Investment in Europe – has it been weak?

Appendix for The Eurorame EFN report for March 2006

Prepared by Ray Barrell, NIESR

Output growth has been relatively weak over the last five years, and domestic demand growth since 2003 has hardly been any higher than GDP growth. Demand growth can be weak because output growth is weak and borrowing costs are high, or because individuals decide to either save more or invest less than they would have done given output and borrowing costs. Weakness in investment that is unexplained by developments in the economy can be a worry for the longer term, as it would mean that the capacity to produce in the future would be constrained. Alternatively weak investment could be the result of capital augmenting technical progress that is easy to embody into the existing capital stock. This could for insatnce, come with computer aided capital stock use improvements which would help increase output with limited investment.

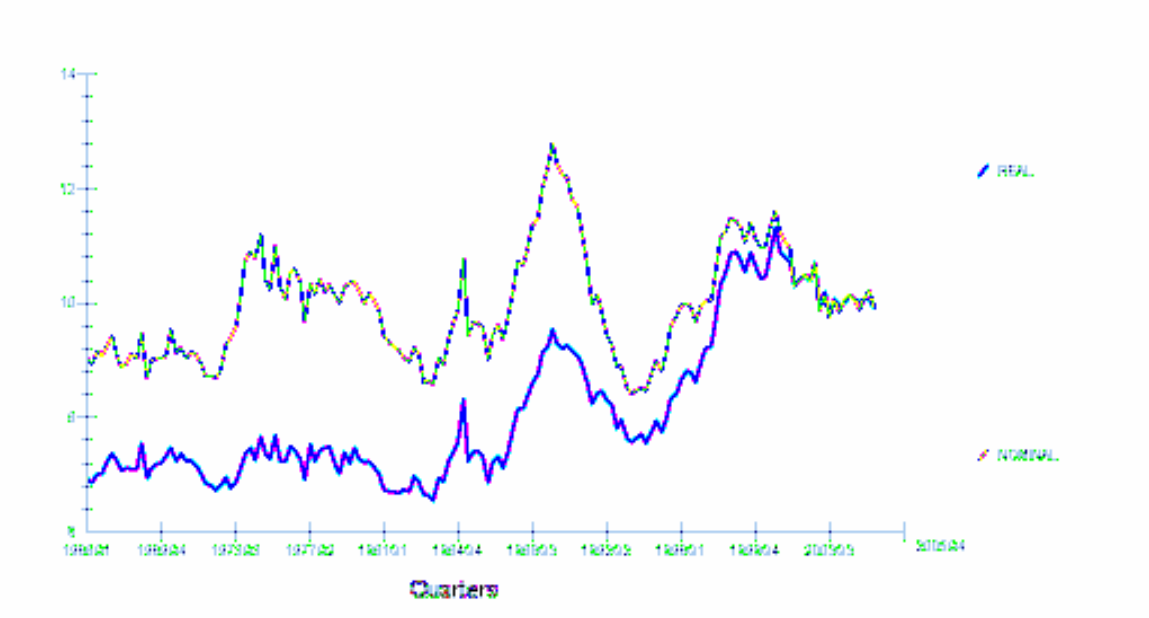
The EUROFRAME group has expert knowledge of many European economies and in this note we survey views on investment behaviour in the major economies. All Institutes maintain models of their economies and comments are based on them. Contributions were received from Christian Dreger at DIW and Carsten-Patick Meier at IfW for Germany, Rebecca Riley at NIESR for the UK, Stefania Tomasini at Promeetia for Italy, Henk Krankendonk from the CPB NBER for the Netherlands and Paavo Sunni at ETLA for Finland. Wifo in Austria and ESRI in Ireland provided written comments on investment modelling in their countries and these views were taken into account. OFCE commented that their investment equations might not have large negative residuals on them, a view shared by all Institutes.

It is difficult to model investment, as adjustment to changes in the equilibrium capital stock can take varying amounts of time depending on essentially subjective decisions about the prospects. Hence all the equations we discuss have large errors on them, and all Institutes accept that there is a degree of uncertainty in their projections. Most Institutes derive their investment equations from a production function, and have labour and capital demand curves. In some cases these are estimated together, as in the work from IfW, whilst in other, such as that from NIESR, DIW and Prometeia, they are estimated essentially separately but with theoretical constraints. In each of these cases we can look at the residuals on our estimated equations to judge whether investment has been weak in the last few years, and residuals for business investment or investment in equipment are plotted for the UK, Italy and Germany in the note. In only one case, the IfW equation for Germany, do the residuals look relatively weak in the last two years, and even then they remain within historical bounds. Investment projections in the Netherlands and Finland are made using more disaggregated models, but in both cases a chart of the projections against outturn from the models used suggest that investment has not been particularly weak in the last three years. However, it is generally agreed that some support to investment has been received by special projects by the government, especially in smaller countries. We conclude that the sources of weak output growth in the Euro Area have to be found elsewhere.

Has UK business investment recently been weak?

Since 2003 the real share of business investment in GDP has remained low in comparison to the recent past (see figure 1). This weakness is even more pronounced if we look at the nominal share of business investment in GDP.

Figure 1: Investment share of GDP (real and nominal)



Existing business investment equations on NiGEM for the main countries have the following structure:

$$\Delta \log IB = cons + \alpha_{ECM} \log(IB/Y)_{-1} + \alpha_{LRR} LRR_{-1} + \alpha_{CU} CU + dynamics$$

where IB is business investment, Y is GDP, LRR is the real rate of interest on 10-year government bonds, and CU is a measure of industry capacity utilisation. Thus, in the long run the real share of business investment in output is determined by the long term real interest rate and a constant, where the long term real interest rate operates as a proxy for the user cost of capital.

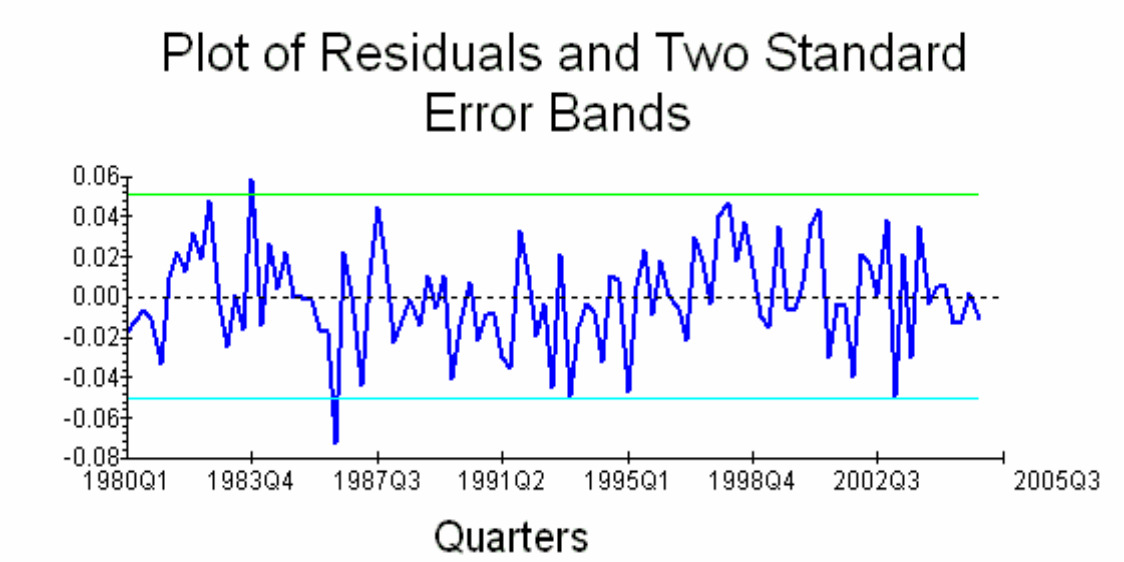
Table 1

Parameter	**Estimate**	**t-statistic**					
				Sample	1980q1-2005q3		
cons	-.32545	(5.09)		$\overline{R}^2$	0.414		
α_{ECM}	-.05434	(2.66)					
α_{LRR}	-.00444	(2.22)		**Serial Corr.**	$\chi^2(4) =$	2.14	(0.709)
α_{CU}	.23170	(5.24)		**RESET**	$\chi^2(1) =$	0.16	(0.693)
$d85q1$	.08900	(3.47)		**Norm**	$\chi^2(2) =$	0.22	(0.894)
$d85q1_{-1}$	-.13696	(5.33)		**Hetero**	$\chi^2(1) =$	1.20	(0.273)

Properties of this relationship for UK business investment are reported in table 1. We use dummies for the first and second quarters of 1985 to control for the sharp rise in investment

that followed the announcement of a change in tax allowances. The equation is estimated over the last 25 years and the associated errors (figure 2) do not suggest that business investment has been particularly weak in the last couple of years (note that weak outcome for q4 not included; but based on latest data release from 24 February 2006). Shortening the sample to the end of 2003, a predictive failure test (Chow's second test) for the following 7 quarters does not suggest that business investment has been any different from that which the equation would predict ($\chi^2(7) = 0.77$ (0.998)). The residuals from the equation are plotted in in Figure 2. The above would suggest that there is little sign of weak business investment in the UK

Figure 2



Modeling in Business Investment in Germany – Kiel equations

We use a CES production function to model the supply side of the German economy. A first order log-linear approximation yields the following expression for potential production:

(1) $\bar{y} = \delta(\bar{l} + \bar{e}) + (1-\delta)k$,

where k is the stock of capital and $\bar{l}$ (denoting the potential hours worked) is determined by the number of individuals in the labor force minus the number of workers who are unemployed for structural reasons and the average number of hours worked per capita.

We assume that profit maximizing firms face a constant price elasticity of demand for their products in a monopolistic competitive market. Under these assumptions, firms will produce a specific quantity such that the relation of prices to marginal costs is fixed and depends on the demand elasticity. If all firms act along these lines, the macroeconomic demands for the optimal levels of the two production factors, labour and capital, are given by

(2a) $l = c_1 + y - \sigma(w^p - p) - (1-\sigma)\bar{e}$

(2b) $k = c_2 + y - \sigma \dfrac{uc}{\exp(p)}$.

Here, p is the price level, $w^p - p$ refers to the real labour cost , uc are the user cost of capital and c_1 and c_2 are parameters determined by the price elasticity of demand. The parameter σ represents the elasticity of substitution between labour and capital.

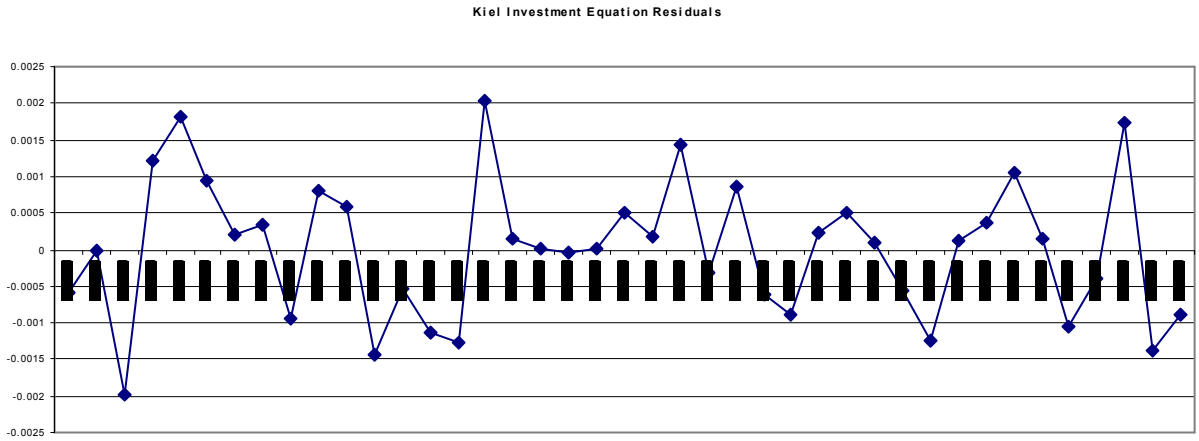
The theoretical model is implemented empirically via set of error-correction equations or their Bewley-transform equivalents. We use annual data for Germany (back until 1991) and West Germany (1960-1990) and the SUR estimator to jointly estimate dynamic versions of (2a) and (2b) under the long-run restriction of an equal elasticity of substitution σ. We find a value of 0.21 for σ.The complete dynamic equation, with a unitary elasticity of the capital stock with respect to economic activity, as in (2b), and $\sigma = 0.21$ imposed, reads as (I^u is business fixed investment, *t*-statistics given in parentheses):

$$\left(I^u/k\right)_t = \underset{(5,48)}{0,054} - \underset{(4,84)}{0,033}\left[(k-y)_{t-4} - 0,21\left(\frac{uc}{\exp(p)}\right)_{t-4}\right] + \underset{(15,88)}{1,023}\,\Delta\left(I^u/k\right)_{t-1} - \underset{(6,16)}{0,389}\,\Delta\left(I^u/k\right)_{t-2}$$

$$+ \underset{(11,13)}{0,145}\,\Delta y_t + \underset{(3,23)}{0,04}\,\Delta y_{t-2} + \underset{(7,12)}{0,005}\,I82 - \underset{(9,73)}{0,005}\,I84$$

$$- \underset{(6,81)}{0,066}\left(\frac{uc}{\exp(p)}\right)_{t-1} + \underset{(2,58)}{0,015}\left(\left(\frac{uc}{\exp(p)}\right)_{t-2} - \left(\frac{uc}{\exp(p)}\right)_{t-3}\right)$$

T: 40 (1965:01- 2005:01), R2: 0,989, DW: 1,87



The residuals in the last two years do look rather negative, suggesting that this approach indicates that investment is perhaps a little weak.

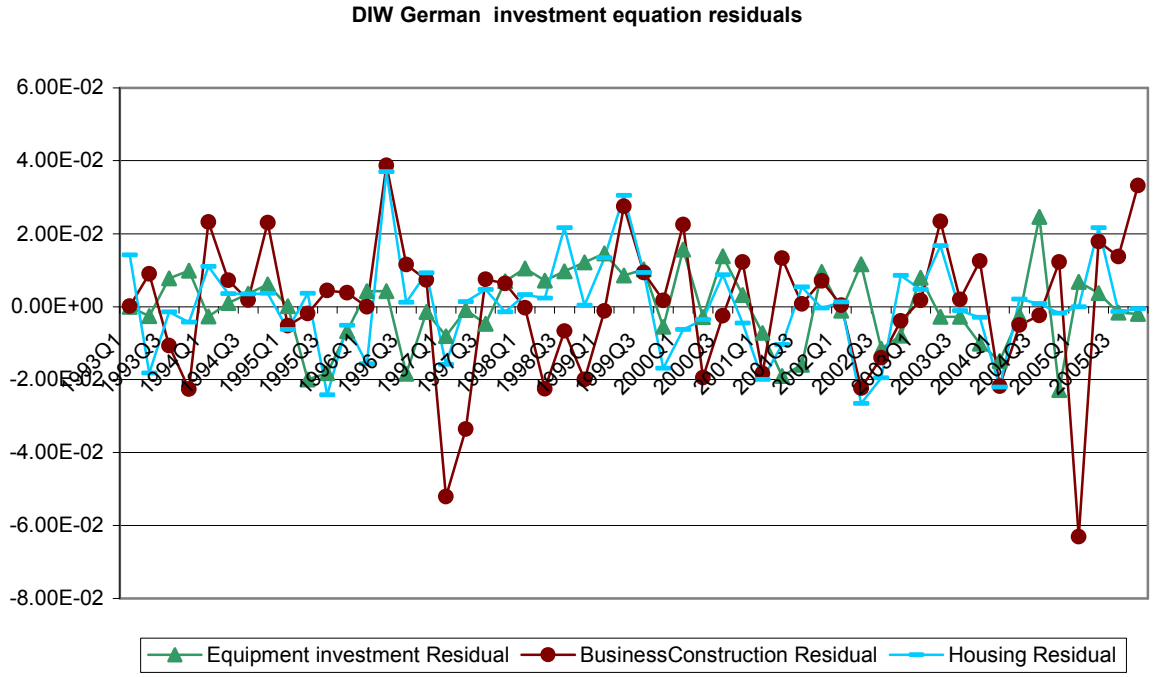
The DIW equations

The equations are part of a macro econometric model for Germany, which has Keynesian style properties in the short run, while the long run corresponds to the neoclassical growth model (Solow Swan). All behavioural equations are estimated as ECMs. They are estimated on data for Germany from 1991q4 to 2005q3. The residuals for these equations do not indicate any specific signs of weakness in the recent past. Only the equipment investment equation is reported in detail, whilst the residuals on the other equations are graphed.

Equipment investment in Germany can be explained by means of an error correction framework, where the short run dynamics are jointly estimated with the long run relationship in only one step. The preferred equation

$$\Delta I_t = \underset{(4.27)}{-0.21} + \underset{(3.87)}{0.60}\, GAP_t - \underset{(2.32)}{0.24}\, \Delta DR_t - \underset{(4.93)}{1.08}\, \Delta KI_t - \underset{(5.05)}{0.10}(I/Y)_{t-4} - \underset{(5.82)}{0.01} UCC_{t-4}$$

is part of a macroeconometric model for the German economy. In this specification, *I* is equipment investment, *GAP* the output gap, i.e. the deviation of actual from potential GDP, in percent of the latter, *DR* the debt ratio, i.e. the ratio of government debt to annual GDP, *KI* capital intensity, expressed as the capital stock per hours worked, *Y* GDP, *UCC* user costs of capital, which are almost identical to the short term real interest rate, Δ the first difference operator and *t* the time index.. All series are in constant prices, and apart from *GAP* and *UCC*, they are in logarithms. The numbers in parentheses denote absolute *t*-values. According to the critical values, cointegration can be clearly detected between the investment share in GDP and the user costs of capital. The implied forecasts for equipment investment based on the entire model are 5.2 for 2006 and 4.3 for 2007. Standard specification tests are largely in favour of the equation.



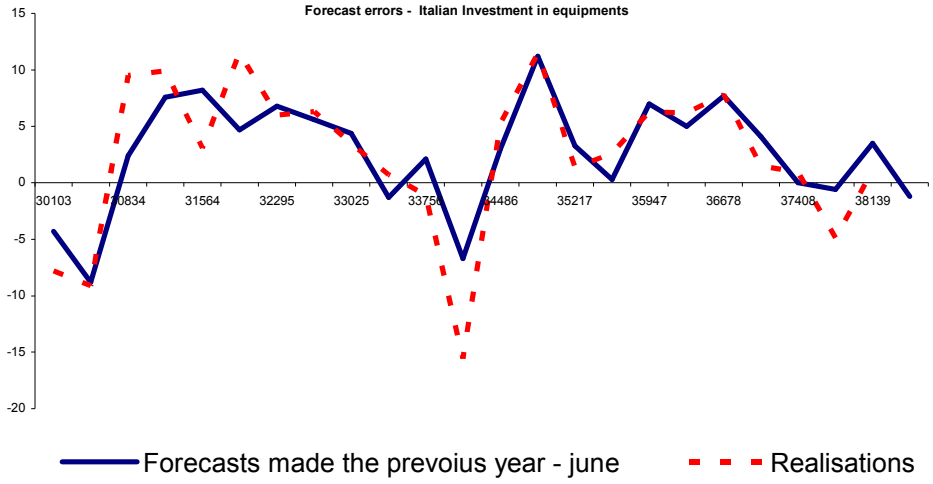
R2=0.68	SE=0.012	JB=4.82 (0.09)
LM(1)=0.74 (0.40)	LM(4)=0.59 (0.67)	LM(8)=0.76 (0.64)
ARCH(1)=0.02 (0.88)	ARCH(4)=0.99 (0.42)	ARCH(8)=1.56(0.17)
RESET(1)=0.03 (0.87)	RESET(2)=0.11 (0.89)	RESET(3)=0.26(0.85)

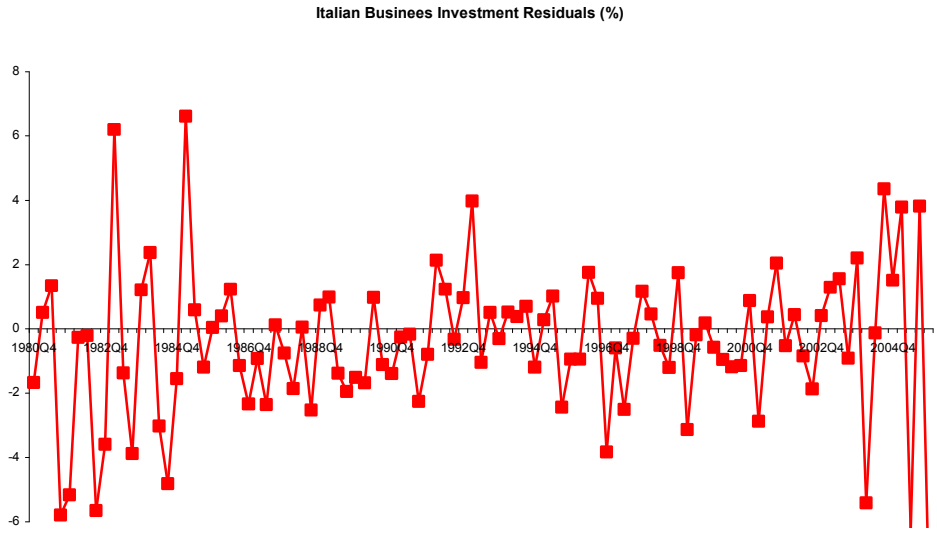
Note: Sample period 1991.1-2005.3. R2=R squared adjusted, SE=standard error of regression, JB=Jarque-Bera test, LM=Lagrange multiplier test for no autocorrelation in the residuals, ARCH=Lagrange multiplier test against conditional heteroscedasticity, RESET=Ramsey test, *p*-values in parantheses.

Investment in Italy

The PROMETEIA macro-econometric model for the Italian economy is based on quarterly data. It has a Cobb-Douglas production function for the market sector (whole economy) with labour and capital as inputs. It distinguishes between equipments (including means of transport) and buildings. The pivotal equation is that for equipments, whereas others (housing and industrial buildings) are treated in a simpler way. The equation explaining investment in equipments is estimated as a VAR-ECM, according to the Johansen approach. In the long run it has two explanatory variables, demand and relative factor prices. Both the costs of capital and labour are quite detailed regarding the institutional features of the Italian fiscal system. In the short term much attention has been paid to the dynamics of the equation and it incorporates other variables, such as lending interest rate and profits. For profits as well the

influence of the public sector on business activity (via taxes and incentives) are taken into account with a lot of detail.





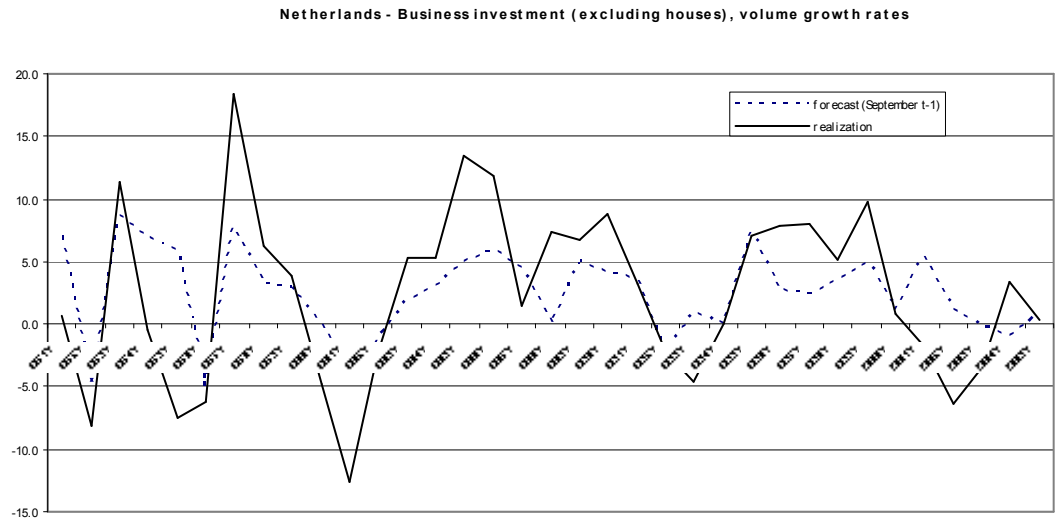
The equation presently used in the model has been re-estimated recently over a sample spanning from the 1980s to 2004. PROMETEIA forecasts one year ahead (presented each June for the following year) have been quite good, as you can see in Fig. 1. Figure 2gives the residuals (in percentage terms). Of course, the forecast is not a mechanical one and does not exactly reflect the result of the equation. The average absolute error over the years 1980-2004 was 2.4 percentage points, much higher than that made for GDP (0.4), but comparable in terms of the respective variances (0.35).

The forecast of the investments in buildings are based on two equations, one for housing investments (related to household disposable income, interest rates, demography and rental prices) and one for building investments to be used for business purposes, simply related to the investments in equipment. Public sector investments are based on exogenous information. In the last seven years, building investments in Italy have boomed, because of the sharp decline in interest rates following the launch of the Monetary Union and some fiscal incentives for restructure properties. For these reasons, and also because Italy did not face a real slack of business investment but only a sluggish growth due to poor exports performance, we have not encountered big problems in forecasting total investment. Major errors arose from the difficulty of evaluating the timing of the impact of some fiscal measures aimed at increasing business investment (the so called Legge Tremonti II).

The Netherlands

The macro-econometric model of CPB (SAFFIER) has a CES production function for the market sector with labour and capital as inputs. Capital is made up of equipments (including means of transport) and buildings. The long run equation for total capital demand is quite simple and has two explanatory variables, production and relative prices. In the short term equations for equipment and buildings more variables are incorporated and also the dynamics has been estimated with more detail.[1]

For the quarterly CPB-forecasts the investments in buildings are based on the exogenous information of colleagues who are engaged in the construction sector. They use for example building permits as short-term indicator for construction activity. The forecast for equipment-investments in the current and next year are mainly based on the model-forecast. Additional information, for example about large investment projects in the energy sector or the delivery of air planes, is also incorporated in the forecasting process.



The forecasting performance of the investment equation is relatively poor. CPB assesses their forecasts once a year. The mean forecast error appears to be close to zero for real GDP-growth and its components for the period 1971-2004. However, the mean absolute error is more then 1%-point for GDP and even more then 4%-point for business investments (excluding houses). The figure illustrates that forecasts of business investments for the next year, published in September, and realizations can differ significantly.

The figure shows also that the forecasts for the years 2001-2003 were too optimistic and for 2004 too pessimistic. This holds especially for the investments in buildings, which declined in this period on average yearly with almost ten percent. Investments in equipments (including means for transport) were forecasted too optimistic especially for the years 2001 and 2002. When we use the realizations for all the exogenous and endogenous variables in the model we can analyze the residuals of the model equations. For the investments in equipment we have only for 2004 a significantly residual. The forecast errors for the years 2001-2003 are mainly

[1] For a geeneral description of the investment equations see CPB Document 30, paragraph 2.1.1 (http://www.cpb.nl/eng/pub/cpbreeksen/document/30/).

caused by a general too optimistic vision on the (international) business cycle. The sharp decline in the investments in building can not be explained by the equations in the model.

Investment in Finland

The traditional Finnish investment ratio (gross fixed investment per value added) in industry has declined considerably in the course of the 1990's and stayed low. The ratio in 1992-2004 was 4.6 percentage points lower than in 1975-1991. The time of the division of the time series is the start of the "Great Finnish Depression of the 1990's". In spite of the decline in the ratio, the growth of the Finnish industrial production grew by 5.0 percent, a bit more than 2 percentage points faster in 1992-2004 than in 1975-1991. If we skip the unexceptional year 1991 the growth difference is still more than 1 percentage point in favour of the more recent period. The decline in the investment ratio mirrors the rapid structural change towards knowledge based (especially ICT) economy. The investment statistics take very poorly into account the investments into R&D. If we correct the ratio by including the R&D investments estimated in Statistics Finland, the adjusted investment ratio does not change between these two periods. However, the growth in industrial production accelerates.