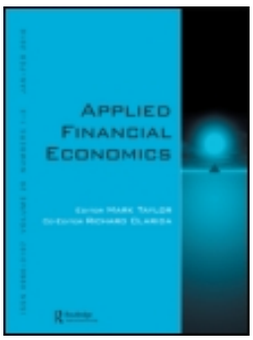

Routledge
Taylor & Francis Group

Applied Financial Economics

ISSN: 0960-3107 (Print) 1466-4305 (Online) Journal homepage: https://www.tandfonline.com/loi/rafe20

Investment and cash flow: evidence for asymmetries in European manufacturing

Konstantinos Drakos & Christos Kallandranis

To cite this article: Konstantinos Drakos & Christos Kallandranis (2007) Investment and cash flow: evidence for asymmetries in European manufacturing, Applied Financial Economics, 17:14, 1191-1200, DOI: 10.1080/09603100600843890

To link to this article: https://doi.org/10.1080/09603100600843890

Applied Financial Economics, 2007, **17**, 1191–1200

Routledge
Taylor & Francis Group

Investment and cash flow: evidence for asymmetries in European manufacturing

Konstantinos Drakos* and Christos Kallandranis

Department of Economics, University of Patras, Greece

An 'excess sensitivity' of investment to internal funds (cash flow) is typically interpreted as evidence for the presence of financing constraints. Building on this, we empirically investigate the possibility of an asymmetric response of investment to the availability of internal funds across expectation states. According to our results the impact of cash flow on investment spending is exacerbated during periods of 'pessimism'. Finally, allowing for both potential sources of asymmetries (across different states of expectations and the business cycle) our results indicate that both sources are significant, with the expectations-driven asymmetry being significantly deeper highlighting the paramount role of expectations.

I. Introduction

Jorgenson (1963) stated that there is no greater gap between economic theory and econometric practice than that which characterizes the literature on business investment in fixed capital. This gap not only remains unfilled until today, but has also widened with more questions added to the research agenda. For instance, it remains an open question whether investment spending of firms is sensitive to the availability of internal funds generated by cash flow. This is an important question because the way in which investment responds to transitory demand shocks and to cyclical variations in profits, crucially depends on whether internal finance constraints capital expenditure (Bond and Meghir, 1994).

A large number of studies have investigated the properties of equilibrium in situations where lenders (principals) cannot costlessly obtain information about the opportunities, characteristics or actions of borrowers (agents) (Townsend, 1979; Stiglitz and Weiss, 1981; Greenwald *et al.*, 1984; Myers and Majluf, 1984; Bernanke and Gertler, 1990; Gertler, 1992; Kiyotaki and Moore, 1997). Although these studies have quite diverse features, they produce a set of predictions that seem to be robust across alternative theoretical setups: (i) under asymmetric information and not fully collateralized loans, external funds are more expensive than internal funds, (ii) this cost differential varies inversely with borrower's net worth and (iii) the otherwise irrelevant mix of financing investment expenditure becomes relevant, with constrained firms exhibiting excess sensitivity on internal funds.

Building on these predictions, another line of research proposed the notion of Financial Accelerator, which in a nutshell suggests that macroeconomic shocks affect borrowers' net worth, thereby producing a 'second-round' amplification of the initial shock (Bernanke *et al.*, 1996). Essentially, since the borrower's net worth affects the premium on external funds, then variations in the former induced by macroeconomic shocks will ultimately propagate these shocks.

Our purpose is to focus on the potentially expectations state-dependent responses of investment

*Corresponding author. E-mail: kdrako@yahoo.co.uk

Applied Financial Economics ISSN 0960–3107 print/ISSN 1466–4305 online © 2007 Taylor & Francis
http://www.tandf.co.uk/journals
DOI: 10.1080/09603100600843890

to cash flow, that would imply an asymmetric impact of capital market imperfections. One may advocate the presence of an 'Expectations Accelerator' through which, negative shocks in expectations could accentuate current financing constraints, in a manner similar to which negative output shocks are amplified through 'second-round' balance sheet effects in the standard Financial Accelerator. The present study makes a twofold contribution to the existing literature. First, it provides an empirical framework that explicitly allows and tests for asymmetries in investment responses to the availability of internal funds across different expectation states. Second, we develop an empirical model that jointly includes the *ex ante* asymmetry due to the state of expectations and the *ex post* asymmetry due to the state of the business cycle.

II. A Brief Review of the Literature

Stiglitz and Weiss (1981) showed that credit rationing may be observed in equilibrium as a result of informational asymmetries between lenders and borrowers. Further research showed that without fully collateralized loans and the borrower's net worth being used as an indicator for her creditworthiness, the perfect substitutability of external and internal funds breaks down. Consequently, this leads to the so-called Financial Hierarchy, which implies that firms wishing to fund their investment plans turn initially to own (internal) resources, while external funds are not sought, until own resources are exhausted. (Townsend, 1979; Greenwald *et al*., 1984; Myers and Majluf, 1984; Bernanke and Gertler, 1990; Gertler, 1992; Kiyotaki and Moore, 1997).

There are two main testable hypotheses derived from this imperfection of the capital market. The first advocates a positive association between cash flow and investment spending, while the second, also known as Financial Accelerator theory, posits that balance sheet positions are more important during downturns in economic activity, via a 'second-round' amplification of adverse shocks.

Numerous empirical studies have tested these hypotheses, where after conditioning on several state variables of investment, they show that balance sheet variables (usually cash flow or more generally measures of liquidity) affect investment spending (see Fazzari *et al*., 1988; Oliner and Rudebusch, 1992; Whited, 1992; Schaller, 1993; Hubbard *et al*., 1995; Goergen and Renneboog, 2001; Ozkan, 2002; Vijverberg, 2004), for US evidence and for European evidence see (Westhead and Storey, 1997; Bond *et al*., 1999; Guariglia, 1999; Audretsch and Elston, 2002; Arrondo and Gomez-Anson, 2003; Bond *et al*., 2003; Berg *et al*., 2004).

A number of studies have provided empirical evidence for the asymmetric response of investment spending to cash flow, indicating an amplification of output shocks via capital market imperfections (see Gertler and Gilchrist, 1993, 1994; Kashyap *et al*., 1994; Bernanke *et al*., 1999; Rafferty and Funk, 2004, for US evidence, and Rondi *et al*. 1998; Vermeulen, 2002 and Peersman and Smets, 2002 for European evidence). Basically, balance sheet profile becomes more important during periods of decline in economic activity when compared with periods of expansion.

III. Empirical Model and Testable Hypotheses

Investment response to capital market imperfections: the benchmark model

Fazzari *et al*. (1988) explored the nexus between financing constraints and investment activity, testing the null hypothesis that under the absence of capital market imperfections a firm's investment decision and cash flow should be unrelated. However, although a positive association between investment and cash flow is consistent with the presence of financing constraints, it may also be compatible with the absence of such constraints. For instance, if cash flow contained additional relevant information about future fundamentals, it would also embody a signal of future profitability rather than solely signifying capital market imperfections (Goergen and Renneboog, 2001; Bond *et al*., 2004). In order to control for market-wide expectations of future profitability, we include in our empirical specification a confidence measure Economic Sentiment Indicator (ESI) as a proxy for expectations and allow changes in confidence (expectations) to exert a direct effect on investment, due to their informational content that stems from their forward-looking nature. In other words, we investigate the robustness of the cash flow-investment association after controlling for an alternative market-wide source of expected future profitability.

Our baseline empirical specification is given by the Sales Accelerator model introduced by Abel and Blanchard (1986). The model assumes that investment grows with past sales, given that past sales reflect the investment opportunity set. We further

condition on the past level of investment and distributed lags of the economic sentiment indicator as shown below[1]:

$$\begin{aligned}\Delta(\mathrm{IK})_{i,t} = {} & \beta_0\Delta(\mathrm{IK})_{i,t-1} + \beta_1[\Delta(\mathrm{CFK})]_{i,t-1} \\ & + \beta_2[\Delta(\mathrm{SK})]_{i,t} + \beta_3[\Delta(\mathrm{SK})]_{i,t-1} \\ & + \beta_4[\Delta(\mathrm{ESI})]_{j,t} + \beta_5[\Delta(\mathrm{ESI})]_{j,t-1} \\ & + \beta_6[\Delta(\mathrm{ESI})]_{j,t-2} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (1)\end{aligned}$$

where, i identifies a specific sector-country pair, t refers to the time period, j refers to country, Δ denotes the first difference operator, β's are unknown parameters to be estimated and ε is a white noise disturbance term. Investment expenditure is denoted by IK, while SK_t and SK_{t-1} are current and one year lagged sales, respectively, CFK is the value of internal funds. Note that all the above variables have been divided by the beginning of period capital stock. ESI_t, ESI_{t-1} and ESI_{t-2} are current, 1 and 2 years lagged Economic Sentiment Indicators[2], respectively. Within this setting, we test whether there is any systematic relation between investment decisions and cash flow as followings:

Hypothesis 1: In the absence of capital market imperfections, investment should be unrelated to cash flow,

$$H_0 : \beta_1 = 0$$

Investment dynamics under capital market imperfections: extending the Benchmark model

We proceed by augmenting the baseline model in two ways in order to investigate different dimensions of asymmetries. The first investigates the possibility of an asymmetry of the financial accelerator *ex ante*, via agents' expectations regarding future economic conditions. Undoubtedly, expectations are bound to be important since investment decisions are by default forward-looking. Hence, we explore whether investment exhibits an asymmetric response to internally generated funds across states of expectations at the time of decision making. The importance of expectations has also been highlighted by Jaffee and Stiglitz (1990), who point out that the anticipation of future credit rationing may have current effects, even when rationing is absent at the time of decision making. Elaborating on this idea and using a formal theoretical model, Saltari and Travaglini (2001) have shown that latent liquidity constraints can affect firms' investment policy even when these liquidity constraints are currently slack. They elegantly demonstrate this, as the outcome of a forward-looking behaviour by the firm that expects future constraints to bind, resulting in current investment decisions to be a function both of current liquidity conditions but also expectations about their future path.

The second augmented version of our baseline model allows for a joint estimation of the two potential sources of asymmetry. In particular, we consider an *ex ante* asymmetry due to expectations (pessimism vs. optimism) and an *ex post* asymmetry due to the state of the business cycle (downturn vs. upturn).

The state of expectations is measured by dichotomizing the space spanned by changes to economic sentiment as follows:

$$\Delta(\mathrm{ESI})^{+}_{j,t}\begin{cases}=1, & \text{if } \Delta(\mathrm{ESI})_{j,t} \geq 0\\ =0, & \text{otherwise}\end{cases}$$

and

$$\Delta(\mathrm{ESI})^{-}_{j,t}\begin{cases}=1, & \text{if } \Delta(\mathrm{ESI})_{j,t} < 0\\ =0, & \text{otherwise}\end{cases}$$

where j and t denote country and year, respectively.

An upward (downward) movement in a given country's sentiment indicator implies that sentiment in the current period is improved (deteriorated) relative to the last period. Hence, we classify a country as being in an optimistic (pessimistic) state of expectations when the economic sentiment indicator has increased (decreased).

In the same spirit, we measure the state of the business cycle in country j at year t, by a dummy that decomposes the changes in the Industrial Production index into 'upturn (nonnegative changes in Industrial Production Index) and downturn (negative changes) as follows:

$$\Delta(\mathrm{IND})^{-}_{j,t}\begin{cases}=0, & \text{if } \Delta(\mathrm{IND})_{j,t} \geq 0\\ =1, & \text{otherwise}\end{cases}$$

Then we estimate a variant of model (1) in order to explore asymmetries across states of expectations:

$$\begin{aligned}\Delta(\mathrm{IK})_{i,t} = {} & \beta_0\Delta(\mathrm{IK})_{i,t-1} + \beta_1^{+}\left[\Delta(\mathrm{CFK})_{i,t-1}\times\Delta(\mathrm{ESI})^{+}_{j,t-1}\right] \\ & + \beta_1^{-}\left[\Delta(\mathrm{CFK})_{i,t-1}\times\Delta(\mathrm{ESI})^{-}_{j,t-1}\right] \\ & + \beta_2[\Delta(\mathrm{SK})]_{i,t} + \beta_3[\Delta(\mathrm{SK})]_{i,t-1} \\ & + \beta_4[\Delta(\mathrm{ESI})]_{j,t} + \beta_5[\Delta(\mathrm{ESI})]_{j,t-1} \\ & + \beta_6[\Delta(\mathrm{ESI})]_{j,t-2} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (2)\end{aligned}$$

[1] The choice of two lags for economic sentiment reflects the trade-off between allowing for a rich enough lag structure and also saving degrees of freedom. In any case, it would be very hard to defend that economic sentiment earlier than 2 years has any predictive power over current.

[2] A detailed description of the variables appears in the data section.

Coefficients β_1^+ and β_1^- in Equation 2, measure the sensitivity of investment with respect to financing constraints, across pessimistic and optimistic states. Note that Model (1) is a special case of Model (2) where investment dependence on cash flow is symmetric across states of expectations. We are interested in testing the validity of the following hypothesis:

Hypothesis 2: Given the imperfection ($\beta_1^+ + \beta_1^- > 0$), a symmetric response of investment across states of expectations requires equality of β_1^+ and β_1^-.

$$H_0: \beta_1^+ - \beta_1^- = 0$$
$$H_0: \beta_1^+ = \beta_1^-$$

In case Hypothesis 2 is rejected one would have evidence for asymmetry, since investment would respond differently to equal magnitudes of cash flow changes across pessimistic and optimistic states of expectations. Our prior is that the asymmetry would take the form $\beta_1^+ < \beta_1^-$, indicating that investment responds more sharply to cash flow in periods of pessimism.

Ac second variant of Model (1) is employed so as to jointly account for *ex ante* and *ex post* asymmetries:

$$\begin{aligned}\Delta(\mathrm{IK})_{i,t} = {} & \beta_0 \Delta(\mathrm{IK})_{i,t-1} + \beta_1 [\Delta(\mathrm{CFK})]_{i,t-1} \\ & + \beta_1^{pes}\left[\Delta(\mathrm{CFK})_{i,t-1} \times \Delta(\mathrm{ESI})_{j,t-1}^{-}\right] \\ & + \beta_1^{down}\left[\Delta(\mathrm{CFK})_{i,t-1} \times \Delta(\mathrm{IND})_{j,t}^{-}\right] \\ & + \beta_2 [\Delta(\mathrm{SK})]_{i,t} + \beta_3 [\Delta(\mathrm{SK})]_{i,t-1} \\ & + \beta_4 [\Delta(\mathrm{ESI})]_{j,t} + \beta_5 [\Delta(\mathrm{ESI})]_{j,t-1} \\ & + \beta_6 [\Delta(\mathrm{ESI})]_{j,t-2} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (3)\end{aligned}$$

The coefficient β_1^{pes} measures the sensitivity of investment during pessimistic states, while β_1^{down} measures investment sensitivity during downturns. The set of hypotheses to be tested is presented subsequently:

Hypothesis 3: Symmetric response of investment across states of expectations.

$$H_0: \beta_1^{pes} = 0$$

Hypothesis 4: Symmetric response of investment across states of the business cycle.

$$H_0: \beta_1^{down} = 0$$

Hypothesis 5: Given asymmetries across (i) states of expectations and (ii) states of the business cycle, the magnitude of *ex ante* and *ex post* asymmetries are equal.

$$H_0: \beta_1^{pes} - \beta_1^{down} = 0$$
$$H_0: \beta_1^{pes} = \beta_1^{down}$$

IV. Empirical Results

Our data set corresponds to the BACH database (Bank for the Accounts of Companies Harmonized) maintained by the European Commission.[3] We use aggregated firm balance sheets and profit and loss accounts for 10 manufacturing industries, across 11 European countries (Austria, Belgium, Italy, France, Netherlands, Germany, Finland, Spain, Portugal, Sweden and Denmark) and for three firm size classes[4] for the period 1987 to 2002. The BACH database[5] is used to construct the Investment – Capital ratio; $\mathrm{IK}_{i,t}$, Sales – Capital ratio; $\mathrm{SK}_{i,t}$ and Cash flow; $\mathrm{CFK}_{i,t}$.

As a proxy for expectations we collect seasonally adjusted monthly observations of the ESI, from the Business and Consumer Surveys of the Economic and Financial Affairs of the European Union.[6] The ESI is a composite measure, which is divided into five

[3] BACH is a database containing harmonized annual accounts data of nonfinancial enterprises and is constructed through the aggregation of a large number of individual firm balance sheet and profit and loss accounts. Before the aggregation takes place, the accounting data are harmonized across countries in a single format, which contains up to 94 accounting items on nonfinancial enterprises either from the balance sheet or the profit and loss accounts. Therefore, each observational unit has one aggregated balance sheet and one profit and loss account that should be relatively comparable across countries.

[4] The three size classes are: small firms (turnover of less than 7 million euros, medium size firms (turnover between 7 and 40 million euros) and large firms (turnover in excess of 40 million euros).

[5] A detailed definition of the variables used is given in Appendix A.

[6] The Directorate General for Economic and Financial Affairs (DG ECFIN) conducts regular harmonized surveys for different sectors of the economies in the European Union (EU) and in the applicant countries. They are addressed to representatives of the industry (manufacturing), the services, retail trade and construction sectors, as well as to consumers. These surveys allow comparisons among different countries' business cycles and have become an indispensable tool for monitoring the evolution of the EU and the Euro area economies, as well as monitoring developments in the applicant countries.

Table 1. Estimation of investment's dependence on cash flow

	Coefficient estimate (SE)					
Regressor	Baseline model		Extension 1: allowing for expectations-dependence		Extension 2: allowing for both sources of asymmetry	
$\Delta(IK_{i,t-1})$	0.0568***	(0.005)	0.0582***	(0.0005)	0.0584***	(0.0005)
$\Delta(SK_{i,t-1})$	0.0364***	(0.0003)	0.0365***	(0.0003)	0.0366***	(0.0003)
$\Delta(SK_{i,t-1})$	−0.003	(0.0002)	−0.0028***	(0.0003)	−0.0027***	(0.0003)
$\Delta(CFK_{i,t-1})$	0.058***	(0.004)	–		0.022***	(0.0041)
$[\Delta(CFK_{i,t-1}) \times \Delta(ESI)^{-}_{j,t-1}]$	–		0.0225***	(0.004)	–	
$[\Delta(CFK_{i,t-1}) \times (ESI)^{-}_{j,t-1}]$	–		0.0956***	(0.0042)	0.071***	(0.0027)
$[\Delta(CFK_{i,t-1}) \times \Delta(IND)^{-}_{j,t}]$	–	–	0.0151***	(0.0027)		
$\Delta(ESI)^{-}_{j,t-1}$	0.007**	(0.003)	0.0082***	(0.0028)	−0.0111***	(0.002)
$\Delta(ESI)^{-}_{j,t-1}$	0.0540***	(0.0039)	0.126***	(0.0028)	0.130***	(0.002)
$\Delta(ESI)^{-}_{j,t-2}$	−0.025***	(0.002)	−0.089***	(0.0026)	−0.090***	(0.0027)
Diagnostics						
m_1	−2.81***	−2.82***	−2.81***			
m_2	−1.26	−1.27	−1.28			
Sargan test	265.97	[0.98]	272.62	[0.97]	272.65	[0.97]
Hypothesis testing						
Hypothesis 1 H_0:$\beta_1 = 0$	209.04***	–	–			
Hypothesis 2 H_0:$\beta_1^{-} = \beta_1^{+}$	–		31.43***		–	
Hypothesis 3 $\beta_1^{pes} = 0$	–		–		662.86***	
Hypothesis 4 $\beta_1^{down} = 0$	–		–		30.28***	
Hypothesis 5 $\beta_1^{pes} - \beta_1^{down} = 0$	–		–		11.68***	

Notes: Values in brackets denote SE, m_1 and m_2 are first- and second-order serial correlation tests, while Sargan stands for the over-identifying restrictions test. Numbers in square brackets denote *p*-values.
*, ** and *** denotes significance at the 10, 5 and 1% levels, respectively.

constituent parts (Industrial Confidence Indicator; 40%, Service Confidence Indicator; 30%, Consumer Confidence Indicator; 20%, Retail Trade Indicator; 5% and Construction Confidence Indicator; 5%) as reported by the Directorate General for Economic and Financial Affairs (DG ECFIN) for the period January 1987 to December 2002.

In order to capture the Business cycle effect we use the seasonally adjusted Industrial Production Index, IND obtained from the Annual Macroeconomic Database (AMECO).[7] The exact measures of ESI and IND employed in our analysis are given by the corresponding annual arithmetic means of the two indices. The descriptive statistics for all variables on a country by country basis as well as in overall terms are provided in Appendix B.

The parameters appearing in Equations 1–3 were estimated using the Generalized Method of Moments (GMM) where lagged levels of the dependent variable and the independent variables are used as instruments (Arellano and Bond, 1991).[8] Given that the errors $\varepsilon_{i,t}$ are not serially correlated, the lagged levels dated $t-2$ and earlier of the dependent variables and the independent variables are valid instruments. The estimation imposes the following linear moment restrictions[9]:

$$E\left[(\varepsilon_{i,t} - \varepsilon_{i,t-1})Z_{i,t-k}\right] = 0 \tag{4}$$

where $k = 2, \ldots, K$ and Z is a vector of instruments.

Arellano and Bond (1991) propose a test for examining first order, m_1 and second order, m_2, serial correlation of the differenced residuals. We also apply the Sargan (1958) test to determine the validity of instruments, which is based on the over-identifying restrictions appearing in Equation 4. Under the null hypothesis of valid instruments, it is asymptotically distributed as χ^2.

The estimation results based on the GMM dynamic panel technique are reported in Table 1.

[7] AMECO is the annual macro-economic database of the European Commission's DG ECFIN. AMECO contains data for EU-25, the euro area, EU Member States, candidate countries and other OECD countries (United States, Japan, Canada, Switzerland, Norway, Iceland, Mexico, Korea, Australia and New Zealand).
[8] It should be noted that $[\Delta ESI]_{j,t-1}$ and $[\Delta ESI]_{j,t-2}$ are treated as pre-determined variables.
[9] Equivalent restrictions apply for the error terms in Equations 1–3.

The over-identifying restrictions are not rejected (see Sargan test) suggesting that the models are well specified and furthermore there is no sign of second-order autocorrelation in the residuals (see m_1 and m_2).[10]

Investment shows a significantly positive dependence on past investment ratio and current sales, while past sales exhibit a weaker (negative) effect. Expectations, via the dynamics of ESI, appear as an important driving factor of investment. This finding is consistent with previously reported findings, where various confidence measures (consumer and/or business confidence) contain significant forecasting power over economic activity in general and investment in particular (Matsusaka and Sbordone, 1995; Santero and Westerlund, 1996; Bodo *et al*., 2000; Lee and Shields, 2000; Lovell and Tien, 2000; Desroches and Gosselin, 2002; Mourougane and Roma, 2002; Utaka, 2003). Recall that ESI is inherently forward-looking and as a result provides an overall (economy-wide) conditional assessment of future economic conditions, which may contain a signal for future profitability of current investment decisions.

Moving now to the parameter of interest, our findings suggest that after conditioning on expectations, cash flow continues to exert a significantly positive impact on investment. Essentially, the rejection of Hypothesis 1 leads us to infer that the relation between cash flow and investment does not merely reflect the informational content of cash flow regarding future profitability. Hence, there is incremental information (over and above expectations) that signifies a structural relationship between the two variables (cash flow and investment), which is the result of capital market imperfections. To sum up, the variation of internal funds explains the variation in business fixed investment due to the special role played by internal funds availability in the presence of financing constraints.

The null hypothesis of perfection in capital markets is strongly rejected, in favour of capital market imperfection. The high sensitivity of investment decisions of firms to liquidity is a recurring theme in the empirical literature, which is quite robust across different periods and countries (Fazzari *et al*., 1988; Oliner and Rudebusch, 1992; Whited, 1992; Schaller, 1993; Bond and Meghir, 1994; Hubbard *et al*., 1995; Goergen and Renneboog, 2001; Vermeulen, 2002; Vijverberg, 2004).

We proceed with inspection of version (2) of the baseline model as reported in column (3) of Table 1. Hypothesis 2 is also rejected, providing us with evidence for the existence of an asymmetric reaction of investment to the availability of internally generated funds. This asymmetry suggests a nonlinear impact of cash flow on investment, depending on the state of expectations. In other words, we document that the state of expectations provides an amplification mechanism for the effects of liquidity constraints. Given this asymmetric reaction, one has to determine the relative magnitude of the differential impact across expectations. It is apparent, from inspection of the estimated parameters that during phases of pessimism the impact of cash flow is intensified. In terms of point estimates of the relevant coefficients, our results suggest that the cash flow effect on investment, conditional on optimistic expectations, is just 23% of the corresponding effect conditional on pessimistic expectations. These findings verify our conjecture that another amplification process is present, operating at a different timing. The differential impact of cash flow across states of expectations highlights their central role in intensifying capital market imperfections.

Finally, we discuss the results from the joint estimation of the two sources of asymmetry (column 4 of Table 1). Focusing on the parameters of interest, both Hypotheses 3 and 4 are strongly rejected, suggesting that the *ex ante* and *ex post* sources of asymmetries are in operation. In particular, the partial derivative of investment with respect to cash flow during periods of pessimism attains a value of 0.07, while the corresponding derivative during periods of downturn is 0.015. Of special interest is Hypothesis 5, which tests the equality of magnitude between the two asymmetries. The null of equal magnitude is emphatically rejected, with the *ex ante* asymmetry being almost six times larger than the *ex post* asymmetry.

V. Conclusion

In this study, we first investigate the presence of capital market imperfections by exploring the relationship between investment and cash flow, controlling for expectations regarding future profitability by including the economic sentiment indicator. According to our results cash flow retains its explanatory power over investment even in the presence of alternative sources of expected

[10] The relevant test detects significant first-order autocorrelation in the residuals. This was expected given the fact that the model is formulated in first differences and consequently the resulting disturbance term exhibits first-order autocorrelation by construction.

future profitability. Secondly, we allow and test for the possibility that the severity of financial constraints for investment depends on the state of expectations. We report evidence for an amplification mechanism of financing constraints that varies with the state of expectations. In particular, investment exhibits excess sensitivity to own funds during periods of pessimism. Thirdly, we incorporate both sources of asymmetry in the investment equation. The findings indicate that both sources are indeed significant with the expectations effect appearing significantly larger. Overall, our results point towards the direction of a non-linear relationship between investment and cash flow, which varies across different states of expectations and business cycle.

References

Abel, A. and Blanchard, O. (1986) The present value of profits and cyclical movement in investment, *Econometrica*, **54**, 249–73.

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**, 277–97.

Arrondo, R. and Gomez-Anson, S. (2003) A study of spanish firms' security issue decision under asymmetric information and agency costs, *Applied Financial Economics*, **13**, 771–82.

Audretsch, D. and Elston, J. (2002) Does firm size matter? Evidence on the impact of liquidity constraints on firm investment, *International Journal of Industrial Organization*, **20**, 1–16.

Berg, C., Hansen, J. and Sellin, P. (2004) The financial accelerator and corporate investment *Sveriges riksbank*, *Economic Review*, **2**, 23–46.

Bernanke, B. and Gertler, M. (1990) Financial fragility and economic performance, *Quarterly Journal of Economics*, **105**, 97–114.

Bernanke, B., Gertler, M. and Gilchrist, S. (1996) Financial accelerator and the flight to quality, *Review of Economics and Statistics*, **78**, 1–15.

Bernanke, B., Gertler, M. and Gilchrist, S. (1999) The financial accelerator in a quantitative business cycle framework, in *Handbook of Macroeconomics* (Eds) J. B. Taylor and M. Woodford, North-Holland, Amsterdam, pp. 1341–93.

Bodo, G., Colinelli, R. and Parigi, G. (2000) Forecasting industrial production in the euro area, *Empirical Economics*, **25**, 541–61.

Bond, S. and Meghir, C. (1994) Investment models and the firm, *Review of Economic Studies*, **61**, 197–222.

Bond, S., Harhoff, D. and Van Reenen, J. (1999). Investment, R&D and financing constraints in Britain and Germany, Working Paper No. W99/5, Institure of Fiscal Studies, London.

Bond, S., Elston, J., Mairesse, J. and Mulkay, B. (2003) Financial factors and investment in Belgium, France, Germany and the UK: comparison using company panel data, *Review of Economics and Statistics*, **85**, 153–65.

Bond, S., Klemm, A., Newton-Smith, R., Syed, M. and Vlieghe, G. (2004). The roles of expected profitability, Tobin's Q and cash flow in econometric models of company investment for Fiscal Studies, Working Paper No. 04/12.

Desroches, B. and Gosselin, A. (2002). The usefulness of consumer confidence indexes in the United States, Bank of Canada, Working Paper No. 2002-22.

Fazzari, S., Hubbard, R. and Petersen, B. (1988) Financing constraints and corporate investment, *Brookings Papers on Economic Activity*, **19**, 141–95.

Gertler, M. (1992) Financial capacity and output fluctuations in an economy with multiperiod financial relationships, *Review of Economic Studies*, **59**, 455–72.

Gertler, M. and Gilchrist, S. (1993) The role of credit market imperfections in the monetary transmission mechanism: arguments and evidence, *Scandinavian Journal of Economics*, **95**, 43–64.

Gertler, M. and Gilchrist, S. (1994) Monetary policy, business cycles and the behaviour of small manufacturing firms, *Quarterly Journal of Economics*, **109**, 309–40.

Goergen, M. and Renneboog, L. (2001) Investment policy, internal financing and ownership concentration in the UK, *Journal of Corporate Finance*, **7**, 257–84.

Greenwald, B., Stiglitz, J. and Weiss, A. (1984) Information imperfections and macroeconomic fluctuations, *American Economic Review*, **74**, 194–99.

Guariglia, A. (1999) The effects of financial constraints on inventory investment; evidence from a panel of uk firms, *Economica*, **66**, 43–62.

Hubbard, G., Kashyap, A. and Whited, T. (1995) Internal finance and firm investment, *Journal of Money, Credit and Banking*, **27**, 323–29.

Jaffee, D. and Stiglitz, J. (1990) Credit rationing, in *Handbook of Monetary Economics* (Eds) B. Friedman and F. Hahn, Amsterdam, North Holland, pp. 837–88.

Jorgenson, D. (1963) Capital Theory and investment behaviour, *American Economic Review*, **57**, 247–59.

Kashyap, A., Lamont, O. and Stein, J. (1994) Credit conditions and the cyclical behaviour of inventories, *Quarterly Journal of Economics*, **109**, 565–92.

Kiyotaki, N. and Moore, J. (1997) Credit cycles, *Journal of Political Economy*, **105**, 211–48.

Lee, K. and Shields, K. (2000) Expectations formation and business cycle fluctuations: an empirical analysis of actual and expected output in UK manufacturing, 1975–1996, *Oxford Bulletin of Economics and Statistics*, **62**, 463–90.

Lovell, C. and Tien, P. (2000) Economic discomfort and consumer sentiment, *Eastern Economic Journal*, **26**, 1–7.

Matsusaka, J. and Sbordone, A. (1995) Consumer confidence and economic fluctuations, *Economic Inquiry*, **33**, 296–318.

Mourougane, A. and Roma, M. (2002). Can confidence indicators be useful to predict short-term real GDP growth?, European Central Bank, Working Paper No. 133.

Myers, S. and Majluf, N. (1984) Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics*, **13**, 187–221.

Oliner, S. and Rudebusch, G. (1992) Sources of the financing hierarchy for business investment, *Review of Economics and Statistics*, **74**, 643–54.

Ozkan, N. (2002) Effects of financial constraints on research and development investment: an empirical investigation, *Applied Financial Economics*, **12**, 827–34.
Peersman, G. and Smets, F. (2002). The industry effects of monetary policy in the Euro Area, European Central Bank, Working Paper No. 165.
Rafferty, M. and Funk, M. (2004) Demand shocks and firm-financed R&D expenditures, *Applied Economics*, **36**, 1529–36.
Rondi, L., Sack, B., Schiantarelli, F. and Sembenelli, A. (1998) Firms' financial and real responses to monetary tightening: evidence for large and small italian companies, *Giornale degli Economisti e Annali di Economia*, **57**, 35–64.
Saltari, E. and Travaglini, G. (2001) Financial constraints and investment decisions, *Scottish Journal of Political Economy*, **48**, 330–44.
Santero, T. and Westerlund, N. (1996). Confidence indicators and their relationship to changes in economic activity, *OECD*, Economics Department, Working Paper No. 270.
Sargan, J. (1958) The estimation of economic relationships using instrumental variables, *Econometrica*, **26**, 393–15.
Schaller, H. (1993) Asymmetric information, liquidity constraints and Canadian investment, *Canadian Journal of Economics*, **26**, 552–74.
Stiglitz, J. and Weiss, A. (1981) Credit rationing in markets with imperfect information, *American Economic Review*, **71**, 393–410.
Townsend, R. (1979) Optimal contracts and competitive markets with costly state verification, *Journal of Economic Theory*, **21**, 265–93.
Utaka, A. (2003) Confidence and the real economy-the Japanese case, *Applied Economics*, **35**, 337–42.
Vermeulen, P. (2002) Business fixed investment: evidence of a financial accelerator in Europe, *Oxford Bulletin of Economics and Statistics*, **64**, 213–31.
Vijverberg, C. (2004) An empirical financial accelerator model: small firms' investment and credit rationing, *Journal of Macroeconomics*, **26**, 101–29.
Westhead, P. and Storey, D. (1997) Financial constraints on the growth of high technology small firms in the United Kingdom, *Applied Financial Economics*, **7**, 197–201.
Whited, T. (1992) Debt, liquidity constraints and corporate investment: evidence from panel data, *Journal of Finance*, **47**, 1425–60.

Appendix A

A1. Construction of the sample

The source of the data is the BACH-database from the European Commission. It contains aggregated balance sheet and profit and loss account information for different industries and size classes of firms. We select 10 manufacturing industries (see below) and 3 size classes for Austria, Belgium, Italy, France, Netherlands, Germany, Finland, Spain, Portugal, Sweden and Denmark. The years of data available are for Austria (1987–2002), for Belgium (1989–2002), for Italy (1987–2002), for France (1987–2002), for Netherlands (1987–2002), for Germany (1987–2000), for Finland (1995–2001), for Spain (1987–2002), for Portugal (1990–2002), for Sweden (1991–2001) and for Denmark (1987–2001). This gives a total of 4022 observations.

A2. Construction of the variables

IK: Investment is measured by BACH item Acquisition of tangible fixed assets minus sales and disposals.

SK: Sales are measured by the sales variable (Turnover) in BACH.

CFK: Cash flow is measured as gross operating profit (net operating profit plus depreciation).

All variables are divided by the beginning-of-period capital stock K proxied by Intangible and Tangible Fixed Assets.

A3. List of the industries used

211: Extraction of metalliferous ores and preliminary processing of metal.
212: Extraction of nonmetalliferous ores and manufacture of nonmetallic mineral products.
213: Chemicals and man-made fibres.
221: Manufacture of metal articles, mechanical and instrument engineering.
222: Electrical and electronic equipment including office and computing equipment.
223: Manufacture of transport equipment.
231: Food, drink and tobacco.
232: Textiles, leather and clothing
233: Timber and paper manufacture, printing.
234: Other manufacturing industries not elsewhere specified (n.e.s.).

Appendix B

Table B1. Summary statistics for IK, SK and CFK (1987–2002)

	IK				SK				CFK			
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Austria	0.150	0.133	0.000	0.730	4.350	3.080	0.926	40.820	0.216	0.179	−0.122	1.870
Belgium	0.290	0.413	0.052	6.700	4.830	1.900	0.624	10.350	0.158	0.109	−0.403	0.581
Denmark	0.063	0.090	−0.242	0.456	3.960	1.610	1.540	16.340	0.249	0.158	−0.471	1.260
Finland	0.164	0.350	−2.190	3.850	3.830	1.930	1.300	13.460	0.323	0.299	−0.079	2.310
France	0.120	0.106	−1.050	1.190	7.380	2.050	3.100	20.400	0.330	0.144	−0.054	1.010
Germany	0.166	0.073	−0.005	0.440	6.670	2.120	2.270	13.940	0.234	0.101	−0.210	0.559
Italy	0.184	0.170	−0.990	3.070	4.280	1.560	0.568	10.360	0.215	0.143	−0.209	0.836
Netherlands	0.111	0.095	−0.063	0.601	3.550	1.500	1.350	12.970	0.209	0.111	−0.210	0.835
Portugal	0.123	0.133	−1.100	0.729	2.940	1.440	0.310	15.640	0.146	0.124	−0.201	0.852
Spain	0.062	0.138	−0.375	1.850	3.600	1.360	0.696	10.500	0.198	0.177	−1.380	1.180
Sweden	0.129	0.173	−0.230	1.550	4.770	2.300	1.390	21.500	0.252	0.221	−1.810	1.090
Overall	0.127	0.202	−2.190	6.700	4.660	2.380	0.310	40.820	0.226	0.168	−1.810	2.310

Notes: Mean, Std. dev., Min, Max, stand for sample average, SD, minimum and maximum respectively. IK stands for investment capital ratio, where investment is measured by BACH item acquisition of tangible fixed assets minus sales and disposals, SK stands for sales capital ratio where sales are measured by the sales variable (Turnover) in BACH and CFK is cash flow capital ratio and is measured from gross operating profit (net operating profit plus depreciation). Capital is the beginning-of-period capital stock and is measured by Intangible and Tangible fixed assets.

Table B2. Summary statistics for ESI, $\Delta(ESI)^+$, $\Delta(ESI)^-$ (1987–2002)

	ESI				Mean		
	Mean	SD	Min.	Max.	$\Delta(ESI)^+$	$\Delta(ESI)^-$	Obs.
Austria	98.19	11.17	81.38	114.82	0.42	0.57	210
Belgium	101.12	8.93	79.97	114.77	0.40	0.60	450
Denmark	98.49	8.91	88.31	115.9	0.53	0.46	450
Finland	101.26	8.75	78.66	112.62	0.46	0.53	450
France	101.28	9.45	82.4	116.53	0.46	0.53	450
Germany	102.24	9.22	82.93	118.73	0.53	0.46	450
Italy	102.11	9.44	80.76	113.61	0.40	0.60	450
Netherlands	100.99	8.54	82.53	113.33	0.46	0.53	450
Portugal	103.97	9.96	79.63	124.03	0.33	0.66	450
Spain	101.06	9.17	77.57	111.55	0.46	0.53	450
Sweden	101.74	11.13	89.13	123.5	0.57	0.42	210
Overall	101.25	9.19	77.57	124.03	0.54	0.45	4470

Notes: Mean, Std. dev., Min, Max, stand for sample average, SD, minimum and maximum. ESI denotes the Economic Sentiment Indicator for each country. $\Delta(ESI)^+$ and $\Delta(ESI)^-$ denote the dummy variables capturing positive and negative changes, respectively for each country. We do not report minimum and maximum values for $\Delta(ESI)^+$ and $\Delta(ESI)^-$ since they are dummy variables.

Table B3. Summary statistics for, IND and $\Delta(IND)^{-}$ (1987–2002)

	IND				$\Delta(IND)^{-}$	
	Mean	SD	Min.	Max.	Mean	Obs.
Austria	104.08	19.10	78.20	135.40	0.57	60
Belgium	101.83	8.35	89.40	115.60	0.60	120
Denmark	98.88	12.42	82.10	118.80	0.46	30
Finland	105.33	24.49	79.60	146.90	0.53	60
France	104.28	8.28	90.40	117.80	0.53	120
Germany	102.54	9.28	88.20	117.60	0.46	90
Italy	97.38	6.71	85.40	107.50	0.60	240
Netherlands	98.24	9.05	84.80	112.10	0.53	120
Portugal	101.16	13.07	80.30	118.90	0.66	180
Spain	102.08	10.54	88.50	119.20	0.53	18
Sweden	98.13	15.32	78.90	120.60	0.42	150
Overall	101.27	5.39	78.20	146.90	0.45	1350

Notes: Mean, Std. dev., Min, Max, stand for sample average, SD, minimum and maximum. IND denotes the Industrial Production Index for each country. $\Delta(IND)^{-}$ denotes the dummy variable capturing negative changes respectively for each country. We do not report minimum and maximum values $\Delta(ESI)^{+}$ since it is dummy variable.