investment-capital ratio, real sales growth, real user cost growth, cash flow on capital, and log of the user cost level in each country. Overall as is usually the case with panel data there is a wide dispersion of the variables used in all countries. Looking at the means, investment over capital is higher in Germany and Spain,

---

[12] Also all publicly owned enterprises were discarded, as they might not be profit oriented.
[13] Earlier years are affected by the radical regulatory changes in accounting introduced in 1985, triggered by an EU directive on the harmonisation of financial statements.
[14] The wider time dimension of these databases makes them preferable to other data-sets containing a larger number of firms which are often available in the countries examined. For example in Italy the CERVED database contains information on balance sheet and profit and loss accounts of all firms excluding sole proprietorships (more or less 500,000 firms), but the first year available is 1993.

[15] They had a sample of 26,071 observations ranging from 1981 to 1991 with a total number of firms of 4,095.
[16] For Germany, coverage calculated over total turnover of the sector in 1996 was 38.4% percent of the turnover of the whole sector. The analysis of the distribution by size indicates that a large portion of small and medium sized enterprises that make up the core of West German industry is present in the sample. Moreover, the sample mirrors the West German industrial structure relatively well.

lower, on similar values, in France and Italy; the dispersion of the variable is higher in Germany and Italy. As to the other variables it is interesting to note that, on average, the ratio of cash flow over capital is higher in France and Germany than in Spain and Italy. The average level of the user cost is higher in the Spanish and French samples; its dispersion is higher in Italy and Spain, probably reflecting the wider dispersion in firms' size.

Table 1b: Summary statistics : complete cleaned data-sets								
Var	**Country**	**Mean**	**Std. Dev.**	**Minimum**	**25%**	**Median**	**75%**	**Maximum**
It/Kt-1								
	Germany	0.181	0.219	0.000	0.059	0.116	0.216	2.291
	France	0.122	0.141	0.000	0.039	0.080	0.151	1.430
	Italy	0.124	0.155	0.000	0.040	0.080	0.151	3.300
	Spain	0.186	0.217	-0.033	0.049	0.117	0.240	1.560
Δlog St								
	Germany	0.021	0.158	-0.596	-0.058	0.021	0.107	0.828
	France	0.029	0.153	-1.780	-0.051	0.029	0.112	1.360
	Italy	0.034	0.196	-2.400	-0.060	0.035	0.131	3.000
	Spain	0.043	0.171	-0.660	-0.051	0.041	0.136	0.780
Δlog Uct								
	Germany	0.025	0.110	-0.356	-0.044	0.025	0.091	0.422
	France	-0.087	0.140	-0.339	-0.107	-0.014	0.089	0.362
	Italy	-0.012	0.263	-2.100	-0.150	-0.008	0.126	1.700
	Spain	0.006	0.150	-0.380	-0.107	0.011	0.113	0.510
CFt/Kt-1								
	Germany	0.276	0.464	-1.191	0.109	0.188	0.325	9.268
	France	0.330	0.330	-0.450	0.160	0.260	0.410	4.320
	Italy	0.196	0.220	-1.200	0.090	0.152	0.244	4.500
	Spain	0.370	0.469	-1.100	0.126	0.256	0.471	5.000
Log Uct								
	Germany	-1.865	0.182	-2.572	-1.984	-1.859	-1.738	-1.126
	France	-1.770	0.140	-2.260	-1.860	-1.770	-1.670	-1.270
	Italy	-1.870	0.272	-3.500	-2.000	-1.860	-1.710	-0.900
	Spain	-1.742	0.185	-3.351	-1.851	-1.736	-1.613	-0.984
		No Obs	**No firms**	**Years**				
	Germany	40362	5876	1989-1997				
	France	61237	6946	1985-1999				
	Italy	94523	8019	1985-1999				
	Spain	19025	2034	1985-1999				

V. Regression results

In this section we present regression results for the specifications reported in equations (8) and (9). We first present estimation results using the WITHIN estimator. We then present estimation results using the GMM estimator developed by Arellano and Bond (1991).

Table 2 reports the results obtained with the WITHIN estimator. We include a full set of time dummies. These will capture the effect of macro influences on firm individual investment. We dropped the lagged dependent variable for two reasons. First, it is known that the WITHIN estimator is biased with certainty when lagged dependent variables are present (Nickell, 1981). This bias is due to the correlation of the fixed effect with the lagged dependent variable. Second, in this way we can compare directly our

WITHIN estimation results with those obtained for U.S. data by Chirinko, Fazzari and Meyer (1999) using a panel of 4095 manufacturing and non-manufacturing firms from 1981-91, that represented 48% of aggregate U.S. non-residential investment in 1987. (See their Table 2 at page 62 for the WITHIN results.)

For all countries, sales have a substantial effect in the long run on the capital stock. We obtain long term sales elasticities ranging from 0.407 in Germany to 0.228 in Italy. Also for all countries, the contemporaneous effect of sales is the largest, ranging from 0.126 in Germany to 0.075 in Italy. All lags of sales growth (up to t-3) have a significant effect on investment. This could be due to many different reasons, including installation lags or adjustment cost. Chirinko et al. (1999) found a rather similar long run sales elasticity of 0.322 with a contemporaneous effect of 0.120 for the U.S.

For all countries except Spain, also the user cost has a significant effect on the capital stock in the long run. We obtain user cost elasticities ranging from –0.63 in Germany to –0.318 in Italy[17]. Chirinko et al. (1999) found a long run user cost elasticity of -0.721. In every country (including the U.S.), except for Spain, these long-term user cost elasticities are even higher than the long-term sales elasticities. Again, the contemporaneous effect is the largest and past user cost changes are generally significant. This provides evidence against simple sales-accelerator models that only include sales and exclude user costs. It is important to note that even for Spain, although the long-run user cost elasticity (UCE) is not significant, the contemporaneous user cost effect is clearly negative and significant. Moreover, in a more parsimonious specification, removing the insignificant lags, the point estimates of the remaining regressors do not significantly change and the long run user cost elasticity is larger, in absolute value, and significant.

Although the WITHIN estimate of the UCE is less than –1 (which is the value it would have in a Cobb Douglas world), there are theoretical arguments suggesting that this within estimate is biased towards zero (see Mankiw and Summers, 1988, or Chirinko et al., 1999). As already noted, Chirinko et al. point out that "*positive investment shocks can cause positive movements in output and the demand for credit that affect the required rates of return on debt and equity*".

[17] The sign and dimension of these two effects are similar to those obtained using specifications with a different lag structure and are similar to that reported in the paper by Gaiotti and Generale that employ a data set that contains also non-manufacturing Italian firms.

Table 2: Models of Investment Demand – 3 lags WITHIN estimates, Dependent Variable: $I_{I,t/}$ $K_{I,t-1}$

Explanatory Variable	GERMANY	FRANCE	ITALY	SPAIN
Δlog $S_{I,t}$	0.126 (0.008)**	0.107 (0.005)**	0.075 (.004)**	0.080 (0.014)**
Δlog $S_{I,t-1}$	0.121 (0.009)**	0.099 (0.005)**	0.072 (0.003)**	0.077 (0.013)**
Δlog $S_{I,t-2}$	0.097 (0.097)**	0.059 (0.005)**	0.048 (0.004)**	0.042 (0.013)**
Δlog $S_{I,t-3}$	0.064 (0.008)**	0.040 (0.005)**	0.031 (0.003)**	0.038 (0.012)**
Long term Sales elasticity	**0.407 (0.022)****	**0.305 (0.011)****	**0.228 (0.010)****	**0.237 (0.033)****
Δlog $UC_{i,t}$	-0.230 (0.013)**	-0.211 (0.0074)**	-0.144 (0.003)**	-0.187 (0.029)**
Δlog $UC_{i,t-1}$	-0.213 (0.014)**	-0.110 (0.0073)**	-0.095 (0.003)**	0.024 (0.030)
Δlog $UC_{i,t-2}$	-0.107 (0.013)**	-0.046 (0.0070)**	-0.052 (0.003)**	0.048 (0.030)
Δlog $UC_{i,t-3}$	-0.080 (0.080)**	-0.015 (0.0060)*	-0.020 (0.002)**	0.023 (0.026)
Long term User cost elasticity	**-0.630 (0.022)****	**-0.382 (0.013)****	**-0.318 (0.01)****	**-0.092 (0.064)**
No. obs.	22734	33,453	62,447	8855
No. Firms	5876	6,946	8,019	2034

The WITHIN estimator could further be biased due to endogeneity of sales and user cost. Therefore we also present the results using the GMM-first difference estimator of Arellano-Bond (1991). This time we include the lagged dependent variable. We use as instruments the lagged variables used in the regression from t-2 onwards. The results are in Table 3.

For all countries, with the partial exception of Spain, the long-run sales elasticities are similar to the WITHIN results. The point estimates increase somewhat for Germany, France and Italy, they decrease for Spain, but the effect of sales on capital remains statistically significant. The effect of sales on investment is clearly a robust feature in every country.

Striking however, is how the point estimates of the long run user cost elasticities change when moving to GMM. These differences are non-uniform across countries. The GMM results show a slightly higher point estimate of the long-run user cost elasticity for Germany (-0.663), a dramatic lower one for France (-0.106) and Italy (-0.111) and a dramatic higher one for Spain (-.259).

So far these are the results obtained not only by means of a common specification, but also by using a common set of instruments. Before proceeding it is worth mentioning some robustness checks made for each country. Comparison with other results is obtained either by running regressions with a slightly modified set of instruments (results not shown) or by taking stock of the results presented in the companion papers of the Monetary Transmission project.

For Germany the AR(2) statistics in the specification presented in Table 3 shows that there might be an autocorrelation problem in the residuals. It is interesting to note that, using King-Fullerton user costs, von Kalckreuth (2001) obtains a smaller user cost elasticity of 0.522 for the same model. In France the significance level of the elasticity of I/K to the user cost turns out to be dependent on the choice of instrument. For Italy, a sensitivity analysis of the results obtained with this specification was conducted by trying different instrument sets. By using a more parsimonious set of instruments, excluding lags 2 and 3 of the user cost, the long run effect of the user cost is -.234, more similar to the outcome of the WITHIN regression. Moreover, the Sargan test accepts the set of instruments at a higher confidence level. The effect of sales is similar to the one observed in table 3. In Spain, the use of a more parsimonious specification leads again to more precise estimates. When removing insignificant lags, the point estimates of the remaining regressors do not significantly vary and the standards errors for the long-run elasticities are significantly lower. In particular, the point estimate for the long run sales elasticity is 0.098 with a standard error of 0.039, and the point estimate of the long run user cost elasticity is – 0.273 with a standard error of 0.131.

Table 3: ADL Models of Investment Demand – 3 lags
GMM estimates, Dependent Variable: $I_{i,t}/K_{i,t-1}$

Explanatory Variable	GERMANY	FRANCE	ITALY	SPAIN
$I_{I,t-1}/K_{i,t-2}$	0.142 (0.017)**	0.024 (0.061)	0.176 (0.007)**	0.123 (0.019)**
$I_{I,t-2}/K_{i,t-3}$	0.010 (0.009)	0.050 (0.011)*	0.022 (0.005)**	-0.004 (0.014)
$I_{I,t-3}/K_{i,t-4}$	0.008 (0.007)	0.029 (0.006)*	0.017 (0.005)**	0.001 (0.012)
$\Sigma\ I_{i,t-n}/K_{i,t-n-1}$	**0.160 (0.026)****	**0.103 (0.031)***	**0.215 (0.013)****	**0.120(0.035)****
$\Delta\log S_{i,t}$	0.162 (0.053)**	0.073 (0.035)*	0.117 (0.032)*	0.038 (0.064)
$\Delta\log S_{i,t-1}$	0.106 (0.013)**	0.086 (0.009)*	0.062 (0.040)**	0.041 (0.017)**
$\Delta\log S_{i,t-2}$	0.069 (0.011)**	0.137 (0.008)*	0.033 (0.005)**	0.027 (0.014)*
$\Delta\log S_{i,t-3}$	0.042 (0.010)**	0.014 (0.006)*	0.013 (0.0054**	0.018 (0.012)
$\Sigma\ \Delta\ \log S_{I,t-n}$	**0.379 (0.062)****	**0.310 (0.024)***	**.224(0.039)****	**0.124(0.075)***
long term Sales elasticity	**0.452 (0.073)****	**0.346 (0.036)***	**.286(0.049)****	**0.141 (0.085)***
$\Delta\log UC_{i,t}$	-0.286 (0.089)**	-0.055 (0.026)*	-0.045 (0.016)**	-0.274 (0.135)**
$\Delta\log UC_{i,t-1}$	-0.170 (0.029)**	-0.045 (0.019)*	-0.027 (0.008)**	-0.003 (0.041)*
$\Delta\log UC_{i,t-2}$	-0.072 (0.021)**	-0.002 (0.011)	-0.011 (0.005)*	0.032 (0.035)
$\Delta\log UC_{i,t-3}$	-0.029 (0.015)	0.007 (0.007)	-0.004 (0.004)	0.017 (0.028)
$\Sigma\ \Delta\ \log UC_{i,t-n}$	**-0.557 (0.134)****	**-0.095 (0.037)***	**-.087(0.030)****	**-0.228(0.177)**
long term User cost elasticity	**-0.663 (0.167)****	**-0.106 (0.048)***	**-.111(0.039)****	**-0.259 (0.201)**
No. Obs.	16858	33453	62447	8855
No. Firms	5876	6946	8019	2034
Sargan-Hansen test	69.81 (p=0.289)	105.12 (p=0.09)	126.8 (p=0.093)	127.26 (p=0.088)
AR(1)	13.74	-6.514 ***	-30.9 **	-14.37**
AR(2)	-2.034 (p=0.042)*	-2.174 (p=0.030)	0.08 (p=0,99)	-0.19 (p=0.849)

Estimation method: 2-step GMM estimates, time dummies
Instruments: Germany: lags 2 and earlier of **I/K, ΔlogS** and **ΔlogUC** ; Spain: lags 2 to 5 of **I/K, ΔlogS** and **ΔlogUC** ; Italy: instruments used **I/K** lags 2 to 6; **ΔlogS** and **ΔlogUC** lags 2 to 4.; France: instruments used **I/K** lags 3 to 5; **ΔlogS** lags 2 to 4 and **ΔlogUC** lags 2 to 5.

We also wanted to check whether the sales and user cost elasticities are sensitive to adding cash flow to the regression. Since Fazzari, Hubbard and Petersen (1988) it is usual to enter cash flow in the regression to allow for liquidity constraints. The results, estimated by GMM are presented in table 4.

As is generally the case in the empirical literature, the cash flow capital ratio enters significantly and with a positive sign. The total effect of cash flow on I/K ranges from a low 0.079 in Germany to a high 0.301 in Italy. The higher coefficient with respect to those obtained in the other countries could indicate that firms' balance sheet conditions are relatively important in Italy. [18] Also the sales elasticity goes down substantively for all

[18] On the other hand, as it is well discussed by Bond et al. (1997), a positive effect of cash flow on investment does not necessarily reflect the presence of financial constraints. If higher cash flows are a good predictor of high activity in the future, it may very well be that a positive relationship between investment and cash flow does not reflect the existence of financial

countries. Since cash flow proxies for future profitability and future sales this result was to be expected. Likewise in the former regression, the sales variable might have picked up some effects that should really have been attributed to liquidity and profits. The long-run user cost elasticities are different with respect to the former GMM results. They are lower for Germany and Italy if for this country we compare the results obtained using the same set of instruments; they are close to zero for France and turn out to be higher for Spain. The change in the long run user cost elasticity when cash flow is entered into the regression can be explained by how the user cost was constructed. The apparent interest rate variable used for constructing the user cost of capital is interest payments divided by the amount of debt. This induces a correlation with cash flow, in which interest payments also are an important part. As noted by Chirinko, Fazzari and Meyer (1999) "*in the regression without cash flow the estimated sum of coefficients of the user cost captures both the conventional substitution effect as well as the income effect induced by financing constraints, which affect investment in the same direction*".

Overall, the results in Tables 2, 3 and 4 suggest that sales, user cost and cash flow are all three important determinants of investment. That user cost enters significantly in investment regressions is an important finding, since it is the prerequisite for an interest rate channel. The finding that (for most countries) the user cost elasticity varies substantially according to estimation method and specification is less satisfying. (Note that this is also the case for the U.S. in Chirinko, Fazzari and Meyer (1999).) However, given that the user cost is a pretty elusive variable this is not too surprising.

constraints. To partially address this critique the regression for Italy was re-run using liquidity stock as a measure of firms' balance sheet conditions. This variable should be less correlated with expectations of future demand conditions: results (not reported) indicate that also liquidity has a positive and significant effect on capital formation; in the regression the sign and significance of sales and the user cost remain unchanged.

Table 4 : ADL Models of Investment Demand – 3 lags including cash flow
GMM estimates, Dependent Variable: $I_{i,t/}$ $K_{I,t-1}$

Explanatory Variable	**GERMANY**	**FRANCE**	**ITALY**	**SPAIN**
$I_{i,t-1}/K_{i,t-2}$	0.124 (0.017)**	0.086(0.01)**	.168(.011)**	0.120(0.021)**
$I_{i,t-2}/K_{i,t-3}$	0.002 (0.009)	0.016(0.007)*	.024(.006)**	0.007 (0.014)
$I_{i,t-3}/K_{i,t-4}$	0.005 (0.007)	0.014(0.006)*	.018(.005)**	0.010 (0.012)
	0.131 (0.026)**	**0.116 (0.033)****	**.206(.016)****	**0.137 (0.038)****
$\Delta\log S_{i,t}$	0.142 (0.054)**	0.031 (0.04)	.045(.033)	-0.043 (0.063)
$\Delta\log S_{i,t-1}$	0.097 (0.014)**	0.055(0.009)**	.039(.006)**	0.028 (0.018)
$\Delta\log S_{i,t-2}$	0.061 (0.011)**	0.017 (0.007)*	.018(.005)**	0.014 (0.014)
$\Delta\log S_{i,t-3}$	0.036 (0.010)**	0.007 (0.005)	.007(.004)	0.016 (0.013)
$\Sigma\ \Delta\ \log S_{i,t-n}$	**0.338 (0.068)****	**0.110 (0.039)****	**.109(.040)****	**0.015(0.075)**
Long term Sales elasticity	**0.387 (0.077)****	**0.124 ((0.046)****	**.138(.050)****	**0.018(0.087)**
$\Delta\log UC_{i,t}$	-0.220 (0.080)**	0.002 (0.03)	-.079(.021)**	-0.279(0.126)**
$\Delta\log UC_{i,t-1}$	-0.151 (0.028)**	-0.03 (0.03)	-.055(.017)**	-0.018 (0.040)
$\Delta\log UC_{i,t-2}$	-0.060 (0.020)**	0.002 (0.013)	-.021(.013)	0.036 (0.034)
$\Delta\log UC_{i,t-3}$	-0.021 (0.015)	0.002 (0.007)	-.006(.005)	0.021 (0.027)
$\Sigma\ \Delta\ \log UC_{i,t-n}$	**-0.452 (0.124)****	**-0.024 (0.032)**	**-.161(.048)****	**-0.240(0.171)**
Long term User cost elasticity	**-0.521 (0.148)****	**-0.027 (0.039)**	**-.204(.060)****	**-0.278(0.198)**
$CF_{i,t}/K_{i,t-1}$	0.043 (0.036)	0.056 (0.03)*	.255(.035)**	0.121 (0.032)**
$CF_{i,t-1}/K_{i,t-2}$	0.011 (0.012)	0.091 (0.015)**	-.025(.019)	0.037 (0.022)*
$CF_{i,t-2}/K_{i,t-3}$	0.011 (0.006)	0.018 (0.007)**	.008(.007)	-0.019(0.009)**
$CF_{i,t-3}/K_{i,t-4}$	0.004 (0.005)	0.008 (0.005)	.000(.006)	-0.006 (0.008)
$\Sigma\ CF_{I,t-n}/K_{i,t-n-1}$	**0.069 (0.027)***	**0.173 (0.030)****	**.238 (.022)****	**0.133(0.032)****
Long term Cash flow sensitivity	**0.079 (0.031)***	**0.196 (0.039)****	**.301 (.028)****	**0.153 (0.037)****
No. Obs.	16858	33,453	62447	8855
No. Firms	5876	6946	8019	2034
Sargan-Hansen test	91.80 (p=0.288)	133.4 (p=0.43)	127.2(p=.40)	149.81 (p=0.17)
AR(1)	13.72**	-24.6**	-30.1**	-14.62**
AR(2)	2.079(p=0.038)*	1.207 (p=0.228)	-.18(p=.86)	0.13 (p= 0.90)

Instruments:
Germany: lags 2 and earlier of all explanatory variables
Italy: instruments used **I/K** lags 2 to 6; **ΔlogS** lags 2 to 4**; ΔlogUC** lag 4; **CF/K** lags 2 to 5.
Spain: lags 2 to 5 of I/K, CF/K and Δlog UC, and lags 2 to 4 of Δlog S.
France: lags 2 to 5 of I/K, CF/K and Δlog S, and lags 3 to 5 of Δlog UC.

VI. The broad credit channel in the euro area

In this section we test whether small and large firms show different investment behaviour. We are especially interested in differences in the coefficient estimates of the cash flow capital ratio. By testing whether the long run effect of the cash flow capital ratio are significantly different for small firms, we are able to compare the behaviour of firms that are likely characterised by weaker balance sheets with that of other firms.

As it is well known: "*models that incorporate financial frictions are more relevant for certain types of agents, certain classes of borrowers, and certain sectors of* *the economy* (Gilchrist and Zakrajsek, 1995)". Moreover, as these authors note: "*because of the difficulties associated with formulating and estimating true structural models, empirical exercises seeking to establish the validity of either a credit channel or a financial accelerator must make comparisons against benchmarks where such credit effects are less likely to be relevant*".

Sample comparisons using size as a discriminating characteristic of the balance sheet conditions of firms are commonly used in the empirical literature that has examined the link between financial constraints and investment spending (see Schiantarelli, 1995 for a discussion). Smaller firms are more likely to be less collateralized, to be more opaque towards external investors and, as far as age is correlated with small size, have less established contacts with lenders, thus making the screening between good and bad firms more difficult. Other characteristics that have been commonly used in these tests are the dividend payout behavior, group membership, the nature of the bank-firm relationship, the degree of ownership concentration. In particular circumstances and in some countries, these characteristics may very well be more important than size. In fact, as Schiantarelli (1995) notes, one problem with splitting the sample along one firm characteristic is that "[this] *single indicator may or may not be a sufficient statistic for the existence of liquidity constraints*".

The analysis of the institutional characteristics that in each country can blur the relevance of the size split is beyond the scope of this paper. In the companion papers that focus on single country evidence other firm characteristics that might prove relevant for the transmission of monetary policy shocks via the balance sheet are analyzed. (See, for example, Chatelain and Tiomo (2001) for France, von Kalckreuth (2001) for Germany, Valderrama (2001) for Austria, Butzen, Fuss and Vermeulen (2001) for Belgium and Gaiotti and Generale (2001) for Italy). We present here only the size split results since these are probably the more easily comparable across countries.

Table 5 : Long term elasticity of sales and user cost and long term effect of cash flow on large and small firms

GMM ADL3 with CF

	GERMANY	**FRANCE**	**ITALY**	**SPAIN**
Δlog S large firms	0.337 (0.086)**	0.073 (0.032)*	0.108(0.051)*	0.040(0.012)**
Diff. Small – Large	**-0.029 (0.125)**	**0.042 (0.04)**	**0.027(0.079)***	**-0.031 (0.021)**
Δlog $UC_{i,\text{ large firms}}$	-0.512 (0.173)**	-0.053 (0.04)	-0.238(0.060)**	-0.153 (0.082)*
Diff. Small – Large	**0.063 (0.255)**	**0.057 (0.18)**	**0.024(0.098)**	**0.072 (0.167)**
CF/K large firms	0.092 (0.038)*	0.221(0.03)**	0.196 (0.027)**	0.116(0.021)**
Diff. Small – Large	**-0.050 (0.050)**	**-0.035(0.031)**	**0.144 (0.045)****	**0.030 (0.033)**

Table 5 contains the regression results of equation (9) when allowing for different coefficients for user cost growth, sales growth and the cash flow capital ratio for large and small firms. With the exception of Italy, we find no systematic differences between large and small firms across countries. This is the case for both the sales and user cost elasticities and for the effect of cash flow. The point estimates of the differences in elasticities are non-systematically positive or negative and usually non-significant.

For Italy, the coefficient for small firms cash flow results significantly higher than that obtained for large firms. The fact that balance sheet conditions are more important for firms that are more probably exposed to problems of information asymmetries seems to confirm the existence of a broad credit channel in Italy. These results seem robust to different model specifications, such as the error correction model estimated in Gaiotti and Generale (2001).

We think however it would be too early to conclude that the broad credit channel is only operative in Italy. Clearly, more sophisticated sample splits might provide significant differences across firms belonging to different groups. The results in Table 5 do indicate that identifying the broad credit channel by only taking into account the size classification might be too much an oversimplification in most euro area countries. Size might not be a sufficient or even correct indicator for some countries of informational asymmetries that are the basis for broad credit channel effects.

Indeed, as already noted above the companion papers of this research project address the issue of heterogeneity across firms under many other different dimensions. For Germany, when firms' ratings are used as a proxy of financial constraints, it turns out that those with a lower rating are more sensitive to financial variables (von Kalckreuth, 2001). For France, firms belonging to the equipment goods sector, firms with a lower rating and firms with a high share of trade credit in the balance sheet are also more sensitive to cash flow (Chatelain and Tiomo, 2001). In addition, for France, the introduction of dummy variables which isolate firms more sensitive to cash flow has the effect of shifting back the user cost elasticity to its level obtained without cash flow, i.e. a significant value below -0.1. For Italy, firms with a high share of intangible assets over total assets, an indication of the extent of asymmetric information, respond more to variables that approximate their financial condition (Generale and Gaiotti, 2001). Moreover, results for other countries, that we do not analyze by means of a common specification, point to the presence of heterogeneity. For Austria, the presence of a "hausbank" (main bank) significantly affects the transmission of monetary impulses. Valderrama (2001) finds that firms with tighter relationships with the main bank react less to cash flow and more to the user cost, than firms with less "intense" relationships. In Luxembourg younger firms seem more exposed to liquidity constraints, measured by means of various financial ratios (Lünemann and Mathä, 2001). For Belgium, Butzen, Fuss and Vermeulen (2001) document a high degree of heterogeneity in firms' reaction to monetary policy depending on the sectors in which the firm operates.

VII. User cost, cash flow , sales and monetary policy: a simulation exercise[19]

In this section, we first analyse the dynamics of the regression equation. We then perform a more complicated simulation exercise to determine the elasticity of investment w.r.t user cost, sales and cash flow. We finally determine the elasticity of investment w.r.t the market interest rate.

We use the point estimates of the coefficients as presented in table 4. In the following, we present the short run time profile of the investment rate I/K in the presence of simple shocks to the explanatory variables (user cost growth, sales growth, CF/K) and compare these profiles over the four European countries.

Consider the following experiment. Imagine a firm for which user cost growth, sales growth, CF/K and the I/K ratio are all at their steady state path. Imagine next, one single shock at time t to user cost growth, e.g. user cost growth at time t is equal to its steady state path value+0.01, and that after time t user cost growth is again at its steady state path. What happens to the I/K rate at time t, t+1, etc, *assuming the paths of the other variables i.e. real sales growth and CF/K are held constant at their steady state path*? A similar experiment can be performed for real sales growth (holding again the other variables at their steady state), or for CF/K.

Note that one could object to this type of analysis on multiple grounds. First, user cost growth, sales growth and CF/K are all endogenous implying that shocks to one variable might have immediate or lagged effects on the other variables. Basically, the regression equation is just 1 equation describing the I/K ratio. In reality, the behaviour of all relevant variables should be described with a multi-equation system. This is however out of the scope of this paper. Second, the regression equation contains the capital stock at both the left-hand side and right-hand side (I/K and CF/K). Since movements in I/K will ultimately move K, CF/K will also change (unless CF moves in the same amount of K). In this first exercise, we also abstract from this second objection (hence implicitly letting CF move at the same rate of K when holding CF/K constant.).

[19] We want to thank Daniele Terlizzese for a patient and productive discussion of the issues involved.

Given the above two objections, we still believe the experiment to be of value. First, the experiment provides a description of the dynamics of the equation concentrating on one variable at a time. Second, more complicated experiments in which shocks to certain variables coincide with (lagged) shocks to other variables are just linear combinations of the above simple experiments. E.g. if one considers a simultaneous shock to sales growth and CF/K then one can simply add the effects on I/K.

We consider two types of shocks for this experiment. We first consider a shock of 1% (i.e the explanatory variable at time t has the value of its steady state+0.01). We next consider a shock which has a magnitude of one ("1") standard deviation of the within firm variation of the variable. We find this last shock especially appealing because it represents a shock relative to the 'normal' variation present in the variable in our data. We indeed find that the within firm variation of user cost growth, sales growth and CF/K is much larger than 1% and differs substantially across variables and across countries.

Tables 6.1-6.3 present the deviation of the I/K-ratio from its steady state path after those two types of shocks, adopting as a benchmark the specification presented in Table 4. Table 6.1 shows the change in I/K after both a 1% (column 1) or 1 standard deviation shock (column 2) in user cost growth. Most of the effects are within the first two year. A 1% increase in user cost growth has the largest effect in Spain and Germany. Misleadingly, the magnitude of the effect seems small. However, in the data, a 1 standard deviation change in the user cost growth rate is much larger than 1%, it is 10,6% in Germany, 26,1% in Italy and 14.5% in Spain. In the first period, a rise in the user cost growth in Germany of 1 standard deviation depresses the I/K ratio by 2.33%. Given the level of average gross investment per unit of capital of 0.181 in Germany, this translates into a drop to 0.1577. Similar larger effects can be observed in Italy and Spain. The comparison between columns 1 and 2 reveal some interesting features of the data and the regression result. Understand the regression equation as a description of investment behaviour in the period of investigation. Then it is clear that this behaviour was determined by two distinct features. First, the magnitude of the reaction of the I/K ratio to shocks to the explanatory variables. Second, the magnitude of those shocks. For instance, whereas the contemporaneous reaction to identical user cost growth shocks in Italy was much smaller than in Germany (as evidenced in column 1), Italian user cost growth shocks were on average much larger than German ones. Combining those two features implies similar behaviour of the I/K ratio after 1 standard deviation shocks (as evidenced in column 2). Note that our regressions are conditional on the historical variation in the data. This historical variation could be quite different from future variation.

Table 6.1. Change in I/K after a one time 1% or 1 standard deviation increase in the user cost growth at time t

	Germany		France		Italy		Spain	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
T	-0.22	-2.33	0.00	0.03	-0.08	-2.06	-0.28	-4.05
t+1	-0.18	-1.88	-0.03	-0.41	-0.07	-1.78	-0.05	-0.75
t+2	-0.08	-0.84	0.00	-0.01	-0.03	-0.90	0.03	0.40
t+3	-0.04	-0.38	0.00	0.02	-0.01	-0.39	0.02	0.31
A 1 standard deviation increase in the user cost growth is equal to 0.106 in Germany, 0.137 in France, 0.261 in Italy and 0.145 in Spain								
Figures in columns (1) represent the deviation of I/K after a 1% increase of the user cost growth								
Figures in columns (2) represent the deviation of I/K after a 1 standard deviation increase								

Table 6.2 shows the change in I/K after both a 1% (column 1) or 1 standard deviation shock (column 2) in sales growth. Again the largest effects can be observed in the first two years. The sales effect is the largest in Germany. A 1 standard deviation increase in the growth rate of sales increases the I/K ratio by 2.26% in the same year.

Table 6.3 shows the change in I/K after both a 1% (column 1) or 1 standard deviation shock (column 2) in the CF/K ratio. The contemporaneous effects are quite large. They are the smallest in Germany. Investment in Italian and Spanish firms in particular seems to move quite strongly simultaneously with CF/K movements.

Table 6.2. Change in I/K after a one time 1% or 1 standard deviation increase in sales growth at time t

	Germany		France		Italy		Spain	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
T	0.16	2.26	0.03	0.44	0.05	0.84	-0.04	-0.68
t+1	0.12	1.77	0.06	0.81	0.05	0.87	0.02	0.36
t+2	0.08	1.16	0.02	0.32	0.03	0.50	0.02	0.26
t+3	0.04	0.59	0.01	0.15	0.01	0.25	0.02	0.28
A 1 standard deviation increase in sales growth is equal 0.145 in Germany, 0.141 in France, 0.187 in Italy and 0.159 in Spain								
Figures in columns (1) represent the deviation of I/K after a 1% increase in sales growth								
Figures in columns (2) represent the deviation of I/K after a 1 standard deviation increase								

Table 6.3. Change in I/K after a one time 1% or 1 standard deviation increase in CF/K at time t

	Germany		France		Italy		Spain	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
T	0.04	1.28	0.06	1.29	0.26	3.90	0.12	3.74
t+1	0.02	0.47	0.10	2.21	0.02	0.27	0.05	1.59
t+2	0.01	0.40	0.03	0.63	0.02	0.26	-0.01	-0.37
t+3	0.01	0.17	0.01	0.29	0.01	0.12	-0.01	-0.18
A 1 standard deviation increase in the user cost growth is equal to 0.305 in Germany, 0.231 in France, 0.153 in Italy and 0.309 in Spain								
Figures in columns (1) represent the deviation of I/K after a 1% increase in CF/K								
Figures in columns (2) represent the deviation of I/K after a 1 standard deviation increase								

The regression equation 'explains' the I/K ratio in terms of user cost growth, sales growth and the CF/K ratio. However, the reader might it more natural to think of the level of investment in terms of the level of user cost, sales or cash flow. After some algebra, the regression equation can also be used to calculate the elasticity of investment (I) w.r.t either the user cost, sales or cash flow. E.g. with the elasticity of investment w.r.t the user cost we mean the percentage change of investment (i.e. I, not I/K) due to a 'permanent' 1% change (from base path) in the user cost level. The wording 'permanent' is important here. In terms of our regression, a permanent change in the user cost level (from base path) corresponds to a one time 1% change in the growth rate (from base path) of user costs. Since the regression is written in terms of the investment capital ratio and the CF/K ratio, calculating this elasticity is somewhat more involved. Appendix C provides details about the calculation.

Table 7.1-7.3 provide the elasticity of investment w.r.t respectively user cost growth, sales growth and cash flow. A substantive elasticity of investment w.r.t its user cost is a necessary condition for an interest channel to be operative. As evidenced in Table 7.1, the elasticity of contemporaneous investment w.r.t the user cost is quite large in Germany (-1.21), Italy (-0.63) and Spain (-1.49). It is negligible in France (0.02), but becomes nonegligible in the year after (-0.24). The elasticity at time t+1 remains substantive in Germany, Italy and in Spain, but is smaller. Overall, table 7.1 provides evidence of a strong and rapid reaction of investment to user cost changes.

Table 7.1. Elasticity of investment with respect to the user cost

	Germany	France	Italy	Spain
T	-1.21	0.02	-0.63	-1.49
T+1	-1.17	-0.24	-0.59	-0.48
T+2	-0.79	-0.03	-0.36	-0.05
T+3	-0.61	0.00	-0.21	-0.06

In table 7.2, the elasticity of investment w.r.t. sales is presented. The contemporaneous elasticities are 0.86 for Germany, 0.25 for France, 0.36 for Italy and – 0.23 for Spain. Surprisingly in Germany, Italy and Spain, investment seems to have a lower contemporaneous elasticity w.r.t. sales than w.r.t its usercost. Given the emphasis on the sales accelerator model and the general ignoring of user cost in the investment literature this is a provocative result. Although undeniably sales growth does have a positive effect on investment, one should not ignore user costs.

Table 7.2. Elasticity of investment with respect to sales

	Germany	France	Italy	Spain
T	0.86	0.25	0.36	-0.23
T+1	0.82	0.50	0.40	0.09
T+2	0.69	0.25	0.27	0.08
T+3	0.54	0.15	0.17	0.10

Table 7.3 provides the elasticity of investment w.r.t cash flow. Due to the past CF/K ratios in the regression, the effect of a permanent increase in cash flow gradually evolves and accumulates over time. The picture that emerges is mixed. In Germany and France the elasticity is generally lower than the sales elasticity. In Italy and Spain it is generally higher.

Table 7.3. Elasticity of investment with respect to CF

	Germany	France	Italy	Spain
T	0,06	0,15	0,40	0,24
T+1	0,10	0,42	0,46	0,38
T+2	0,13	0,54	0,52	0,39
T+3	0,16	0,60	0,55	0,42

To understand the effect of monetary policy on investment Tables 7.1-7.3 are not sufficient. A relevant question is: ‘How do market interest rates affect user costs and cash flow in those four euro area countries’?[20] Essentially, the interest channel or ‘cash flow channel’ works through two sequences. In the first sequence, the market interest rate has to change firm fundamentals (user cost, and cash flow). In the second sequence, these firm fundamentals have an effect on investment with the elasticities as presented in tables 7.1-7.3. Below we present some evidence on the first sequence and show how combined with the second sequence the channels of monetary policy are different across countries.

We first investigate the effect of market interest rate changes on the user cost. The first important fact that should be noted is that interest rates form a part of the user cost of capital. The importance or weight on this part depends on the importance of the other parts like depreciation and relative price changes. Since the user cost contains directly an interest rate in its definition, the elasticity of the user cost with respect to the interest rate can therefore be calculated directly. It is equal to:

$$\frac{\partial UC_{it}}{\partial i} * \frac{i}{UC_{it}} = \frac{AI_{it}(\frac{D_{it}}{D_{it}+E_{it}})(1-\tau_t)+(LD_{it})(\frac{E_{it}}{D_{it}+E_{it}})}{AI_{it}(\frac{D_{it}}{D_{it}+E_{it}})(1-\tau_t)+(LD_{it})(\frac{E_{it}}{D_{it}+E_{it}})-(1-\delta_s)\frac{\Delta P^{I}_{st+1}}{P^{I}_{st}}+\delta_s}$$

The elasticity is simply the weight of the interest rate in the user cost definition. Hence, if depreciation or changes in relative prices are large, interest changes will have small effects on the user cost. Table 8 shows the relative importance of the interest rate in the user cost definition in the different countries for an average firm in the data set. It is relatively high in Spain and Italy, somewhat lower in France and lowest in Germany. Therefore, market interest rate changes will have larger effects on user cost in Italy and Spain than in France and Germany.

[20] Another relevant question is: ‘How do market interest rates affect sales?’ We do not attempt to answer that question. Interest rate shocks do not have a ‘mechanical’ effect on sales in the same way as interest rates shocks have on user cost and cash flow (interest rates are part of user costs, and interest payments are part of cash flow). Although interest rates can influence firm individual demand (e.g for investment goods or durable consumer goods producing firms), this demand effect is much more difficult to quantify. Trying to do this here would require a whole new paper.

Table 8 : Important elasticities

	Germany	France	Italy	Spain
(1) $\frac{\partial uc}{\partial i} * \frac{i}{uc}$	0.32	0.58	0.70	0.652
(2) $\frac{\partial CF}{\partial i} * \frac{i}{CF}$	-0.32	-0.28	-0.60	-0.471

We now consider the effect of a permanent 1% change in the market interest rate through the user cost. Note that by this we mean e.g. a change in the interest rate from 5% to 5.05%, not from 5% to 6%. Table 8 shows us how much the user cost will change permanently. So e.g. a 1% permanent increase in the market interest rate leads to a user cost change of 0.32% in Germany and 0.70% in Italy. Combining this with the results of table 7.1 renders us the dynamic effects on investment of a 1% change in the market interest rate. The results are presented in table 9.

We find relatively large effects in Germany, Italy and Spain. If one were to consider e.g. a 50 basispoints increase of a market interest rate of 5% to 5.50%, one would have to multiply the numbers in table 9 by 10. Such a policy experiment would lead to contemporaneous 3.9% decrease in investment in Germany, 4.5% in Italy, 9.8% in Spain and no effect in France.

Table 9. Elasticity of investment with respect to the market interest rate through the user cost

	Germany	France	Italy	Spain
T	-0.39	0.01	-0.44	-0.97
T+1	-0.38	-0.14	-0.41	-0.31
T+2	-0.25	-0.02	-0.25	-0.04
T+3	-0.19	0.00	-0.15	-0.04

We also investigate the effect of permanent change in the market interest rate on cash flow. Since interest payments are a flow, they decrease cash flow. When firms have higher interest payments to make, they have lower cash flow, ceteris paribus. The elasticity of cash flow with respect to the interest rate can also be calculated directly. It is equal to:

$$\frac{\partial CF_t}{\partial i_{t-1}} * \frac{i_{t-1}}{CF_t} = -\frac{(1-\tau)i_{i,t-1}D_{i,t-1}}{(1-\tau)(pY - Costs - i_{i,t-1}D_{i,t-1})},$$

The elasticity is equal to the inverse coverage ratio, i.e. interest payments over cash flow. The higher the inverse coverage ratio is, the higher will be the effect of interest payments on cash flow. Table 8 shows the elasticity of cash flow w.r.t to the market interest rate for the average firm in the samples. Italy and Spain display again higher values of this elasticity. Presumably this is due to high nominal interest rates for both countries during the years of investigation. Also, the term structure of debt of the firms has played a role. In Italy, e.g. firms historically were financed with expensive short-term debt. In the future, given the unified interest rates, this might possibly change dramatically.

Table 10 presents the effect on the growth rate of the capital stock (or investment) of a transitory increase of 1% of the interest rate trough the effect on cash flow. The effects are in general relatively small in all countries. Consider again a 50 basis points increase of a market interest rate of 5% to 5.50%. Such a policy experiment would lead, after the first year, to a contemporaneous 0.2% decrease in investment in Germany, 0.4% in France, 2.4% in Italy and 1.1% in Spain.

Table 10. Elasticity of investment with respect to the market interest rate through cash flow

	Germany	France	Italy	Spain
T	-0.02	-0.04	-0.24	-0.11
T+1	-0.03	-0.12	-0.28	-0.18
T+2	-0.04	-0.15	-0.31	-0.18
T+3	-0.05	-0.17	-0.33	-0.20

VIII Conclusion

This paper presents a comparable set of results on the monetary transmission channels on firm investment for the four largest countries of the euro area. We focus on two different channels that affect investment. The interest channel is operative when market interest fluctuations change the user cost of capital and hence investment. The broad credit channel is operative when market interest fluctuations change the balance sheet condition and the available cash flow of firms and through this investment. This paper is the first to provide an investigation of those two channels for the four largest economies of the euro area, based on results from a unique comparative study using large firm databases for each country, containing in total over 215,000 observations from 1985 to 1999. Its emphasis on using large micro-datasets makes this exercise an important complement to the vast macro-literature in which euro area countries are compared.

We find investment to be sensitive to user cost changes in all those four countries. Most of the effect of user cost changes is born within the first two years. This implies an operative interest channel in these euro area countries. We also find investment in all those countries to be quite sensitive to sales and cash flow movements. We have further investigated whether significant differences exist between large and small firms in investment behaviour. We find that only in Italy smaller firms react more to cash flow movements. We argue that size might not be the right indicator in all countries to investigate the broad credit channel.

APPENDIX

A: Cleaning of the Samples:

All the samples were cleaned for outliers by removing percentiles from the variables used in the regression. More details can be found in von Kalckreuth (2001), Gaiotti and Generale (2001), Chatelain and Tiomo (2001).

B. Definition of the User cost variable

The user cost is constructed as,

$$UC = \frac{P_{st}^{I}}{P_{st}}\frac{(1-itc_t-\tau_t z_s)}{(1-\tau_t)}[AI_{it}(\frac{D_{it}}{D_{it}+E_{it}})(1-\tau_t)+(LD_i)(\frac{E_{it}}{D_{it}+E_{it}})-(1-\delta_s)\frac{\Delta P_{st+1}^{I}}{P^{I}_{st}}+\delta_s]$$

with

i: firm specific,

s: sector-specific,

t: time-varying,

P^{I} the investment price, P the value-added price,

τ the highest marginal corporate tax rate,

δ the depreciation rate.

AI: apparent interest rate, as interest payment over gross debt

D: gross debt

LD: long term debt rate

E: book value of equity

z : present value of depreciation allowances

itc: investment tax credit.

C. Simulation

In this appendix we explain the calculation of the elasticity of investment w.r.t user cost, sales and cash flow. It is largely based on an idea developed and explained to us by Daniele Terlizzese.

Start from the estimated equation (where we have dropped the subscripts i):

$$\frac{I_t}{K_{t-1}} = f + \omega_1 \frac{I_{t-1}}{K_{t-2}} + \omega_2 \frac{I_{t-2}}{K_{t-3}} + \omega_3 \frac{I_{t-3}}{K_{t-4}} + \theta_0 \Delta y_t + \theta_1 \Delta y_{t-1} + \theta_2 \Delta y_{t-2} + \theta_3 \Delta y_{t-3} +$$
$$- \sigma_0 \Delta uc_t - \sigma_1 \Delta uc_{t-1} - \sigma_2 \Delta uc_{t-2} - \sigma_3 \Delta uc_{t-3} + \gamma_1 \frac{CF_t}{K_{t-1}} + \gamma_2 \frac{CF_{t-1}}{K_{t-2}} + \gamma_3 \frac{CF_{t-2}}{K_{t-3}} + \gamma_4 \frac{CF_{t-3}}{K_{t-4}}$$
$$time\ dummies\ + \varepsilon_t$$

and the capital accumulation equation:

$$K_t = (1-\delta) K_{t-1} + I_t$$

Define $g_t \equiv \frac{K_t - K_{t-1}}{K_{t-1}} \equiv \frac{I_t}{K_{t-1}} - \delta$. Then we can rewrite the estimated equation by:

$$g_t = f \ + \delta(\omega_1 + \omega_2 + \omega_3 - 1) + \omega_1 g_{t-1} + \omega_2 g_{t-2} + \omega_3 g_{t-3} + \theta_0 \Delta y_t + \theta_1 \Delta y_{t-1} + \theta_2 \Delta y_{t-2} + \theta_3 \Delta y_{t-3} +$$
$$- \sigma_0 \Delta uc_t - \sigma_1 \Delta uc_{t-1} - \sigma_2 \Delta uc_{t-2} - \sigma_3 \Delta uc_{t-3} + \gamma_1 \frac{CF_t}{K_{t-1}} + \gamma_2 \frac{CF_{t-1}}{K_{t-2}} + \gamma_3 \frac{CF_{t-2}}{K_{t-3}} + \gamma_4 \frac{CF_{t-3}}{K_{t-4}}$$
$$time\ dummies\ + \varepsilon_t$$

Consider now, starting in period t, a shock to Δuc_t of 1% (0.01) and define g_t^s as the corresponding new value of g_t and define $K_{t+\tau}^s$ as the corresponding new value of $K_{t+\tau}$.

Define also $\eta_{t+\tau} \equiv \frac{K_{t+\tau}^s - K_{t+\tau}}{K_{t+\tau}}$. Some algebra shows that:

$$\eta_t = \frac{(g_t^s - g_t)}{(1+g_t)} \text{ and } \eta_{t+\tau} = \eta_{t+\tau-1} \frac{(1+g^s{}_{t+\tau})}{(1+g_{t+\tau})} + \frac{(g_{t+\tau}^s - g_{t+\tau})}{(1+g_{t+\tau})}$$

It is immediately clear that : $g_t^s - g_t = -\sigma_0 * 0.01$. And after some algebra that:

$$g_{t+1}^s - g_{t+1} = \omega_1 (g_t^s - g_t) - \sigma_1 * 0.01 - \gamma_1 \frac{CF_{t+1}}{K_t} \frac{\eta_t}{1+\eta_t},$$

$$g_{t+2}^s - g_{t+2} = \omega_1 (g_{t+1}^s - g_{t+1}) + \omega_2 (g_t^s - g_t) - \sigma_2 * 0.01 - \gamma_1 \frac{CF_{t+2}}{K_{t+1}} \frac{\eta_{t+1}}{1+\eta_{t+1}} - \gamma_2 \frac{CF_{t+1}}{K_t} \frac{\eta_t}{1+\eta_t},$$

$$g^s_{t+3} - g_{t+3} = \omega_1 (g^s_{t+2} - g_{t+2}) + \omega_2 (g^s_{t+1} - g_{t+1}) + \omega_3 (g^s_t - g_t) - \sigma_3 * 0.01 - \gamma_1 \frac{CF_{t+3}}{K_{t+2}} \frac{\eta_{t+2}}{1+\eta_{t+2}} - \gamma_2 \frac{CF_{t+2}}{K_{t+1}} \frac{\eta_{t+1}}{1+\eta_{t+1}}$$

$$-\gamma_2 \frac{CF_{t+1}}{K_t} \frac{\eta_t}{1+\eta_t},$$

and so onwards. Given a baseline path for CF/K and g, these equations allow to compute recursively all values of $\eta_{t+\tau}$. The elasticity of the capital stock is then given by 100* $\eta_{t+\tau}$. The elasticity of investment can be easily recovered from that of capital. Define $\eta^I{}_{t+\tau} \equiv \frac{I^s_{t+\tau} - I_{t+\tau}}{I_{t+\tau}}$, then we have using the capital accumulation equation,

$\eta^I{}_t = \eta_t \frac{K_t}{I_t}$ for period t , and $\eta^I{}_{t+\tau} = \eta_{t+\tau} \frac{K_{t+\tau}}{I_{t+\tau}} - (1-\delta)\eta_{t+\tau-1} \frac{K_{t+\tau-1}}{I_{t+\tau}}$ for all later periods. To use these equations we need the baseline paths for $\frac{K_t}{I_t}$, and $\frac{K_{t+\tau-1}}{I_{t+\tau}}$ as well as the values of the depreciation rate. To keep the calculations as simple as possible we assumed all these variables to be constant. To recover δ we used the following identity

$$\delta = \frac{I_t}{K_{t-1}} - g$$

where g is assumed to be equal to the average growth of sales in each country; given δ we then have:

$$\frac{K_t}{I_t} = (1-\delta)\frac{K_{t-1}}{I_t} + 1.$$

We also used the baseline path of CF/K to be the sample average of this variable in each country.

Now consider a 1% shock to cash flow; in period t we will have:

$$g^s_t - g_t = \gamma_1 \left(\frac{CF^s{}_t}{K_{t-1}} - \frac{CF\ _t}{K_{t-1}} \right) = 0.01\gamma_1 c_t$$

where c =CF/K. In period t+1 it will be:

$$g^s_{t+1} - g_{t+1} = \alpha_1 (g^s{}_t - gt) + \gamma_1 c_{t+1} \frac{(0.01-\eta_t)}{(1+\eta_t)} + 0.01\gamma_2 c_t$$

$$g^s_{t+2} - g_{t+2} = \alpha_1 (g^s{}_{t+1} - g_{t+1}) + \alpha_2 \ (g^s{}_t - g_t) + \gamma_1 c_{t+2} \frac{(0.01-\eta_{t+1})}{(1+\eta_{t+1})} + \gamma_2 c_{t+1} \frac{(0.01-\eta_t)}{(1+\eta_t)} + 0.01\gamma_3 c_t$$

and so on. We assume that c remains constant in the baseline.

REFERENCES

Arellano, M, and Bond, S. (1991):"Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations," *Review of Economic Studies*, 58, 277-297.

Auerbach A.J. (1983): "Taxation, Corporate Financial Policy and the Cost of Capital". *Journal of Economic Literature,* Vol 21, 905-40.

Banco de España (2000): "Results of non-financial corporations. Annual Report- 1999", Central Balance Sheet Office, Banco de España.

Bond, S., Elston, J., Mairesse, J. and Mulkay, B. (1997): "A Comparaison of Empirical Investment Equations using Company Panel Data for France, Germany, Belgium and the UK", *NBER working paper n°5900.*

Butzen, P., Fuss, C. and Vermeulen, P. (2001): "The credit channel in Belgium: an investigation with micro-level firm data". *ECB Working Paper, No. 107.*

Chatelain, J.B., Tiomo, A. (2001): "Investment, the Cost of Capital and Monetary Policy in the Nineties in France: A Panel Data Investigation". *ECB Working Paper, No. 106.*

Chirinko, R., Fazzari, S. and Meyer A. (1999): "How responsive is business capital formation to its user cost? An exploration with micro data", *Journal of Public Economics*, 74, 53-80.

Cummins, J., Hassett, K. and Hubbard, G. (1994): "A reconsideration of investment behavior using tax reforms as natural experiments", *Brookings Papers on Economic Activity*, 2, 1-60.

Cummins, J., Hassett, K. and Hubbard, G. (1996): "Tax reforms and investment: a cross-country comparison", *Journal of Public Economics*, 62, 237-273.

Deutsche Bundesbank (1998): “The methodological basis of the Deutsche Bundesbank’s corporate balance sheet statistics’’, *Monthly Report,* October, 49-64.

Eisner, R. and Nadiri, M. (1968): “Investment behavior and the neo-classical theory”, *The review of economics and statistics*, 50, 369-382.

Fazzari, S., Hubbard, G. and Petersen, B. (1988): “Financing constraints and corporate investment”, *Brookings Papers on Economic Activity*, 1, 141-206.

Friderichs, H., and Sauvé A. (1999): “The Annual Accounts Databases on Non-Financial Enterprises of the Banque de France and the Deutsche Bundesbank: Methodological Aspects and Comparability”, in: Sauvé, A, and Scheuer M.(eds.), “*Corporate Finance in Germany and France”* (Deutsche Bundesbank, 1999), 33-62.

Gaiotti, E, Generale, A (2001): “Does Monetary Policy has asymmetric Effects ? A Look at the Investment Decisions of Italian Firms”. *ECB Working Paper, No. 110.*

Gilchrist, S. and Zakrajsek, E. (1995): “The importance of credit for macroeconomic activity: identification through heterogeneity”, in Peek, J. and Rosengreen, E.“*Is bank lending important for the transmission of monetary policy?*”

Guiso, L., Kashyap, A., Panetta, F., and Terlizzese, D. (1999), “ Will a common European Monetary policy have asymmetric effects?”, *Federal Reserve Bank of Chicago Economic Perspectives,* 23(4), 56-75.

Hall, B.H., Mairesse, J. and Mulkay, B. (1999): “Firm-level investment in France and the United States : an exploration of what we have learned in twenty years”, *Annales d’Economie et de Statistique, 55-56.*

Hall, B.H., Mairesse, J. and Mulkay, B. (2000): “Firm-level investment and R&D in France and the United States : A Comparison”, *Annales d’Economie et de Statistique, 55-56.*

Hall, B.H., Mairesse, J. and Mulkay, B. (2001): “Investissement des Entreprises et Contraintes Financières en France et aux Etats-Unis”, *Economie et Statistique,* 341-342, 67-84.

Harhoff, D. and Ramb, F. (2001): "Investment and Taxation in Germany: Evidence from Firm-Level Panel Data", in *Investing today for the world of tomorrow*, Deutsche Bundesbank, Ed., Berlin, Heidelberg, New York: Springer

Hayashi, F (2000): "The Cost of Capital, Q, and the Theory of Investment" in *Econometrics and the Cost of Capital,* Lawrence J. Lau ed., The MIT Press, 55-83.

Hsiao, C. (1986): "The analysis of panel data". Cambridge: Cambridge University Press.

v. Kalckreuth, U. (2001): "Monetary transmission in Germany: New perspectives on financial constraints and investment spending". *ECB Working Paper, No. 109.*

King, M. (1977): *Public policy and the corporation*. London: Chapman and Hall.

King, M. and Fullerton, D. (ed.) (1984): *The taxation of income from capital. A comparative study of the United States, the United Kingdom, Sweden and West Germany*. Chicago and London, The University of Chicago Press.

Lünnemann, P. and Mathä, T. (2001): "Monetary transmission: empirical evidence from Luxembourg firm level data". *ECB Working Paper, No. 111.*

Mankiw, G. and Summers, L. (1988): "Money demand and the effects of fiscal policies: a reply", *Journal of Money, Credit and Banking*, 20, 714-717.

Mojon, B., Smets F., and Vermeulen, P. (2001): "Investment and monetary policy in the euro area". *ECB Working Paper No. 78.*

Nickell, S. (1981): "Biases in dynamic models with fixed effects", *Econometrica*, 54, 1417-1425.

Schiantarelli, F. (1995): "Financial constraints and investment: a critical review of methodological issues and international evidence", in Peek J. and Rosengreen, E. "*Is bank lending important for the transmission of monetary policy?*"

Stoss, E. (2001) " Deutsche Bundesbank's Corporate Balance sheet statistics and areas of application." In *Schmollers Jahrbuch, Journal of Applied Social Science Studies,* 121. 131-137.

Valderrama, M. (2001) "Credit channel and investment behavior in Austria: A micro-econometric approach", *ECB Working Paper, No. 108.*

European Central Bank Working Paper Series

1 "A global hazard index for the world foreign exchange markets" by V. Brousseau and F. Scacciavillani, May 1999.

2 "What does the single monetary policy do? A SVAR benchmark for the European Central Bank" by C. Monticelli and O. Tristani, May 1999.

3 "Fiscal policy effectiveness and neutrality results in a non-Ricardian world" by C. Detken, May 1999.

4 "From the ERM to the euro: new evidence on economic and policy convergence among EU countries" by I. Angeloni and L. Dedola, May 1999.

5 "Core inflation: a review of some conceptual issues" by M. Wynne, May 1999.

6 "The demand for M3 in the euro area" by G. Coenen and J.-L. Vega, September 1999.

7 "A cross-country comparison of market structures in European banking" by O. de Bandt and E. P. Davis, September 1999.

8 "Inflation zone targeting" by A. Orphanides and V. Wieland, October 1999.

9 "Asymptotic confidence bands for the estimated autocovariance and autocorrelation functions of vector autoregressive models" by G. Coenen, January 2000.

10 "On the effectiveness of sterilized foreign exchange intervention" by R. Fatum, February 2000.

11 "Is the yield curve a useful information variable for the Eurosystem?" by J. M. Berk and P. van Bergeijk, February 2000.

12 "Indicator variables for optimal policy" by L. E. O. Svensson and M. Woodford, February 2000.

13 "Monetary policy with uncertain parameters" by U. Söderström, February 2000.

14 "Assessing nominal income rules for monetary policy with model and data uncertainty" by G. D. Rudebusch, February 2000.

15 "The quest for prosperity without inflation" by A. Orphanides, March 2000.

16 "Estimating the implied distribution of the future short term interest rate using the Longstaff-Schwartz model" by P. Hördahl, March 2000.

17 "Alternative measures of the NAIRU in the euro area: estimates and assessment" by S. Fabiani and R. Mestre, March 2000.

18 "House prices and the macroeconomy in Europe: Results from a structural VAR analysis" by M. Iacoviello, April 2000.

19 "The euro and international capital markets" by C. Detken and P. Hartmann, April 2000.

20 "Convergence of fiscal policies in the euro area" by O. De Bandt and F. P. Mongelli, May 2000.

21 "Firm size and monetary policy transmission: evidence from German business survey data" by M. Ehrmann, May 2000.

22 "Regulating access to international large value payment systems" by C. Holthausen and T. Rønde, June 2000.

23 "Escaping Nash inflation" by In-Koo Cho and T. J. Sargent, June 2000.

24 "What horizon for price stability" by F. Smets, July 2000.

25 "Caution and conservatism in the making of monetary policy" by P. Schellekens, July 2000.

26 "Which kind of transparency? On the need for clarity in monetary policy-making" by B. Winkler, August 2000.

27 "This is what the US leading indicators lead" by M. Camacho and G. Perez-Quiros, August 2000.

28 "Learning, uncertainty and central bank activism in an economy with strategic interactions" by M. Ellison and N. Valla, August 2000.

29 "The sources of unemployment fluctuations: an empirical application to the Italian case" by S. Fabiani, A. Locarno, G. Oneto and P. Sestito, September 2000.

30 "A small estimated euro area model with rational expectations and nominal rigidities" by G. Coenen and V. Wieland, September 2000.

31 "The disappearing tax base: Is foreign direct investment eroding corporate income taxes?" by R. Gropp and K. Kostial, September 2000.

32 "Can indeterminacy explain the short-run non-neutrality of money?" by F. De Fiore, September 2000.

33 "The information content of M3 for future inflation" by C. Trecroci and J. L. Vega, October 2000.

34 "Capital market development, corporate governance and the credibility of exchange rate pegs" by O. Castrén and T. Takalo, October 2000.

35 "Systemic risk: A survey" by O. De Bandt and P. Hartmann, November 2000.

36 "Measuring core inflation in the euro area" by C. Morana, November 2000.

37 "Business fixed investment: Evidence of a financial accelerator in Europe" by P. Vermeulen, November 2000.

38 "The optimal inflation tax when taxes are costly to collect" by F. De Fiore, November 2000.

39 "A money demand system for euro area M3" by C. Brand and N. Cassola, November 2000.

40 "Financial structure and the interest rate channel of ECB monetary policy" by B. Mojon, November 2000.

41 "Why adopt transparency? The publication of central bank forecasts" by P. M. Geraats, January 2001.

42 "An area-wide model (AWM) for the euro area" by G. Fagan, J. Henry and R. Mestre, January 2001.

43 "Sources of economic renewal: from the traditional firm to the knowledge firm" by D. R. Palenzuela, February 2001.

44 "The supply and demand for eurosystem deposits – The first 18 months" by U. Bindseil and F. Seitz, February 2001.

45 "Testing the Rank of the Hankel matrix: a statistical approach" by G. Camba-Mendez and G. Kapetanios, February 2001.

46 "A two-factor model of the German term structure of interest rates" by N. Cassola and J. B. Luís, February 2001.

47 "Deposit insurance and moral hazard: does the counterfactual matter?" by R. Gropp and J. Vesala, February 2001.

48 "Financial market integration in Europe: on the effects of EMU on stock markets" by M. Fratzscher, March 2001.

49 "Business cycle and monetary policy analysis in a structural sticky-price model of the euro area" by M. Casares, March 2001.

50 "Employment and productivity growth in service and manufacturing sectors in France, Germany and the US" by T. von Wachter, March 2001.

51 "The functional form of the demand for euro area M1" by L. Stracca, March 2001.

52 "Are the effects of monetary policy in the euro area greater in recessions than in booms?" by G. Peersman and F. Smets, March 2001.

53 "An evaluation of some measures of core inflation for the euro area" by J.-L. Vega and M. A. Wynne, April 2001.

54 "Assessment criteria for output gap estimates" by G. Camba-Méndez and D. R. Palenzuela, April 2001.

55 "Modelling the demand for loans to the private sector in the euro area" by A. Calza, G. Gartner and J. Sousa, April 2001.

56 “Stabilization policy in a two country model and the role of financial frictions” by E. Faia, April 2001.

57 “Model-based indicators of labour market rigidity” by S. Fabiani and D. Rodriguez-Palenzuela, April 2001.

58 “Business cycle asymmetries in stock returns: evidence from higher order moments and conditional densities” by G. Perez-Quiros and A. Timmermann, April 2001.

59 “Uncertain potential output: implications for monetary policy” by M. Ehrmann and F. Smets, April 2001.

60 “A multi-country trend indicator for euro area inflation: computation and properties” by E. Angelini, J. Henry and R. Mestre, April 2001.

61 “Diffusion index-based inflation forecasts for the euro area” by E. Angelini, J. Henry and R. Mestre, April 2001.

62 “Spectral based methods to identify common trends and common cycles” by G. C. Mendez and G. Kapetanios, April 2001.

63 “Does money lead inflation in the euro area?” by S. N. Altimari, May 2001.

64 “Exchange rate volatility and euro area imports” by R. Anderton and F. Skudelny, May 2001.

65 “A system approach for measuring the euro area NAIRU” by S. Fabiani and R. Mestre, May 2001.

66 “Can short-term foreign exchange volatility be predicted by the Global Hazard Index?” by V. Brousseau and F. Scacciavillani, June 2001.

67 “The daily market for funds in Europe: Has something changed with the EMU?” by G. P. Quiros and H. R. Mendizabal, June 2001.

68 “The performance of forecast-based monetary policy rules under model uncertainty” by A. Levin, V. Wieland and J. C.Williams, July 2001.

69 “The ECB monetary policy strategy and the money market” by V. Gaspar, G. Perez-Quiros and J. Sicilia, July 2001.

70 “Central Bank forecasts of liquidity factors: Quality, publication and the control of the overnight rate” by U. Bindseil, July 2001.

71 “Asset market linkages in crisis periods” by P. Hartmann, S. Straetmans and C. G. de Vries, July 2001.

72 “Bank concentration and retail interest rates” by S. Corvoisier and R. Gropp, July 2001.

73 “Interbank lending and monetary policy transmission – evidence for Germany” by M. Ehrmann and A. Worms, July 2001.

74 "Interbank market integration under asymmetric information" by X. Freixas and C. Holthausen, August 2001.

75 "Value at risk models in finance" by S. Manganelli and R. F. Engle, August 2001.

76 "Rating agency actions and the pricing of debt and equity of European banks: What can we infer about private sector monitoring of bank soundness?" by R. Gropp and A. J. Richards, August 2001.

77 "Cyclically adjusted budget balances: An alternative approach" by C. Bouthevillain, P. Cour-Thimann, G. van den Dool, P. Hernández de Cos, G. Langenus, M. Mohr, S. Momigliano and M. Tujula, September 2001.

78 "Investment and monetary policy in the euro area" by B. Mojon, F. Smets and P. Vermeulen, September 2001.

79 "Does liquidity matter? Properties of a synthetic divisia monetary aggregate in the euro area" by L. Stracca, October 2001.

80 "The microstructure of the euro money market" by P. Hartmann, M. Manna and A. Manzanares, October 2001.

81 "What can changes in structural factors tell us about unemployment in Europe?" by J. Morgan and A. Mourougane, October 2001.

82 "Economic forecasting: some lessons from recent research" by D. Hendry and M. Clements, October 2001.

83 "Chi-squared tests of interval and density forecasts, and the Bank of England's fan charts" by K. F. Wallis, November 2001.

84 "Data uncertainty and the role of money as an information variable for monetary policy" by G. Coenen, A. Levin and V. Wieland, November 2001.

85 "Determinants of the euro real effective exchange rate: a BEER/PEER approach" by F. Maeso-Fernandez, C. Osbat and B. Schnatz, November 2001.

86 "Rational expectations and near rational alternatives: how best to form expecations" by M. Beeby, S. G. Hall and S. B. Henry, November 2001.

87 "Credit rationing, output gap and business cycles" by F. Boissay, November 2001.

88 "Why is it so difficult to beat the random walk forecast of exchange rates?" by L. Kilian and M. P. Taylor, November 2001.

89 "Monetary policy and fears of instability" by V. Brousseau and Carsten Detken, November 2001.

90 "Public pensions and growth" by S. Lambrecht, P. Michel and J. -P. Vidal, November 2001.

91 "The monetary transmission mechanism in the euro area: more evidence from VAR analysis" by G. Peersman and F. Smets, December 2001.

92 "A VAR description of the effects of the monetary policy in the individual countries of the euro area" by B. Mojon and G. Peersman, December 2001.

93 "The monetary transmission mechanism at the euro-area level: issues and results using structural macroeconomic models" by P. McAdam and J. Morgan, December 2001.

94 "Monetary policy transmission in the euro area: What do aggregate and national structural models tell us?" by P. van Els, A. Locarno, J. Morgan and J.-P. Villetelle, December 2001.

95 "Some stylised facts on the euro area business cycle" by A.-M. Agresti and B. Mojon, December 2001.

96 "The reaction of bank lending to monetary policy measures in Germany" by A.Worms, December 2001.

97 "Asymmetries in bank lending behaviour. Austria during the 1990s." by S. Kaufmann, December 2001.

98 "The credit channel in the Netherlands: evidence from bank balance sheets" by L. De Haan, December 2001.

99 "Is there a bank lending channel of monetary policy in Spain?" by I. Hernando and J. Martínez-Pagés, December 2001.

100 "Transmission of monetary policy shocks in Finland: evidence from bank level data on loans" by J. Topi and J. Vilmunen, December 2001.

101 "Monetary policy and bank lending in France: are there asymmetries?" by C. Loupias, F. Savignac and P. Sevestre, December 2001.

102 "The bank lending channel of monetary policy: identification and estimation using Portuguese micro bank data" by L. Farinha and C. Robalo Marques, December 2001.

103 "Bank-specific characteristics and monetary policy transmission: the case of Italy" by L. Gambacorta, December 2001.

104 "Is there a bank lending channel of monetary policy in Greece? Evidence from bank level data" by S. N. Brissimis, N. C. Kamberoglou and G. T. Simigiannis, December 2001.

105 "Financial systems and the role of banks in monetary policy transmission in the euro area" by M. Ehrmann, L. Gambacorta, J. Martínez-Pagés, P. Sevestre, A. Worms, December 2001.

106 "Investment, the cost of capital, and monetary policy in the nineties in France: a panel data investigation" by J. B. Chatelain and A. Tiomo, December 2001.

107 "The interest rate and credit channel in Belgium: an investigation with micro-level firm data" by P. Butzen, C. Fuss and P. Vermeulen, December 2001.

108 “Credit channel and investment behaviour in Austria: a micro-econometric approach” by M. Valderrama, December 2001.

109 “Monetary transmission in Germany: new perspectives on financial constraints and investment spending” by U. von Kalckreuth, December 2001.

110 “Does monetary policy have asymmetric effects? A look at the investment decisions of Italian firms” by E. Gaiotti and A. Generale, December 2001.

111 “Monetary transmission: empirical evidence from Luxembourg firm level data” by P. Lünnemann and T. Mathä, December 2001.

112 “Firm investment and monetary transmission in the euro area” by J. B. Chatelain, A. Generale, I. Hernando, U. von Kalckreuth and P. Vermeulen, December 2001.