Forecasting aggregate investment in the euro area: do indicators of financial conditions help?

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1. Introduction

The past few years have seen a resurgence of interest in the role that financial conditions play in corporate investment decisions, stemming essentially from the presumption that the current economic cycle is partly shaped by developments in asset prices and gearing. More specifically, in the second half of the 1990s both equity valuations and corporate indebtedness rose sharply to unprecedented levels. The subsequent bursting of the stock market bubble and the protracted slowdown in demand might have led to higher cyclical sensitivity of companies' investment expenditure if companies had had to adjust more rapidly in order to meet debt obligations and adjust their balance sheets. As pointed out by Jaeger (2003), this has important implications for forecasters and policymakers. Indeed, the investment outlook in recent forecasts and projections from international (and private) organisations mostly incorporated some dampening effect from corporate balance sheet adjustments.[2]

There are strong theoretical considerations for taking into account balance sheet effects when assessing corporate investment. Modern finance theory suggests that informational asymmetries can introduce a wedge between (lower) internal and (higher) external costs of finance. If large enough, such a wedge implies that investment projects may have positive net present values but may nevertheless not go ahead or be delayed if there is a lack of internal funds. Adverse financial conditions can also take the form of outright quantity constraints, implying that firms cannot raise external funds at any given cost. In general, constrained firms are likely to be those with relatively small amounts of liquid assets and net worth, where the latter implies lower values of debt collateral. In examining financial constraints in investment, most of the empirical literature has focused on microeconomic data, given that cost and quantity constraints are likely to be related to firm-specific characteristics and that aggregation can blur the identification of important parts of firms' behaviour.

By contrast, forecasts of capital investment are typically undertaken in the context of macroeconomic models with no explicit role for financial constraints. Indeed, the aggregate investment equations in macroeconomic models are typically of a "demand accelerator" or "Q" type and do not normally allow for an impact from financial conditions on investment, other than through cost of capital terms or Q-ratios. At the same time, Bond and Meghir (1994) argue that empirical findings in such equations of investment-profit sensitivities might not reflect financial constraints but simply pick up investment opportunities that are not properly captured by (expected) demand variables and the available proxies for the Q-ratio. Similar problems may exist with regard to other indicators of financial conditions such as share prices. Thus, even if the inclusion of financial variables improves the explanatory power of aggregate investment equations, the economic interpretation of this effect could still be ambiguous.

In this paper we assess the predictive power of various financial indicators in parsimonious aggregate investment equations. Abstracting from theoretical underpinnings, we conduct a horserace exercise where the criterion for incremental predictive power of these indicators is a reduction in the root mean square error of out-of-sample forecasts. We use financial indicators that are more or less readily available to forecasters in order to assess whether ad hoc judgment is the best way to take account of financial variables in projections, or whether there could be a role for a more systematic treatment in

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[1] The views expressed in this paper are those of the authors and do not necessarily represent the views of the European Central Bank.

[2] See, for instance, the ECB's *Monthly Bulletin* of June 2003, the IMF's *World Economic Outlook* of April 2003, the European Commission's *Spring 2003 Forecast* of April 2003 and the *OECD Economic Outlook* of June 2003.

investment equations. The exercise confirms a number of well known problems in estimating aggregate investment equations, in particular the difficulty of finding a significant and stable relationship between financial developments and investment. This may reflect the fact that the typical linear aggregate investment equations used in macroeconomic models are ill-suited to capture the impact of financial variables, given that financing conditions may be more relevant in downturns than in upturns or may start being binding beyond certain thresholds only.

The structure of this paper is as follows. Section 2 discusses some stylised facts of adjustment processes in the corporate sector's capital and financial accounts. This helps to understand the various options - in addition to adjusting investment - which firms may have in reacting to cost of capital and balance sheet problems. It also helps to identify financial quantity variables that are potentially useful in signalling financial constraints on investment. Section 3 examines the statistical significance of financial variables in investment equations and their ability to improve the out-of-sample forecasts. The finding is that improvements in forecast errors - if any - are quantitatively limited. One possible explanation for this is that investment and financial indicators do not have the linear relationship assumed in conventional equations. We test this possibility in terms of regime dependency, but only in very few cases find the estimated sensitivity of investment to financial indicators to be significantly different between regimes. The apparent lack of statistical significance could reflect the failure of those financial variables that are readily available to forecasters to accurately capture the nature and extent of financial constraints. Section 4 concludes.

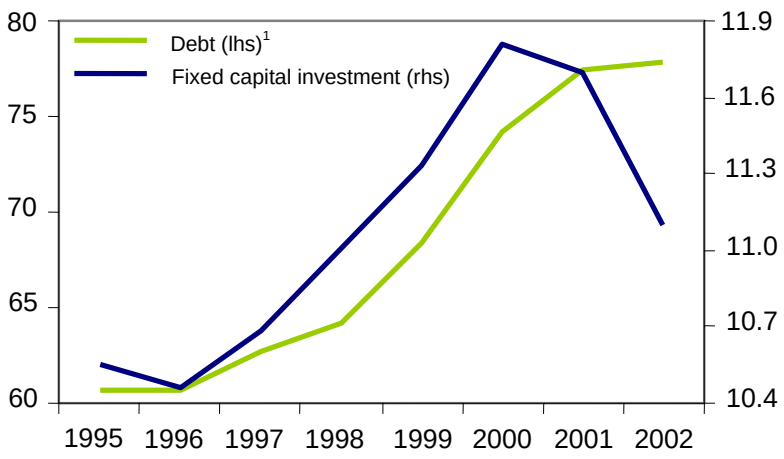
2. Stylised facts of balance sheet adjustments in the corporate sector

This section introduces a general flow of funds framework for analysing balance sheet adjustments in the non-financial corporate sector. The framework is used to review the buoyant investment developments in the second half of the 1990s and their relation to the run-up in corporate debt. As a ratio to GDP, corporate investment increased relatively strongly - by more than 1 percentage point - between 1995 and 2000, and the debt ratio at the same time increased quickly to very high levels of around 75% (Graph 1). Looking at these developments in terms of associated flows helps to assess the adjustments made in the past few years and also gives some indications with regard to the options for further balance sheet corrections in the period ahead.

Graph 1

Investment and debt of euro area non-financial corporations

As a percentage of nominal GDP



[1] Includes loans and debt securities (excluding financial derivatives) issued by and pension fund reserves of non-financial corporations.

Sources: ECB; OECD; Eurostat; authors' own calculations.

The real and financial sides of corporate investment decisions are tied together by a budget constraint. In general terms, outlays for capital investment (*I*) and financial investment (*FI*) are financed by changes in internal funds (*IF*) and external funds, where the latter can take the form of debt (*D*) and/or equity (*E*):

$$I + FI = \Delta IF + \Delta D + \Delta E \qquad (1)$$

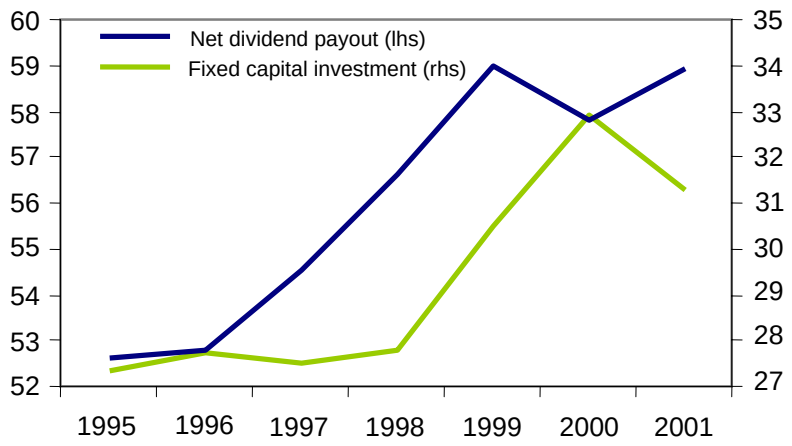
Conversely, the identity implies that in order to reduce debt, businesses have to cut back on investment, generate more internal funds or issue new shares. For tax-paying corporations, the flow of internal funds available for investment essentially reflects profits after subtracting taxes, interest payments and dividend payouts. In addition, the national accounts identify a number of other positions that can affect changes in internal funds, such as net transfers, net acquisitions of non-financial, non-produced assets, or net property incomes from rents and reinvested earnings of foreign direct investment. However, these other positions are relatively small and amount on balance to only 2-3% of the gross operating surplus in the euro area corporate sector. Moreover, due to their nature they are unlikely to play an important active role in businesses' balance sheet adjustment considerations. As official euro area-wide national accounts data for institutional sectors are not yet available, we constructed own estimates for the non-financial corporate sector in the period 1995 to 2001. The estimates are based on OECD data for the individual countries and complement the information from the ECB's monetary and financial accounts available for the period 1995 to 2002.

The pecking order theory of finance establishes a general preference for internal over external funds, and, with regard to the latter, for debt over equity as firms issue the safest security first (Myers (2001)). Looking first at the developments in internal funds, towards the end of the 1990s an increasing part was absorbed by the upturn in corporate spending on capital investment. In 2000, the ratio of fixed capital investment to gross operating surplus peaked at around 58%. Funds were also increasingly absorbed by net dividend payouts, which amounted to around one third of the gross operating surplus at the end of the 1990s (Graph 2). In addition, taxes paid on profits and wealth saw a relatively strong increase to around 10% of gross operating surplus. By contrast, relatively low interest payments took some of the strain off the internally available funds, falling to around 12% of gross operating surplus at the end of the 1990s (Graph 3). Taken together, however, these expenditures exceeded the available internal funds by an increasing margin, reflected in higher net borrowing requirements. This became particularly apparent when in 2000 corporate accounts, mainly in the telecommunications sector, were burdened down by the purchase of UMTS licences.

Graph 2

Investment and dividends of euro area non-financial corporations

As a percentage of gross operating surplus

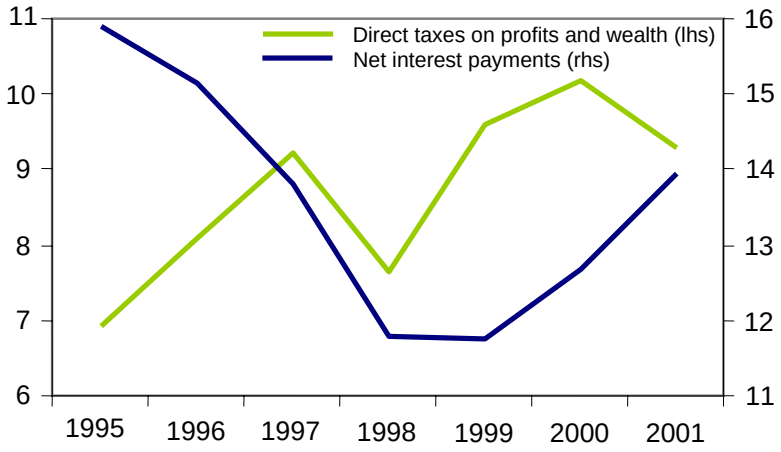


Sources: OECD; authors' own calculations.

Graph 3

Taxes and interest payments of euro area non-financial corporations

As a percentage of gross operating surplus



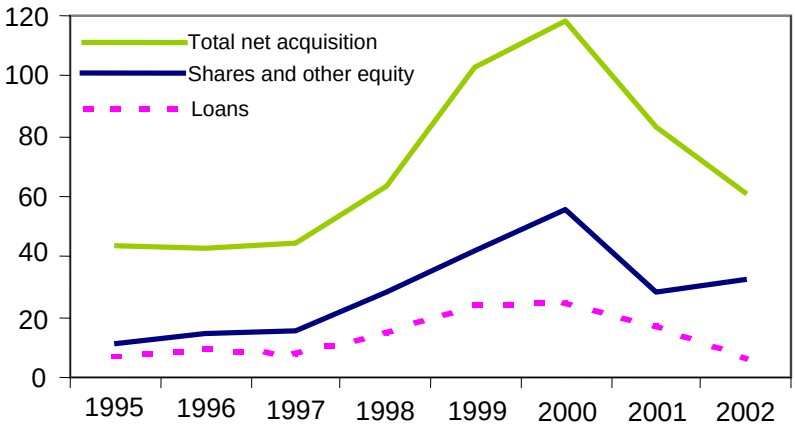
Sources: OECD; authors' own calculations.

The late 1990s were also a period of relatively buoyant financial investment activity. This activity to some extent reflected portfolio investments in a period where stock market prices kept climbing to unprecedented levels. In addition, there was a strong pickup in mergers and acquisitions (M&A) activity, explained by a combination of structural and cyclical factors which fostered, mainly in some sectors like high-tech and telecommunications, the expansion and the scale of the activity of euro area firms domestically and abroad. Overall, net financial investment increased much more strongly than fixed capital investment and in 2000 clearly exceeded the latter while in 1995 it had been less than half of it. Equity investment alone amounted to almost 60% of fixed capital formation in 2000 and intercompany loans accounted for another 20% (Graph 4).

Graph 4

Net financial investment of euro area non-financial corporations

As a percentage of fixed capital formation

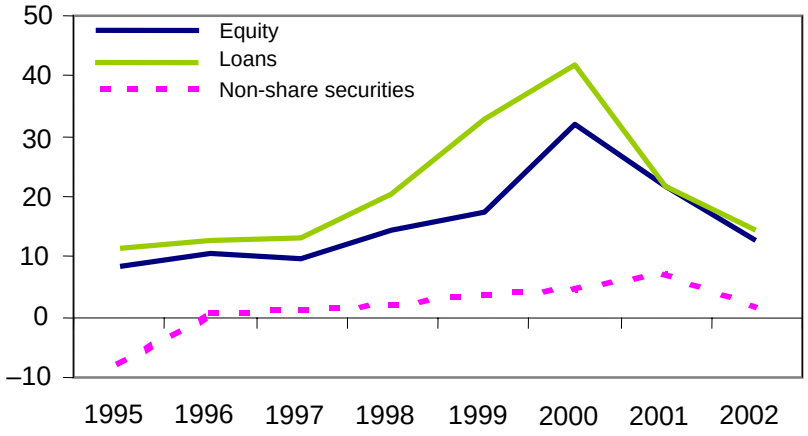


Sources: ECB; authors' own calculations.

Graph 5

Net incurrence of liabilities of euro area non-financial corporations

As a percentage of gross operating surplus[1]



[1] Operating surplus for 2002 estimated from economy-wide data.

Sources: ECB; OECD; authors' own calculations.

The sum of capital and financial investment implied a widening financing gap vis-à-vis the available internal funds and showed in a strongly rising incurrence of liabilities. In 2000 this almost reached the volume of corporate profits, with loans being the largest component of gross operating surplus at around 40% (Graph 5). While over the second half of the 1990s overall debt financing (loans plus debt securities issued) gained relative importance vis-à-vis the issuance of shares and other equity, the latter was particularly strong in 2000 at the height of the stock market boom. Given the buoyant stock price developments until early 2000, some conventional leverage indicators (eg debt in relation to financial or total assets) did not immediately reflect the rising indebtedness of euro area corporations, while others, such as ratios of debt to operating surplus or to GDP, started to reflect it earlier. The strong and protracted fall in stock prices from 2000 onwards not only had repercussions on firms' leverage ratios but in an environment of relatively low interest rates also significantly increased the cost of equity in relation to that of debt. As a consequence, financing via quoted shares was cut back and the relative importance of debt issuance rose again in 2001. In particular, the issuance of debt securities continued to rise relatively strongly right into the early phases of the downturn, reflecting in part the fact that some of the earlier M&A activities were financed through short-term bridge loans which were later substituted by the issuance of debt securities.

The more moderate recourse to external funds that took place after 2000 reflects the lower demand for finance associated with the economic slowdown and the stock market decline but also the return to more normal levels after the one-off boost related to the purchase of UMTS licences. In addition, supply factors could also have played a role if the high level of indebtedness had signalled risks to financial market participants and given rise to more cautious lending policies by banks. Such supply side considerations could have affected the availability of new funds for firms (mainly in the case of the most heavily indebted firms) and/or the risk premia incorporated in their cost. Since 2000, euro area non-financial corporations seem to have been under pressure to improve their financial structure and rationalise investments they have carried out in the past. In some cases (such as telecoms), this involved not only debt restructuring but also business reorganisation, including asset sales in order to generate internal financing resources, despite lower market values.

The adjustment process towards lower financing gaps also involved lower capital investment, while dividend payouts seem to have remained more resilient as a ratio to the gross operating surplus. The role of dividends in the impact of balance sheet adjustment on investment depends on the ranking of business and shareholder objectives. For some corporations, continuity of dividend payments may be on a par with investment and consolidation, given that dividend payout policies can have important signalling effects for financial markets and shareholders. However, with stock prices being low, share

repurchases could be an alternative use of available funds in providing positive signals to financial markets. The debt service burden remained subdued in 2001 and 2002 despite the high level of indebtedness, but, given that profit developments have also remained weak, interest payments took up a slightly rising share in gross operating surplus. By early 2003, the efforts made to generate more internal funds and deleverage balance sheets had not yet translated into visible improvements in debt ratios. Looking forward, more adjustment might thus be needed, but this may be easier once the recovery is fully under way and allows for some "growing-out" effect in terms of higher profits.

The analysis above points to a number of financial variables that interact with fixed capital investment in balance sheet adjustment processes. Forecasting investment in the presence of potential financial constraints would thus ideally consider all the accounting identities implied by the flow of funds. However, in practice, the data set of timely financial variables that is normally available to forecasters tends to be limited and to consist of prices rather than quantities. Moreover, feedback loops between the financial sector and the real economy are typically not taken into account. Forecasters are therefore typically obliged to inform their judgment on the basis of cruder tools. This issue is addressed below.

3. Including financial indicators in investment equations - some empirical results

3.1 Preliminary steps

In this section we establish a benchmark investment equation, which we then use in out-of-sample forecast exercises to examine the statistical relevance of financial variables. The ECB's forecast models are based on quarterly data. A breakdown of quarterly euro area-wide investment by main types of products has recently become available, but a breakdown according to institutional sectors is not available as yet. For the purpose of this paper, it was therefore necessary to choose an investment series on the basis of the available breakdown that is as close as possible to corporate investment. Two measures were considered: non-housing investment and non-construction investment, which, respectively, account for around three quarters and half of total euro area investment. Excluding all construction investment has the drawback of not taking into account the increasing share of buildings and office space in corporate investment as the services sector gains in importance. On the other hand, using non-housing investment implies the drawback of including public infrastructure investment, which does not follow the same determinants as business investment. As this was perceived to be a lesser problem, the focus below is on non-housing investment. This implies looking at investment activities that reflect - to around three quarters - decisions made in the corporate sector (Graph 6).

The analysis presented is carried out with the aim of drawing possible practical conclusions for forecasters. In this respect, we "let the data speak" as much as possible. In particular, we remain agnostic in terms of which measure (growth rates, ratios, etc) to use for the various financial indicators and about the leads and lags involved in their relationship with investment.

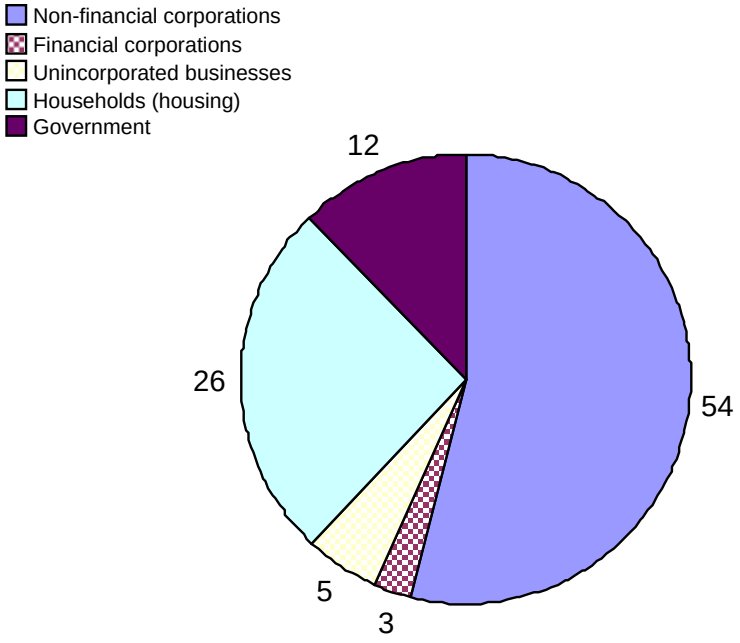
Correlation analysis

As a first step, we compute cross-correlation coefficients in order to obtain some initial indication of which indicators are likely to be useful in explaining developments in the investment ratio. Correlations can also point to a specific measure for a given indicator and specific leads or lags at which it may be relevant. Table 1 shows average correlation coefficients between a series of variables and quarter-on-quarter differences in the ratio of real non-housing investment to GDP. The range of indicators attempts to capture demand conditions and expectations of economic activity as well as financing conditions. Section 2 provided some guidance as to which financial variables would be useful to include, but most of these indicators are financial quantity variables that are not part of the data set used in the ECB's macroeconomic projections. This reflects the fact that for the euro area as a whole these data mostly cover only a very short time period, which makes it difficult to derive reliable empirical evidence on their relevance in structural equations underlying macroeconomic models.

Graph 6

Investment by institutional sector in 2001

Values, as a percentage of total economy investment



Sources: OECD; author's own calculations.

For the purpose of this paper, the choice of financial indicators was therefore guided, first and foremost, by data availability for longer time horizons and, second, by the availability of proxy forecasts or exogenous assumptions for the future developments of these variables in forecasting exercises. As far as possible, both price and quantity aspects of financing conditions are included in the set of financial indicators, although data are more readily available for prices than quantities. Details on data sources and definitions are provided in the annexes. Various measures are tested for each variable, such as quarter-on-quarter growth rates or ratios to gross operating surplus. For some volatile variables, such as share prices, a smoothed growth rate (taking a two-quarter moving average) is also tested. The shaded cells denote the highest correlation coefficients (including those close to, ie an arbitrary ±0.03 from, the maximum) for each indicator and measure.

The main features emerging from this analysis are the following.

As regards *demand variables*, developments in GDP and final demand are strongly correlated with those in the investment ratio, while the correlation between euro area foreign demand and investment is not significant. Similarly, the correlation between the growth rate of GDP excluding investment and the investment/GDP ratio is rather low. The latter observation probably reflects the fact that investment is determined by specific factors which may not affect other expenditure components, and that there exist spillover effects within different investment categories that are missed when investment is excluded from the demand indicator. *Capacity utilisation* seems to be lagging investment, when considered in level terms, while its changes are coincident or leading. The drawback of this indicator is that it refers to the manufacturing sector only, while the share of corporate investment accounted for by services sector companies is likely to have increased in recent years, to significant levels.

The various *financial indicators* show similar results, with most of them apparently being coincident at correlation coefficients of 0.3-0.5. The three measures of financing costs considered here (long-term interest rates, cost of equity, and the composite cost of financing measure) show the expected negative correlation with investment. Over the common sample of available data for the three cost measures, the cost of equity shows the strongest link with investment. This may reflect the fact that developments in share prices which underpin this variable are linked to corporate investment not only

Table 1

Correlation with change in non-housing investment/GDP ratio

Quarters (q) lead or lag	Measure	Lead				Coincident	Lag			
		4q	3q	2q	1q		1q	2q	3q	4q
GDP	GR	0.21	0.34	0.36	0.42	0.49	0.40	0.39	0.24	0.19
Final demand	GR	0.26	0.42	0.47	0.49	0.57	0.47	0.38	0.21	0.07
GDP excluding non-housing investment	GR	0.14	0.21	0.21	0.28	0.14	0.26	0.23	0.09	0.08
Foreign demand	GR	0.21	0.03	0.12	0.03	0.05	0.00	–0.01	0.12	0.09
Capacity utilisation rate	L	–0.06	0.06	0.18	0.28	0.40	0.46	0.55	0.57	0.55
	D	0.39	0.40	0.40	0.37	0.38	0.19	0.29	0.09	–0.08
Stock market capitalisation	GR	0.29	0.26	0.28	0.42	0.40	0.21	0.28	0.13	0.05
	GRS	0.32	0.32	0.32	0.42	0.48	0.37	0.29	0.24	0.10
Share price index	GR	0.28	0.23	0.27	0.40	0.37	0.17	0.25	0.09	0.00
	GRS	0.30	0.30	0.29	0.40	0.45	0.33	0.25	0.20	0.05
Price/earnings ratio	L	0.25	0.27	0.31	0.34	0.31	0.29	0.27	0.25	0.21
Dividend yield	L	–0.32	–0.35	–0.38	–0.42	–0.42	–0.40	–0.39	–0.36	–0.33
Dividend/earnings ratio	L	–0.14	–0.20	–0.27	–0.36	–0.47	–0.51	–0.55	–0.53	–0.53
Long-term interest rates (COST)	L	0.05	0.07	0.05	0.06	0.03	0.06	0.04	0.00	–0.02
	D	–0.17	–0.01	–0.04	–0.06	0.01	0.10	–0.01	–0.07	0.02
Cost of equity issuance	L	–0.33	–0.39	–0.54	–0.55	–0.48	–0.48	–0.38	–0.26	–0.17
	D	–0.24	–0.14	–0.31	–0.13	0.05	–0.03	0.10	0.10	0.12
Composite cost of financing	L	–0.33	–0.35	–0.38	–0.41	–0.38	–0.34	–0.33	–0.31	–0.28
	D	–0.32	–0.09	–0.19	–0.17	0.08	0.25	0.14	0.18	0.29
Yield curve	L	0.39	0.38	0.35	0.30	0.28	0.21	0.17	0.06	–0.02
Corporate loans	GR	–0.06	0.12	0.21	0.24	0.29	0.36	0.52	0.41	0.42
	GRS	–0.16	0.04	0.20	0.26	0.32	0.39	0.53	0.57	0.52
	RX	–0.24	–0.25	–0.33	–0.38	–0.42	–0.43	–0.42	–0.38	–0.37
	RXD	–0.21	–0.02	–0.07	–0.13	–0.06	0.09	0.23	0.22	0.27
Gross operating surplus	GR	0.28	0.17	0.31	0.37	0.31	0.16	0.08	0.01	–0.08
	GRS	0.41	0.30	0.32	0.45	0.44	0.32	0.16	0.06	–0.05
Expected earnings	GR	0.24	0.24	0.23	0.32	0.42	0.22	0.29	0.12	0.17
	GRS	0.22	0.31	0.30	0.35	0.48	0.41	0.33	0.26	0.19
Corporate debt	RX	–0.27	–0.28	–0.36	–0.42	–0.46	–0.47	–0.45	–0.41	–0.39
	RXD	–0.26	–0.07	–0.10	–0.17	–0.08	0.09	0.24	0.23	0.27

Note: Sample 1980:1-2003:1, except for cost of equity: 1988:1-2003:1. Financial variables expressed in real terms, except ratios, cost of equity issuance and composite cost of financing deflated (see Annex 1). L refers to levels; D is the quarter-on-quarter difference; GR is the quarter-on-quarter growth rate; GRS refers to the quarter-on-quarter growth rate of the two-quarter moving average level; RX is the ratio to gross operating surplus; and RXD is the quarter-on-quarter difference in this ratio.

via the implied cost of share issuance but also because both variables are influenced by expectations of future economic activity. As regards variables capturing the availability of internal and external funds, correlations of 0.4-0.5 are found between investment, on the one hand, and loans or profits, on the other. The ratios of loans and debt to operating surplus capture developments in the leverage of the corporate sector. These variables show a negative correlation with investment, which is consistent with the idea that a worsening in balance sheet conditions may act as a constraint on investment expenditure.

Benchmark equation

As a second step, we derive a benchmark equation for investment against which we can subsequently analyse the possible impact of financial variables. Quarter-on-quarter differences in the ratio of non-housing investment to GDP (NHIR) are regressed on real GDP growth and COST, the real long-term interest rate adjusted for the relative decline in non-housing investment good prices.[3] Although relatively standard, this equation differs from the investment equations which are included in some macroeconomic models such as the ECB's area-wide model (Fagan et al (2001)). The latter are often derived from production functions where investment growth is explained within an error correction format, with a long-term relationship between the capital stock and real GDP and cost of external finance. However, for the euro area, no data on the capital stock are available and own estimates would have introduced considerable data uncertainty in the estimates.

The lag structure of the equation is determined using PC-GETS,[4] starting with a maximum of four lags for each variable and using instrumental variable estimation in order to account for collinearity. The list of instruments comprises lagged values of the dependent and explanatory variables, as well as euro area exports and the rate of capacity utilisation. The results of IV estimation were very similar to that from OLS estimation. Using PC-GETS has the advantage of "letting the data speak", which seems particularly convenient for the purpose of this paper, considering that there is little a priori knowledge as to the combination and lag structure in which the real economy and financial variables should enter the equation. For instance, GDP growth may account for both current demand conditions and expectations of future activity. Remaining agnostic a priori as regards the lag structure of the equations thus seems a sensible approach. The benchmark equation takes the following form:

$$d(NHIR) = C + \sum_{i=1}^{4} \alpha_i * d(NHIR(-i)) + \sum_{i=0}^{4} \beta_i * d\log(GDP(-i)) + \sum_{i=0}^{4} \gamma_i * d(COST(-i))$$

The estimation results are shown in Table 2. The dummies for the second and third quarters of 1984 were selected by PC-GETS and capture the impact of the strikes in the German industrial sector at the time, related to disputes about the introduction of the 35-hour working week. The results shown in Table 2 imply, upon recalculation, that demand is the main explanatory factor of investment, with an elasticity of around 2.5. This importance is in line with the empirical literature and specifications typically used in macroeconomic forecasting models. Moreover, a 100 basis point increase in nominal interest rates cuts investment by around 50 basis points instantaneously and 80 basis points in the long term. The equation passes the usual residual and stability tests. However, there is some evidence of heteroskedasticity, which may be a sign that some information is missing and/or that the relationship between investment, on the one side, and demand and interest rates, on the other, is non-linear. Moreover, the standard error is of the same order as the average absolute value of the dependent variable and similar to the standard error of a simple autoregressive equation.

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[3] Cointegration analysis within the standard Johansen approach showed no cointegration relationship between investment, GDP and long-term interest rates. This may be due to the fact that the sample is relatively short, with the investment/GDP ratio exhibiting large and protracted swings. Given the absence of any stable long-term relationship, the equation only includes short-term dynamics.

[4] PC-GETS is a software designed to implement D Hendry's general-to-specific approach, one of the main elements of the LSE approach to econometrics. This method is particularly suitable when, as in the case at hand, the precise formulation of the equation under analysis is not known a priori.

Table 2

Benchmark equation - estimation results

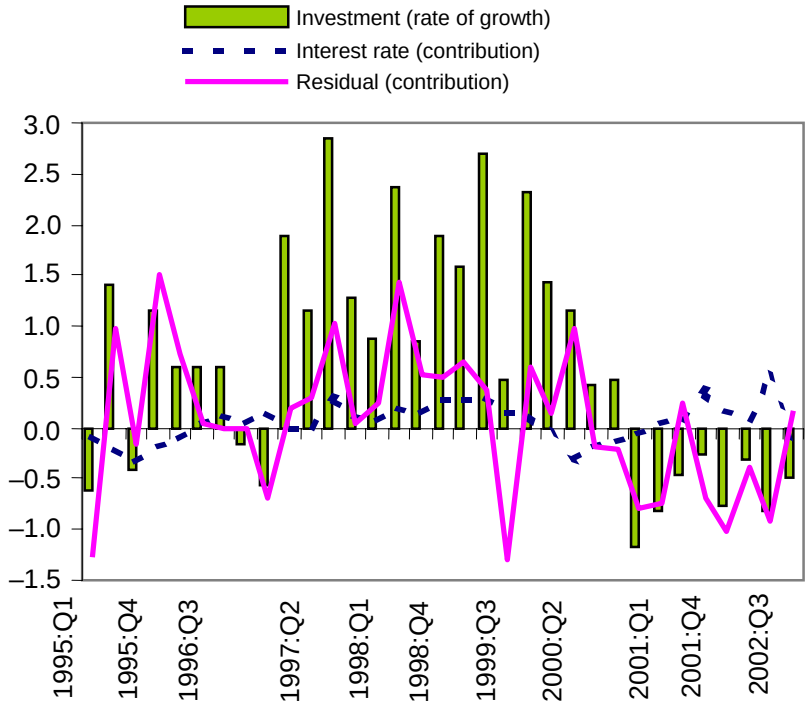
Dependent variable: d(NHIR)
Sample: 1980:1 to 2003:1
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std error	t-statistic	Prob
C	–0.06	0.02	–3.27	0.0016
D(NHIR (–1))	0.25	0.08	3.01	0.0035
D(NHIR (–2))	0.23	0.09	2.55	0.0127
Dlog(GDP)*100	0.12	0.03	3.99	0.0001
D(COST(–4))	–0.25	0.12	–2.21	0.0298
D842	0.36	0.04	9.21	0.0000
D843	–0.43	0.03	–12.81	0.0000
R-squared	0.54	Mean dependent variable		–0.0024
Adjusted R-squared	0.50	S D dependent variable		0.15
S E of regression	0.11	Akaike info criterion		–1.50
Durbin-Watson statistic	2.08	Schwarz criterion		–1.31
F-statistic	15.6	Prob (F-statistic)		0.0000

Graph 7

Contributions of interest rates and unexplained part in benchmark equation

Quarter-on-quarter growth in investment, in per cent and percentage points



Sources: Eurostat; authors' own estimates.

As regards recent developments, compared with the predictions of the benchmark equation, investment was consistently higher in the late 1990s and has been consistently weaker since the end of 2000 (Graph 7). This gives rise to the possibility that other factors have raised and then dampened euro area investment. The remainder of this section looks at whether some of these unexplained developments in investment may be accounted for by financing conditions.

3.2 Linear analysis

Linear estimates of the impact of financial variables

In order to assess the role of financial variables in determining investment, the benchmark equation is augmented by the financial indicators reported in Table 1 (including their various measures such as quarter-on-quarter rates and ratios to gross operating surplus). The variables are included one by one, as taking into account several at the same time was perceived to be too onerous in terms of degrees of freedom. As before, PC-GETS is used to determine the lag structure. The approach admittedly amounts to data mining: the objective is to find significance for a measure or a set of measures for a given financial indicator. At the same time, deciding a priori on a given measure and lag structure is not feasible as most indicators probably capture various channels through which they could affect investment, which could correspond to different measures or lags of the indicators. Table 3 shows the indicators and measures which are significant, together with the estimated lag structure. Most financial indicators are found to be significant, although introducing them in the benchmark equation sometimes implies that the interest rate term is no longer significant.

The forecasting performance of the benchmark and the augmented equations are compared in terms of an out-of-sample forecasting exercise carried out on a rolling basis. More precisely, each equation is estimated up to a particular quarter Q and forecasts are produced for investment for the four following quarters. These forecasts are saved. Then, the equation is estimated up to Q+1, with forecasts again produced for the next four quarters, and so on. The average of root mean square errors (RMSE) for one-, two-, three- and four-quarter-ahead forecasts is shown in Table 4. Three different out-of-sample periods are used: one for forecasts over a six-year period (1997:1 to 2003:1),[5] the two others corresponding to a split of this period between the upturn (1997:1 to 2000:1) and the recent slowdown (2001:1 to 2003:1). In this exercise, financial variables are assumed to be known over the forecast horizons, while, in real forecasting conditions, financial variables also need to be forecast or, more often, derived from technical assumptions. Forecast or assumption errors as regards developments in financial variables would thus tend to worsen the forecasting performance of the augmented equations compared with what is shown in Table 4. GDP and long-term interest rates are also assumed to be known, but as this is the case in both the benchmark and the augmented equations, it should not affect the relative reliability of the forecasts. A further difference compared with real-time forecasting conditions is that currently available series, ie including possible revisions to back data, are used. In the absence of a database of vintages of national accounts data going far enough into the past, the impact of data revisions on the results could not be tested. In this respect, financial variables have the advantage that they are not revised.

Table 4 shows in-sample standard errors and out-of-sample RMSEs for the benchmark equation and the improvement (in bold) or worsening in these measures obtained from the augmented equations. For reference, the results of forecasts of investment based on an autoregressive equation are also reported.

In several cases, taking into account financial variables yields lower RMSEs. However, the improvement is rarely statistically significant,[6] or, when it is, it is relatively small. Graphs 8 and 9 illustrate these results. Graph 9 shows examples of the forecasts produced with the benchmark equation and with two augmented equations: the patterns of these three forecasts are very similar.

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[5] The choice of 1997:1 as a starting quarter for the out-of-sample exercise is to a large extent arbitrary. It represents a trade-off between leaving enough in-sample data points to have reliable estimates and having a long enough out-of-sample period for the comparison of RMSEs to be meaningful. Moreover, starting in 1997 presents the advantage of having both upturn and downturn phases in the out-of-sample period.

[6] According to a Diebold and Mariano (1995) test, corrected for the small sample bias as advised by Harvey et al (1997).

Taking GDP as known, the forecasts are transformed in terms of quarter-on-quarter investment growth, and Graph 9 shows the part of investment growth which is not accounted for by determinants in the benchmark and some augmented equations. While both graphs show that including financial variables helps capture investment developments somewhat better, a significant part of investment developments remains unexplained. In particular, the estimated impact of financial variables cannot account for the observed large declines in investment of the past two years.

Table 3

Linear estimations with financial indicators

Indicator	Measure	Financial variable		Demand		Interest rates	
		Lag	Coeff	Lag	Coeff	Lag	Coeff
Benchmark				0	0.13	4	–0.25
Stock market capitalisation	GR	–1	0.005	0	0.13	Not significant	
Share price index	GR	–1	0.005	0	0.13	Not significant	
	GRS	0	0.006	0	0.12	Not significant	
Dividend yield	L	0	–0.02	0	0.13	Not significant	
Dividend/earnings ratio	L	0	–0.002	0	0.13	4	–0.24
Cost of equity issuance	L	0	–0.07	0	0.18	Not significant	
Composite cost of financing	L	1	–0.07	0	0.13	Not included[1]	
		3	0.06	3	0.06		
	D	1	–0.12	0	0.12	Not included[1]	
				3	0.05		
Yield curve	L	0	0.03	0	0.14	Not significant	
				3	0.07		
Corporate loans	GR	4	–0.03	0	0.13	4	–0.25
	GRS	0	0.05	0	0.10	4	–0.26
		4	–0.07				
	RX	3	–3.4	0	0.13	4	–0.26
	RXD	4	–59	0	0.14	Not significant	
				3	0.05		
Gross operating surplus	GR	1	0.02	0	0.15	4	–0.26
		2	0.02	3	0.08		
	GRS	4	0.02	0	0.12	Not significant	
Expected earnings	GR	0	0.006	0	0.13	4	
	GRS	0	0.011	0	0.12	Not significant	
Corporate debt	RX	0	–1.43	0	0.10	4	–0.33
		3	1.30	3	0.06		
	RXD	2	–2.3	0	0.14	4	–0.32
				3	0.06		

[1] Interest rates are already included in the composite cost of financing measure. OLS and IV estimations generally give the same results except for the dividend yield, the dividend/earnings ratio, the level of and the difference in the ratio of loans to gross operating surplus, and the quarter-on-quarter difference in the ratio of debt to gross operating surplus.

Table 4

In-sample and out-of-sample performance

		In-sample standard error	Out-of-sample RMSE		
			1997:1-2003:1	1997:1-2000:4	2001:1-2003:1
PC-GETS benchmark		0.11	0.11	0.12	0.09
AR equation		14.1	17.1	15.4	20.2
Stock market capitalisation	GR	0.1	**–7.5**	**–6.7**	**–9.7**
Share price index	GR	0.2	**–9.3**	**–7.7**	**–13.9**
	GRS	**–2.2**	**–7.0**	**–2.1**	**–21.1**
Dividend yields	L	2.1	**–2.1**	**–8.8**	13.3
Dividend/earnings ratio	L	**–1.0**	4.3	**–9.6**	33.8
Cost of equity issuance	L	10.0	0.8	5.8	**–13.7**
Composite cost of financing	L	**–5.6**	**–8.0**	**–15.2**	8.4
	D	**–8.0**	**–10.9**	**–9.1**	**–15.8**
Yield curve	L	24.4	4.1	3.2	6.2
Corporate loans	GR	**–6.7**	**–0.4**	0.8	–3.6
	GRS	**–10.1**	**–5.9**	**–4.9**	**–8.3**
	RX	0.5	12.4	22.2	**–18.6**
	RXD	**–0.6**	1.2	13.1	**–40.7**
Gross operating surplus	GR	**–3.1**	14.6	12.8	19.3
	GRS	1.1	2.1	5.5	**–7.2**
Expected earnings	GR	0.4	**–7.8**	**–14.2**	7.3
	GRS	**–1.7**	**–12.0**	**–10.7**	**–15.3**
Corporate debt	RX	**–3.3**	7.5	13.7	**–10.4**
	RXD	**–0.1**	7.8	8.4	6.4

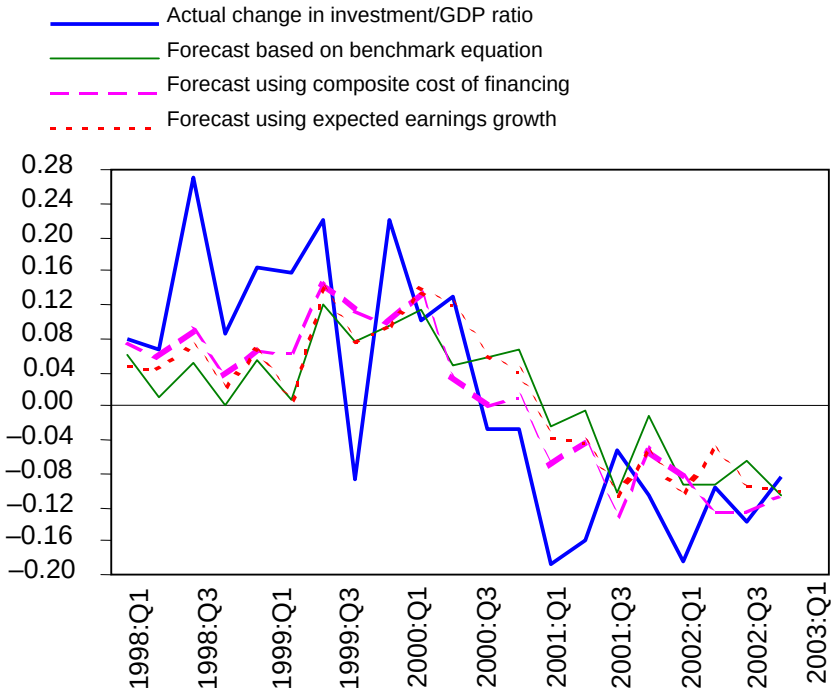
Note: Benchmark: standard error and average of RMSEs for one- to four-quarter-ahead forecasts in percentage points. Other equations: percentage improvement (–) or worsening (+) compared with benchmark.

Several factors may account for the failure to find stronger quantitative evidence of financial indicators in aggregate investment equations. For instance, available indicators may not capture accurately the nature and extent of the financing constraints faced by corporations. Moreover, some sector- or firm-specific factors may not be adequately captured within the macroeconomic framework. Another possibility is that the relationship between investment and financial indicators is non-linear. This latter issue is addressed in the following subsection. From the perspective of projections, resorting to non-linear representations of investment poses significant problems, since including such representations within a macroeconomic model is fraught with difficulties. The idea is therefore to investigate whether non-linear relationships may help understand the relevance of financial variables for investment in the past. This would then guide judgment about the possible effect of financial variables within the projections horizon, while any adjustment would probably have to remain largely ad hoc.

Graph 8

Four-quarter-ahead forecasts of quarter-on-quarter change in investment/GDP ratio

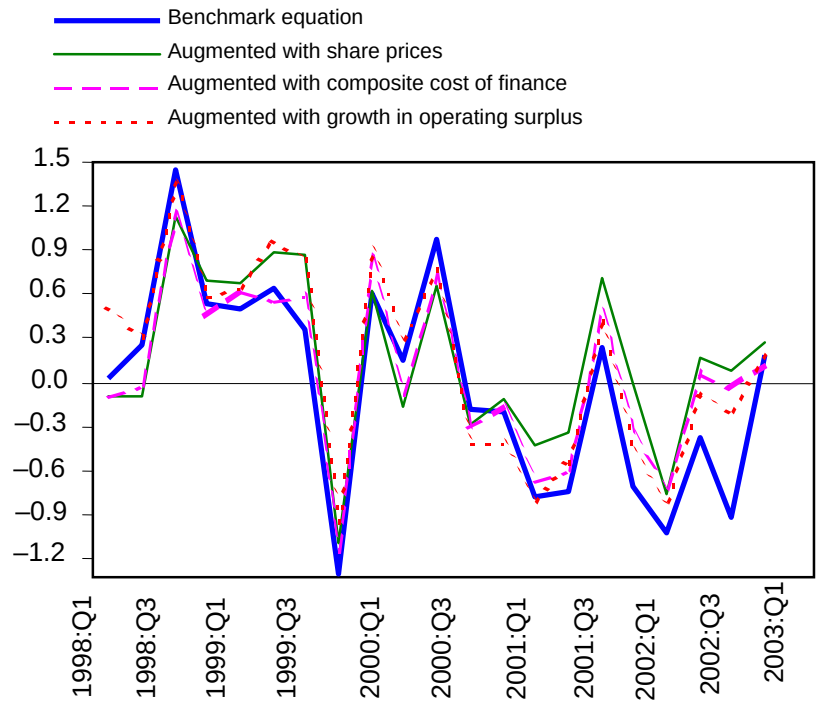
In percentage points



Graph 9

Quarter-on-quarter growth in investment unexplained by determinants from various equations

In percentage points



3.3 Non-linear analysis

Non-linearities in the relationship between investment and financial factors may arise for two reasons. First, financial factors may affect investment decisions differently depending on the stage of the business cycle. A second non-linear aspect relates to different elasticities of investment to the financial variables depending on the state of the financial indicator itself. The underlying idea is that, as long as financing conditions are broadly in line with historical averages, they may not matter for investment. Financing conditions may affect corporate investment to a significant extent only once particularly buoyant or unfavourable conditions prevail. Obviously, periods of favourable (respectively unfavourable) financial conditions are likely to match broadly the phases of higher (respectively lower) growth. Therefore, the two tests of possible non-linearities carried out in this paper, while complementary, are not fully independent.

Non-linearity over the business cycle

A business cycle chronology is determined using a two-stage Markov switching model of quarter-on-quarter real GDP growth:

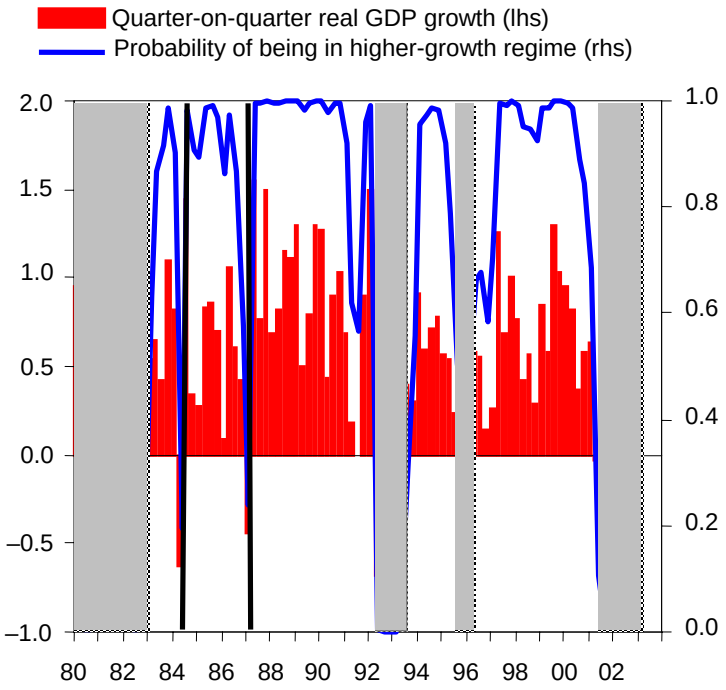
$$d\log(GDP) = \mu_S + \sigma_t v_t \text{ for s = 1,2} \qquad (2)$$

where v_t are independent and identically distributed random variables with zero mean and unit variance and μ_s corresponds to the average real GDP growth in regime *s*. The estimated average quarter-on-quarter GDP growth rates are 0.06% in the lower-growth phase and 0.74% in the higher-growth phase. Graph 10 shows the estimated probability of being in the high-growth phase. In this framework, three periods of lower growth are identified: the early 1980s, the early 1990s and the current slowdown. As usual in non-linear analysis, an important caveat to bear in mind when interpreting these results is the relatively low robustness. Graph 10 shows that the lower-growth regime has been a relatively rare event over the past two decades (32 out of 92 quarters in the sample considered), which tends to undermine reliability of the estimation of different elasticities over each regime.

Graph 10

Real GDP growth and probabilities of high and low growth regimes

In per cent



Note: Shaded areas denote low-growth phases.
Sources: Eurostat; authors' own estimates.

Table 5

Elasticities of investment to financial indicators in higher- and lower-growth regimes[1]

Indicator	Measure	Lag of financial indicator	Low growth	High growth	Significant difference[2]
Stock market capitalisation	GR	1	0	0.002	No
Share price index	GR	1	–0.001	**0.003**	No
	GRS	0	0	**0.004**	No
Dividend yield	L	0	–0.01	–0.02	–
Dividend/earnings ratio	L	0	–0.07	**–0.10**	No
Cost of equity issuance	L	0	0	0	–
Composite cost of financing	L	1	–0.03	**–0.08**	No
		3	0.02	**0.06**	No
	D	1	**–0.07**	**–0.11**	No
Yield curve	L	0	**0.08**	0	**Yes**
Corporate loans	GR	4	**–0.07**	**–0.02**	**Yes**
	GRS	0	**–0.08**	**0.07**	**Yes**
		4	–0.02	**–0.07**	No
	RX	3	**20.6**	–6.3	**Yes**
	RXD	4	**–124**	–31	**Yes**
Gross operating surplus	GR	1	**0.05**	0.00	**Yes**
		2	0.01	0.01	–
	GRS	4	**0.04**	**0.03**	No
Expected earnings	GR	0	**0.008**	**0.006**	No
	GRS	0	**0.017**	**0.005**	No
Corporate debt	RX	0	**–1.19**	**–0.70**	No
		3	**1.39**	0.35	No
	RXD	2	–0.15	–0.25	–

[1] Significant values are highlighted in bold. [2] Based on the standard errors of the estimated coefficients.

Switching regression equations are estimated in order to assess possible asymmetries over the business cycle in the response of investment to financial indicators, generically labelled *FIN_INDIC*. The following equation is estimated:[7]

$$d(NHIR) = C(s) + \alpha_1(s) * d(NHIR(-1)) + \alpha_2(s) * d(NHIR(-2)) + \beta_1(s) * d\log(GDP) + \gamma(s) * dCOST(-4) + \mu(s) * FIN\_INDIC$$

where s = 1 and 2 according to the chronology shown in Graph 10. That is, starting from the structure of the benchmark equation which had been selected by PC-GETS in the linear case, we include one

[7] More parsimonious specifications in which only the elasticity of investment to the financial indicator is regime-dependent have also been estimated. These failed to show any significant differences in the response of investment to financial variables across the stages of the business cycle. The results are available from the authors upon request.

financial indicator at a time and allow elasticities to differ between the two identified phases of the business cycle.

Table 5 shows the estimated elasticities of investment to financial variables in each of the two growth regimes. Only in a few cases are elasticities found to be significantly different between high- and low-growth phases. Moreover, within these cases, some indicators seem to be more relevant during the higher-growth phase, while others are more relevant during the lower-growth regime. An interesting feature stemming from this exercise relates to the elasticity of investment to long-term interest rates, which, in most cases, is found to be more negative during higher-growth periods. This result also holds when no financial indicator is included in the estimating equation. Moreover, it is usually the case that, during lower-growth periods, the elasticity of investment to long-term interest rates is not significant. This result supports the view that, at times in which the outlook is uncertain, companies tend to hold back their investment projects, even when cost of finance is attractively low.

Non-linearity according to state of financial indicators

Asymmetry of the response of investment to financial variables is analysed in a similar manner. For each financial variable, a Markov switching model with two regimes is estimated, thereby defining phases of "favourable" and "unfavourable" financial conditions. For instance, for share prices, the favourable phase corresponds to high-growth periods. Conversely, for corporate debt, the favourable phase corresponds to the regime of lower debt growth.[8] As before, switching regression equations are estimated. For some indicators, the phases defined by the Markov switching model do not lend themselves to such an estimation. Indeed, the dividend yield and the ratios of loans and debt to operating surplus are found to have been in the same regime since the mid-1980s. As a result, these variables are excluded from the analysis.

Table 6 shows the results, presented in the same way as in Table 5. In most cases, financial variables are found to be significant when they are favourable. As regards periods of unfavourable financing conditions, the various indicators give different results. Indicators of stock market developments are not found to be significant. This result could reflect the fact that companies have usually been able to find alternative sources of finance when the stock market declined (namely bank loans). However, corporate loans and gross operating surplus, two indicators reflecting the availability of funds for investment, seem to matter more during their unfavourable periods. For the latter indicator, attention needs to be drawn to the fact that, even for the phase of "unfavourable" conditions, the average growth rate is positive. The significantly positive investment elasticity in periods of high growth in operating surplus reduces to zero in phases where growth in gross operating surplus is relatively low. This finding on loans and operating surplus fits the argument of the existence of financial accelerator effects often found in studies based on firm-level data. When profit growth is low and/or leverage ratios are high, the extra effort needed to restore balance sheets acts as an additional negative factor on investment.

Overall, the econometric analysis presented in this paper suggests that financial variables add little information, if any, to explaining and forecasting developments in investment. There is some tentative evidence of asymmetries in the response of investment to financial variables depending on the state of the cycle and of financing conditions. First, when demand conditions (and hence prospects) are particularly bad, cost of finance does not seem to have any significant impact on investment. Second, when corporate profit growth is relatively low and/or corporate leverage is relatively high, investment seems to react more strongly to financing conditions.

[8] For the growth rate of corporate loans, the classification between favourable and unfavourable phases is ambiguous. Loans as a reflection of availability of funds suggest that the higher growth phase would be the "favourable" one, while loan growth as an indicator of corporate leverage suggests that the lower growth phase would be the "favourable" one. Based on the positive correlation between investment and loans, "favourable" loan conditions in Table 6 correspond to periods of higher loan growth, but this is only a matter of presentation as elasticities are not found to be significantly different between phases.

Table 6

Elasticity of investment to financial indicators in favourable and unfavourable phases of financing conditions[1]

Indicator	Measure	Lag of financial indicator	Unfavourable	Favourable	Significant difference[2]
Stock market capitalisation	GR	1	0	0.003	No
Share price index	GR	1	0	**0.007**	**Yes**
	GRS	0	0	**0.004**	**Yes**
Dividend/earnings ratio	L	0	–0.10	**–0.09**	No
Cost of equity issuance	L	0	0	–0.14	**Yes**
Composite cost of financing	L	1	**–0.07**	**–0.06**	No
		3	**0.07**	**0.07**	No
	D	1	**–0.16**	**–0.08**	**Yes**
Yield curve	L	0	**0.06**	***–0.03***	**Yes**
Corporate loans	GR	4	0.02	**–0.04**	No
	GRS	0	0.07	0.01	No
		4	**–0.09**	**–0.08**	No
	RXD	4	**–124**	**–31**	**Yes**
Gross operating surplus	GR	1	0	**0.04**	**Yes**
		2	**0.01**	**0.02**	**Yes**
	GRS	4	0	**0.08**	**Yes**
Expected earnings	GR	0	***–0.01***	**0.01**	**Yes**
	GRS	0	***–0.007***	**0.01**	**Yes**

[1] Significant values are highlighted in bold. Italic cells: elasticity with wrong sign. [2] Based on the standard errors of the estimated coefficients.

4. Conclusions

The issue of possible financial constraints on a recovery in capital investment featured prominently in recent forecast discussions. This paper seeks to add to this discussion by examining the quantitative importance of financial variables in forecasts of aggregate investment. The methods used are somewhat crude and ad hoc, but the results broadly confirm prior perceptions. First, financial variables tend to be quantitatively insignificant in aggregate investment equations that include demand and cost of capital terms. On average, they help very little in improving the forecast accuracy of these equations. Second, there is some tentative evidence that the relevance of financial variables, if any, only emerges in particular periods. The results from linear specifications typically used in macroeconomic forecasting models should thus be cross-checked with the information from non-linear relationships. Overall, however, the analysis presented here suggests that, for forecasting purposes, not much is won when proceeding with aggregate investment equations that simply have indicators of financial conditions added to the set of right-hand variables. Put positively, this implies that the impact of financing conditions on investment should probably be taken into account in a more systematic and consistent way.

In principle, the quantity financial variables that interplay with expenditures on fixed capital investment can be forecast within a fully fledged flow of funds framework, in which the feedback mechanisms from

the real to the financial side would be explicitly modelled through behavioural equations. Such a forecasting approach has been tested in some national central banks. The advantage is that it provides a closed and transparent system to discuss projections under different scenarios, letting forecasters monitor the different repercussions between financial and non-financial variables when changes in a position of a particular sector are rebalanced by changes in other variables along the accounting identities. In practice, however, the complexity of the behavioural relationships underlying flow of funds positions requires many restrictive assumptions and judgmental input. As a consequence, the uncertainty surrounding flow of funds forecasts is usually relatively high.

Annex 1:
Data sources

The quarterly data used in the regression analysis cover the period 1980:1 to 2003:1, with the exception of the cost of equity issuance measure, which is available as of 1987:1. For some variables, official data are only available for part of the sample period, and the missing data were compiled from the available national data.

National accounts

GDP (constant prices): Eurostat data from 1991:1, own estimates based on available national data prior to 1991:1.

GDP deflator: Eurostat data from 1991:1, own estimates based on available national data prior to 1991:1.

Non-housing investment (constant prices): Eurostat data from 1991:1, own estimates based on available national data prior to 1991:1.

Deflator for non-housing investment: Eurostat data from 1991:1, own estimates based on available national data prior to 1991:1.

Gross operating surplus (current prices): Eurostat data for total economy from 1991:1, own estimates based on available data prior to 1991:1. No breakdown in institutional sectors is available. Adjusted for income of self-employed, assuming identical per-head wage income of employees and self-employed.

Financial variables

Long-term interest rate: ECB calculation based on 10-year government bond yields or closest available bond maturity. COST used in benchmark equation is expressed as COST = log(1+LIRR*ITD/YED), where LIRR refers to 10-year government bond yields deflated by the GDP deflator. ITD/YED measures relative prices of capital goods as the ratio of the deflators for investment and GDP.

Yield curve: long-term (10-year) interest rate minus short-term (three-month) interest rate.

Stock market capitalisation and share price index: euro area overall variables computed and provided by Datastream, deflated by the GDP deflator.

Price/earnings ratio: Datastream data, calculated as total market value over total earnings, providing an earnings-weighted average of the ratios of constituents.

Dividend/yield ratio: Datastream data, calculated as total dividend amount as a percentage of the total market value for the constituents.

Dividend/earnings ratio: calculated as the product of dividend/yield and price/earnings ratios.

Expected earnings: calculated from Datastream data on price/earnings ratios and share prices, deflated by the GDP deflator.

Cost of equity issuance: ECB estimate (see Annex 2).

Composite cost of financing: ECB estimate (see Annex 2).

Debt (non-financial corporate sector): official ECB quarterly monetary and financial accounts for 1997:1 to 2003:1, prior to 1997:1 compilation based on available country data, deflated by the GDP deflator.

Loans (non-financial corporate sector): official ECB quarterly monetary and financial accounts for 1997:1 to 2003:1, prior to 1997:1 compilation based on available country data, deflated by the GDP deflator.

Annex 2:
Compilation of cost of finance measures[9]

In this paper, two measures of the cost of non-financial corporations for taking up financing means are used: the cost of equity issuance and a composite cost of financing indicator.

The cost of equity issuance

While the interest payments paid on a bank loan or the coupons paid on a corporate bond can be considered as good measures of the cost of a bank loan and of issuing a corporate bond, there is no simple measure for the cost of issuing equity. The notion closest to the interest rate on a loan or a bond is the dividend yield, calculated as the ratio of current dividends per share over the price of the corporation's stock. However, dividend yields are only an imperfect measure of the cost of quoted equity, as such a measure must also take into account the fact that equities have no fixed maturity and are not subject to a systematic repayment of a fixed amount of capital at a fixed date in the future (like corporate bonds and bank loans).

The price of equity should be equal to the expected discounted sum of all future dividends paid out by the corporation. From this, it is possible to find a measure of the cost of equity that depends on the current dividend yield and on the growth rates of dividends in the future. As the chronology of future dividend growth rates is by nature unknown, two assumptions are necessary. First, it is assumed that the real average dividend growth rate for the next four years is equal to analysts' four-year-ahead real earnings growth rate expectations extracted from the monthly Thomson Financial First Call (TFFC) analysts' survey. Second, after a transition phase of eight years, the rate of growth in dividends is set to an estimate of the potential real GDP growth rate of the euro area economy, at 2.25%. This is the midpoint of the range assumed for trend potential growth in the calculation of the ECB's reference value for monetary growth. Overall, changes in the real cost of equity depend mainly on the current dividend yield and to a lesser extent on the analysts' four-year-ahead earnings growth rate expectations.

The composite cost of financing

The cost of financing of euro area non-financial corporations as used in this paper combines the marginal costs of taking up loans, market-based debt and quoted equity. The weights of the different components are based on the longer-term financing structure (in stocks) of non-financial corporations. Given data limitations, the cost of finance indicator does not address the impact of different tax regimes between financing vehicles or countries or the effect of possible non-price restrictions that non-financial corporations might face when choosing a financing means. The cost of loans, the cost of market-based debt and the cost of quoted equity have been weighted according to the shares of the notional stocks (calculated as outstanding amounts in 1997:4 extended by quarterly flows) of loans, market-based debt and quoted equity in these liabilities of non-financial corporations according to the quarterly financial accounts.

The cost of loans is measured as a composite lending rate based on short-term and long-term retail bank lending rates on loans to non-financial corporations. Due to data limitations, long-term interest rates have been estimated on a sample of euro area countries before November 1996 and back to 1990. Short-term cost and long-term cost of loans have been weighted according to the shares of the notional stocks of short-term and long-term loans in the loans of non-financial corporations.

The cost of market-based debt is obtained by aggregating yields of Merrill Lynch corporate bond indices. First, an index of the average yield of corporate bonds with a maturity greater than one year issued by euro area non-financial corporations with investment grade rating (ie BBB and better). Second, for high-yield bonds of non-financial corporations, the "total euro currency high-yield index" is

[9] Prepared by Louis Bé Duc, Stéphane Guéné and Petra Köhler.

used as a proxy. Before 1998 and back to 1990, corporate bond yields of a sample of euro area countries, weighted by GDP weights corresponding to the purchasing power parity in 2001, were used.

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