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What explains developments in business investment?

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What explains developments in business investment?

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Summary

Business investment plays a crucial role in cyclical developments in the Norwegian economy. Mainland business investment has been relatively weak since the financial crisis erupted in autumn 2008, even though the key policy rate in Norway has been reduced to a historically low level. Estimations for the period 2003-2014 suggest that investment in the post-crisis period was restrained by weak future prospects and limited access to funding, while the decline in the interest rate level in isolation helped support investment. When future prospects improve, investment may rise considerably faster than mainland GDP. Our calculations indicate that the long-term equilibrium level of business investment as a share of GDP is around 10 percent, approximately 1 percentage point higher than the current level.

[1] The authors thank André Kallåk Anundsen, Kåre Hagelund, Per Espen Lilleås, Bjørn Naug, Kjell Bjørn Nordal, Einar Wøien Nordbø, Kjetil Olsen, Birger Vikøren and other colleagues at Norges Bank for useful input and comments.

Contents

1. Introduction

Business investment plays a crucial role in cyclical developments in the Norwegian economy. Historically, business investment has fluctuated widely. Mainland business investment has been relatively weak since the financial crisis erupted in autumn 2008, even though the key policy rate has been reduced to a historically low level. Sluggish business investment may have restrained growth in the Norwegian economy and lowered the growth capacity of the economy ahead.

Since 2008, business investment has also been sluggish in other OECD countries. Over the past year, the weak business investment performance in OECD countries has been analysed by international organisations and authorities such as the OECD (Lewis et al., 2014), the IMF (Barkbu et al., 2015) and the BIS (Banerjee et al., 2015), on the basis of traditional theoretical models, among other approaches. The results of these analyses suggest that business investment in other countries has been restrained by factors including low output, expectations of poor profitability ahead and uncertainty surrounding economic developments and economic policy.

In this article we analyse the most important drivers of mainland business investment in Norway. Like Barkbu et al., we begin by estimating two traditional theoretical models, an accelerator model and a neoclassical model. Then we estimate an internally developed model of business investment that combines insights from the traditional theoretical models with newer theories. The model using variables from newer theories (the preferred model) performs better than the two traditional theoretical models, with regard to both statistical and forecasting properties.

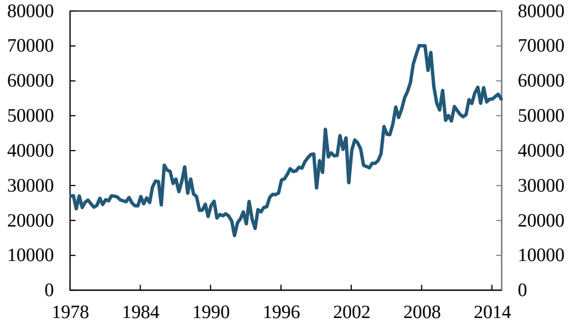
The preferred model contains effects of the interest rate on corporate loans, GDP, firms' profitability, availability of funding and firms' future prospects. According to the model, investment in the post-crisis period has been restrained by weak future prospects, moderate GDP growth, falling profitability and somewhat reduced availability of bank funding.

The model suggests that investment may rise considerably faster than mainland GDP when future prospects improve. In the model, the investment share trends towards a long-term equilibrium level of around 10 percent when the explanatory variables are set equal to their average values. Other calculations based on theoretical relationships and historical averages indicate that the long-term equilibrium level of the investment share may be higher than 10 percent. Overall, this suggests that the investment share may rise by approximately 1 percentage point from the current level when fundamental factors normalise.

2. Historical developments

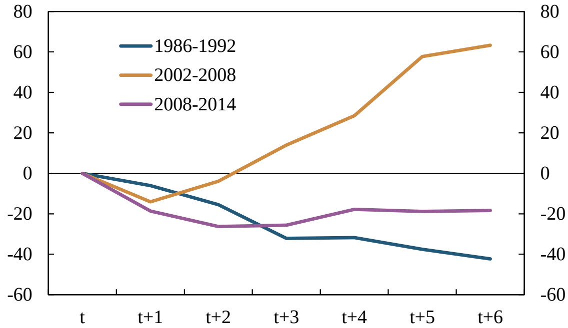
Over the past decades, there have been wide and persistent fluctuations in business investment in Norway (see Chart 1). After an overall increase of 90 percent between 2003 and 2008, business investment fell by 26 percent over the two subsequent years. In 2014, business investment was still 18 percent lower than in the peak year 2008 (see Chart 2). Business investment as a share of mainland GDP fell from over 12 percent in 2008 to around 9 percent in 2014 and is currently close to its average from 1978 (see Chart 3).

Chart 1. Business investment. Constant prices. Seasonally adjusted. In millions of NOK. 1978 Q1 – 2014 Q4



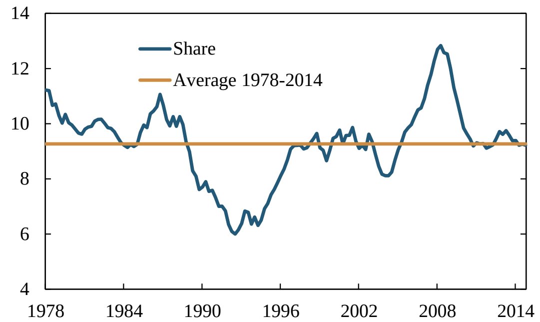
Source: Statistics Norway

Chart 2. Business investment. Cumulative percentage change over three different six-year periods. 1986 – 2014



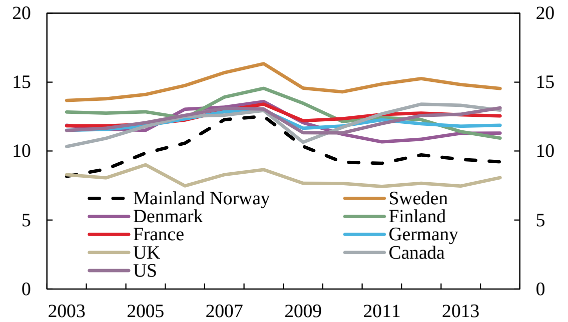
Source: Statistics Norway

Chart 3. Business investment as a share of GDP mainland Norway. Constant prices. Percent. 1978 Q1 – 2014 Q4



Source: Statistics Norway

Chart 4. Business investment as a share of GDP. Constant prices. Percent. 2003 – 2014



Sources: OECD and Statistics Norway

Since 2008, developments in mainland investment have also been weak compared with other OECD countries (see Chart 4). Between 2008 Q1 and 2009 Q3, business investment as a share of mainland GDP fell by over 3 percentage points, approximately 1 percentage point more than the average for 18 OECD countries in the same period (Lewis et al.).[2] Also in the post-crisis period, developments in the investment share have been weaker in mainland Norway than in other countries. While the investment share has picked up in a number of countries, the Norwegian investment share was still over 3 percentage points lower in 2014 than in 2008, resulting in a Norwegian investment share that was 2.5 percentage points below the average for the 18 OECD countries in 2013.

The decline in Norwegian business investment in the wake of the financial crisis is less pronounced than the one following the Norwegian banking crisis at the end of the 1980s. Between 1986 and 1992, investment fell by 42 percent, 24 percentage points more than in the six-year period 2008-2014. As a share of mainland GDP, business investment fell by nearly 5 percentage points between 1986 and 1992, while the decline over the six-year period 2008-2014 was just above 3 percentage points. The investment share is currently at the level of the average for the period 1978-2014. By comparison, 11 years passed before the investment share had returned to its average level after the banking crisis.

[2] Lewis et al. include Norway in their analysis, but consider business investment and petroleum investment together.

3. Theory and the literature

Developments in business investment are determined by firms' expected return on investment and uncertainty regarding developments ahead. In isolation, a lower interest rate level boosts investment because it improves business profitability and reduces the required rate of return on future investment. Investment demand is also influenced by the volume of goods and services to be produced and the rate at which the capital stock depreciates. In addition, reduced access to funding will pull down investment, especially among firms with limited equity financing. Interest rates, output levels, the economic outlook and financial market developments therefore have a bearing on business investment.

Since the 1950s, the economic literature has emphasised a number of different drivers of business investment. In 1958, Modigliani and Miller claimed that developments in investment depend only on profitability considerations, not on how firms finance their activities (Modigliani and Miller, 1958). The Modigliani-Miller theorem shows that firms' cost of capital is unaffected by their capital structure. Equity capital is more expensive than debt capital, but at the same time, increasing equity capital will reduce the volatility of the return on equity and the risk of debt capital. An increase in equity thus reduces the required rate of return on both equity and debt capital, and the weighted sum of the cost of capital remains unchanged. The theorem assumes perfectly efficient capital markets, which entails among other things an absence of distortions in the tax system, bankruptcy costs and asymmetric information.

In the literature, the profitability of investment is derived in several ways. The financial literature usually compares the return on investment with risk-adjusted return requirements, while in the other theoretical models, it is profitable to invest as long as marginal productivity is higher than the user cost of capital. Tobin (1969) showed that the profitability of an investment can be derived by the ratio between an asset's market value and its replacement cost – referred to as Tobin's Q. According to Tobin, it is attractive for a firm to invest as long as Tobin's Q is higher than 1, because the stock of real capital has a higher expected value to the firm than the cost of replacing it. Since an equity price reflects the market value of a company, equity prices may be an indicator of the attractiveness of investing. The empirical literature generally finds that equity prices can predict a substantial portion of developments in investment (Banerjee et al., 2015, Barro, 1990, Bosworth, 1975, Fama, 1981, Fischer and Merton, 1984, and Sensenbrenner, 1990). Banerjee et al. find a strong, positive correlation between equity prices and investment in the G7 countries for the period 1990-2014. In an empirical investigation, Morck et al. (1990) find no evidence that equity prices in themselves influence US firms' investment decisions, but they find that equity prices can reflect fundamental factors that have a bearing on investment decisions. Equity prices reflect firms' expected earnings, among other things (Ahmad et al., 2014, Bosworth, 1975, Elton et al., 1981, Fischer and Merton, 1984, and Liu et al., 2007).

Along with Tobin's Q, accelerator models and neoclassical models are among the most widely used theoretical models for investment in the economic literature. In accelerator models, firms' desired level of investment is determined by output growth and depreciation (Jorgenson, 1971). Neoclassical models and accelerator models have a number of similarities. Common to both types of model is that investment is determined by output growth and depreciation, while neoclassical models also focus on the user cost of capital to explain developments in investment (Barkbu et al.). Output growth and the user cost of capital are intended to measure changes in the desired capital stock.

Barkbu et al. estimate both an accelerator model and a neoclassical model for the euro area. They conclude that the actual changes in output can explain a considerable portion of the weakness of business investment since 2008. Banerjee et al. use firms' equity prices and profits as measures of expected profitability. In the period 1990-2014, both equity prices and profits are positively correlated with investment growth in the G7 countries. Therefore, they conclude that the lack of profitable investment opportunities has restrained investment growth in the G7 countries in the post-crisis period.

A growing body of literature shows that investment decisions are also influenced by factors other than the expected profitability of new investment, contrary to the well-known Modigliani-Miller theorem. Asymmetrical information between borrower and lender gives rise to agency costs, which raise the price of external funding relative to internally generated capital (see e.g. Bernanke and Gertler, 1989). Since lenders do not have perfect information regarding borrowers' debt-servicing capacity or borrower behaviour, they require a margin for this agency cost from borrowers. The margin required by lenders to issue loans varies over time (see Chart 9). This margin has a bearing on developments in business investment, because it affects both firms' profitability and the required rate of return on investment. Factors affecting the margin on loans may therefore also influence firms' investment decisions. Hammersland and Jacobsen (2008) find a short-run relationship for the Norwegian economy where changes in property prices amplify effects on credit and economic activity. This relationship suggests that in Norway, cyclical fluctuations are amplified by agency costs. However, Banerjee et al. find no strong, positive effects of cheap and readily accessible external funding on business investment in the G7 countries in the post-crisis period.

A number of studies show that firms' financial position affects their finance cost and thus firms' investment decisions (Lewis et al. and Stein, 2003). The financial position influences both the demand for and the price of external funding (agency cost). The need for costly external funding is lower among highly profitable firms that use their profits to increase equity and liquidity (internal funding). Such an improvement in firms' balance sheets also reduces the risk on corporate loans. In isolation, this reduces the agency cost and thus the price of external funding. Developments in indicators of firms' financial position may therefore signal changes in business investment.

Several studies find that firms' cash flow has a bearing on their investment decisions (Mills et al., 1994, and Mizen and Vermuelen, 2005). Mizen and Vermuelen find a positive relationship between investment and cash flow in Germany and the UK over the period 1993-99. However, problems associated with asymmetric information, and thus the effect of firms' balance sheets, may be less pronounced in countries such as Norway and Germany, where investment is largely financed by banks. Banks have ample access to information about their borrowers and are likely to have fewer problems associated with asymmetric information than bond market investors. Bond et al. (2003) finds that firms' cash flow has a greater bearing on investment in market-based countries such as the UK than in countries where investment is largely financed by banks, such as Belgium, France and Germany. However, Mizen and Vermuelen find no differences in the relationship between cash flow and investment in the UK and Germany when they control for differences in firm size and industry.

Ruscher and Wolff (2012) show that companies with a low equity ratio and low liquidity buffer are more likely to reduce their investment in bad times. Mills et al. (1994) find strong support for the importance of financial factors such as leverage ratio and liquidity buffer for investment decisions, especially for smaller firms. Bernanke and Gertler show how changes in firms' profitability and balance sheet structure result in investment cycles. Investment cycles may be further amplified by fluctuations in property prices (see Kiyotaki and Moore, 1997). In bad times, lower equity and collateral values may result in higher agency costs and more expensive external funding. Higher finance costs have a dampening effect on business investment, pulling down economic activity further. Lower economic activity further reduces firms' profitability and collateral values. Hammersland and Jacobsen find such a relationship in Norway, where fluctuations in property prices and credit amplify the effect of shocks on economic activity in the short term. This suggests that indicators that capture changes in collateral values may signal fluctuations in business investment.

Increased uncertainty may also weigh on business investment. Baum et al. (2010) use variation in individual firms' equity prices as a measure of firm-specific uncertainty. Furthermore, they use variation in the S&P 500 index as a measure of macroeconomic uncertainty. Their results suggest that both increased macroeconomic uncertainty and increased firm-specific uncertainty impair investment. Banerjee et al. use variation in GDP forecasts as a measure of uncertainty and find a significant negative correlation between this uncertainty measure and business investment. Also a number of other studies, such as Bloom (2009), EIB (2013), Barkbu et al. and Lewis et al., find that higher levels of uncertainty weaken investment. Other studies also indicate that political uncertainty may have reduced business investment in the post-crisis period. Baker et al. (2013) develop an economic policy uncertainty index and find that it helps to explain the weakness in business investment in the US and Europe since 2007.

4. Estimating two theoretical models

4.1 Accelerator model

Like Barkbu et al., we begin by estimating a conventional accelerator model of investment. The accelerator model is based on the assumption that investment (I_t) can be explained by changes in the desired level of the capital stock ($K^*_{t-i} - K^*_{t-i-1}$) and depreciation (δK_{t-1}) (see Jorgenson and Siebert, 1968):

$$(1) \quad I_t = \sum_{i=0}^{\infty} \omega_i \, \Delta K^*_{t-i} + \delta K_{t-1}$$

Changes in the desired level of the capital stock are assumed to be proportional to changes in GDP (ΔY_t):

$$(2) \quad \Delta K^*_t = c \Delta Y_t$$

where c is the "accelerator" that is assumed to be constant. We add a constant term (α) and an error term (e_t) that is assumed to be normally distributed. Like Barkbu et al. we divide equation (1) by the capital stock in the previous period (K_{t-1}):

$$(3) \quad \frac{I_t}{K_{t-1}} = \frac{\alpha}{K_{t-1}} + \sum_{i=1}^{\infty} \beta_i \frac{\Delta Y_{t-i}}{K_{t-1}} + \delta + e_t$$

The constant term δ can be interpreted as an indirect measure of the depreciation rate. To avoid potential endogeneity problems, we do not include the contemporaneous value of GDP growth. We use data between 1989 Q1 and 2014 Q4 inclusive to estimate equation (3) (see Appendix 1 for a detailed description of the data series).[3] The estimated values of β_i ($\beta_i = c\omega_i$) are expected to be positive.

As in the accelerator model that Barkbu et al. estimates for the euro area, the model has a positive autocorrelation in the error term (see Table 1 in Appendix 2). The positive autocorrelation indicates that the model is misspecified (see Granger and Newbold, 1974).[4] Positive autocorrelation in the error term may result in estimators that are not consistent and

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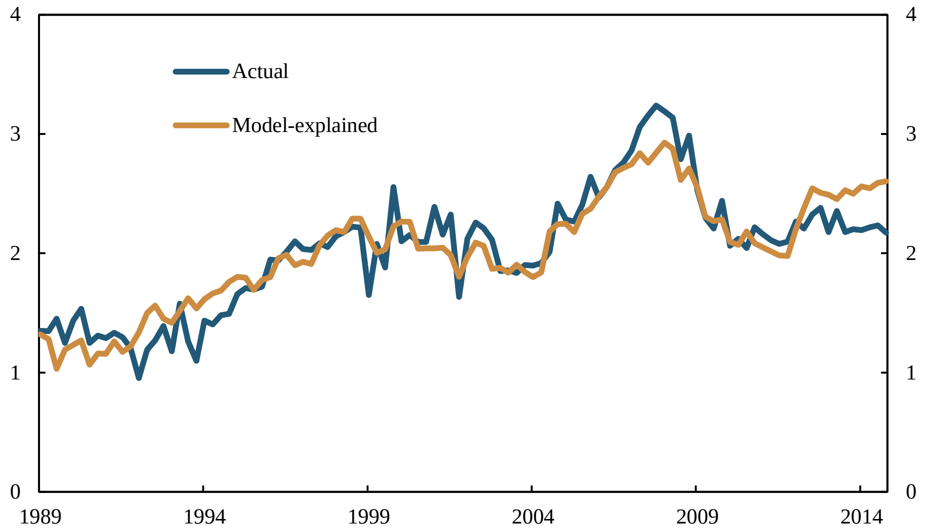
[3] Like Barkbu et al. we use a time lag (i) of up to 12 quarters.

[4] Unit root tests indicate that $\frac{\alpha}{K_{t-1}}$ is integrated of order 2, $\frac{I_t}{K_{t-1}}$ is integrated of order 1, and $\frac{\Delta Y_t}{K_{t-1}}$ is stationary. If $\frac{\alpha}{K_{t-1}}$ is integrated of order 2, equation (3) will not be balanced. This can create spurious regression problems (see Granger and Newbold, 1974).

explanatory variables that are less significant than indicated by t-values. The estimated coefficient must therefore be interpreted with caution.

The signs of the estimated coefficients correspond with the theoretical model, indicating a positive correlation between output and investment in mainland Norway. Barkbu et al. find similar results for the euro area. The accelerator model explains a considerable portion of the fluctuations in business investment but has overpredicted investment in mainland Norway in both 2013 and 2014 (see Chart 5).

Chart 5. Actual and model-explained changes in mainland business investment as a share of capital stock in the previous period. Accelerator model. Percent. 1989 Q1 – 2014 Q4



Sources: Norges Bank and Statistics Norway

4.2 Neoclassical model

The accelerator model does not explain the weak developments in business investment in 2013 and 2014. In addition, the accelerator model is probably misspecified. We therefore investigate whether the neoclassical model is better suited to explaining developments in business investment.

The neoclassical model is based on many of the same assumptions as the accelerator model, but also takes into account firms' profit maximisation. Thus, the desired level of the capital stock is given by the level where the marginal productivity of capital is equal to the real user cost of capital (r). The user cost of capital is the total cost associated with owning and using a unit of capital for a period. If we assume that output is given by a Cobb-Douglas production function, the desired level of the capital stock will be:

$$K_t^* = \frac{\theta Y_t}{r_t}$$

where θ is the output elasticity of capital. We calculate the real user cost of capital (r) using the standard formula from Hall and Jorgensen (1967):

$$r = \frac{[1 - \tau(Z + k)](r^* + \delta)}{(1 + \tau)}$$

where τ is the corporate tax rate, Z is the present value of the depreciation deduction allowances, k is other tax deductions, r^* is the real finance cost and δ is depreciation. Increased finance costs pull up the required rate of return, and the user cost of capital thus rises. The user cost of capital also increases with a higher rate of depreciation, because capital falls in value. This effect is mitigated somewhat by the fact that higher depreciation rates result in increased tax deductions.

We derive Z using the following relationship from Benge et al. (1998):

$$Z = \frac{\delta'}{1+i^*}[1 + \left(\frac{1-\delta'}{1+i^*}\right) + \left(\frac{1-\delta'}{1+i^*}\right)^2 + \ldots = \frac{\delta'}{i^* + \delta'}$$

where δ' is the firms' reported depreciation rate and i^* the nominal discount rate.

Firms' funding costs are calculated by weighting firms' borrowing rates and required return on equity by firms' debt and equity ratios. Real funding cost (r^*) is calculated by adjusting funding cost for tax (τ) and inflation (π):

$$r^* = \left[\frac{D * i * (1-\tau)}{(D+E)} + \frac{E * CE}{(D+E)}\right] - \pi$$

Like Barkbu et al., we also include a measure of access to funding (fc) in the neoclassical model because r does not necessarily capture changes in credit rationing:

$$(4) \qquad \frac{I_t}{K_{t-1}} = \frac{\alpha}{K_{t-1}} + \sum_{i=1}^{\infty} \beta_i \frac{\Delta\left(\frac{Y_{t-i}}{r_{t-i}}\right)}{K_{t-1}} + \sum_{i=0}^{\infty} \gamma_i fc_{t-i} + \delta + e_t$$

We use data between 1989 Q1 and 2014 Q4 inclusive to estimate equation (5) (see Appendix 1 for a detailed description of the data series). Banks' lending margins are used as a measure of fc[5]. In the neoclassical model, the estimated values of β_i ($\beta_i = \theta\omega_i$) are supposed to be positive, while the estimated values for γ_i are supposed to be negative.

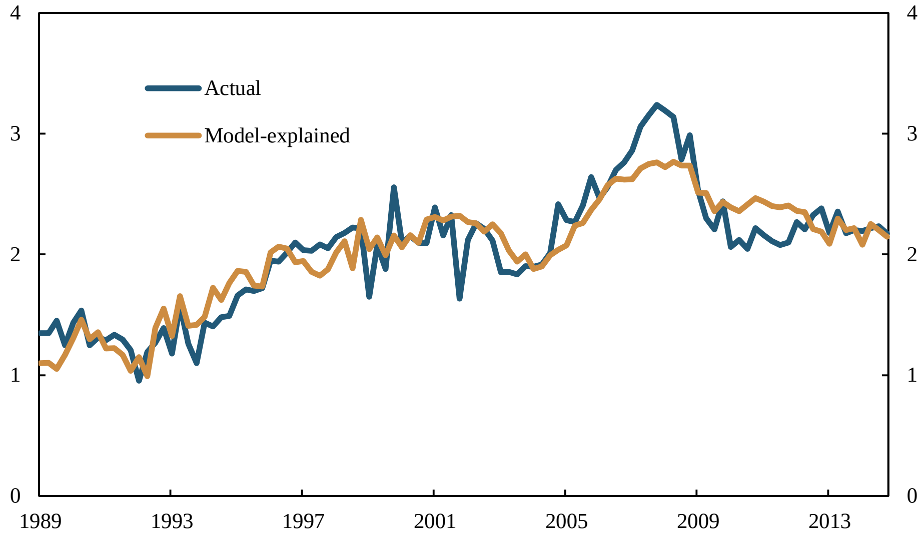
As in the neoclassical model that Barkbu et al. estimate for the euro area, there is a positive autocorrelation in the error term. This indicates that also the neoclassical model is misspecified. The estimated coefficients must therefore be interpreted with caution. The signs of the estimated coefficients suggest that reduced access to funding (fc) results in lower investment in our data set (see Table 2 in Appendix 2). The estimated coefficients for the change in the desired capital stock (β_i) are generally not significantly different from zero.[6]

The neoclassical model explains the current level of investment in mainland Norway better than the accelerator model (see Chart 6). This may indicate that the user cost of capital and margin on corporate loans help to explain a greater share of recent developments in business investment.

[5] Banks can change the lending margin without affecting the criteria for obtaining loans (access to credit). For example, fluctuations in money market rates can change lending margins without affecting access to credit. The margin on corporate loans is therefore not a perfect measure of access to credit. However, for the estimation period, the lending margin is the best available measure of access to credit.

[6] Unit root tests indicate that the error term, $\frac{\Delta\left(\frac{Y_{t-i}}{r_{t-i}}\right)}{K_{t-1}}$ and fc_{t-i} are stationary.

Chart 6. Actual and model-explained developments in business investment as share of capital stock in the previous period. Neoclassical model. Percent. 1989 Q1 – 2014 Q4



Sources: Norges Bank and Statistics Norway

5. Estimating a model using variables from more recent theories

The economics literature increasingly shows that investment decisions are influenced by several factors that are not captured by the traditional models that we have estimated in Section 4. Therefore, to better explain developments in business investment, we wish to combine insights from accelerator and neoclassical models with more recent theories. Potential explanatory variables have been chosen with a view to measuring how business investment is influenced by future prospects, access to and cost of funding, firms' balance sheets and uncertainty regarding economic developments and economic policy.

We utilise a procedure where we model business investment using different combinations of all explanatory variables from Appendix 1. We first exclude explanatory variables with estimated signs that do not correspond with the theory in Section 3. Then we sequentially remove the least significant variables. Since investment as a share of GDP is stationary over time, we impose a long-term elasticity for GDP equal to 1. This restriction is not rejected by the data.

The preferred model is an error correction model for the logarithm of business investment (see box 1). The model contains effects of the interest rate on corporate loans, GDP, firms' profitability, access to funding and firms' future prospects. Future prospects are measured by comparing the equity prices of Norwegian companies with their book value per share (price-to-book ratio) while access to funding is approximated by the margin on corporate loans.

Box 1 Business investment model

$$\Delta investment_t = \underset{(5.88)}{-1.34} - \underset{(2.54)}{0.24}(investment_{t-1} - investment_{t-4})$$

$$\underset{(5.49)}{-0.59}(investment - gdp)_{t-1} + \underset{(4.30)}{0.18}pb_{t-5} + \underset{(2.40)}{0.001}ROE_{t-4}$$

$$\underset{(3.31)}{-0.027}LENDING\ RATE_{t-4} - \underset{(2.16)}{0.11}margin_{t-4} + \underset{(2.99)}{2.30}\Delta gdp_{t-1} + \underset{(4.66)}{3.80}\Delta gdp_{t-2} + \underset{(3.96)}{2.80}\Delta gdp_{t-3}$$

$$R^2 = 0.79, Durbin\ Watson\ statistic = 2.00.$$

Estimation period: 2003 Q1 – 2014 Q4.
Estimation method: Least squares.
Absolute t-values appear in brackets under the estimates.
R^2 is the share of the variation in the left-side variable explained by the model.
Δ is a difference operator: $\Delta X_t = X_t - X_{t-1}$
Variables are defined as (lower-case letters indicate that the variable is measured on a logarithmic scale):

investment	= Business investment for mainland Norway. Seasonally adjusted volume. Source: Statistics Norway
gdp	= GDP mainland Norway. Seasonally adjusted volume. Source: Statistics Norway
pb	= Price-to-book ratio. Oslo Børs Benchmark Index. Source: Bloomberg
ROE	= Return on equity for Norwegian-registered non-financial enterprises listed on Oslo Børs. Percent. Source: Statistics Norway
LENDING RATE	= Interest rate on corporate loans from all banks and mortgage companies. Percent. Source: Statistics Norway
margin	= Interest rate on corporate loans from all banks and mortgage companies less the three-month Nibor. Percent. Source: Statistics Norway

The model is estimated over a 12-year period between 2003 Q1 and 2014 Q4 inclusive. The estimation period is limited by the fact that quarterly data for Norwegian firms' profitability is only available back to 2002. The error term is stationary and contains neither autocorrelation nor heteroskedacity (see Table 3-5 in Appendix 2). The estimated coefficient of the error correction term between investment and GDP is significantly different from zero, which indicates that there is cointegration and that the error term is stationary.[7]

The model suggests that availability of both internal and external funding plays an important role for business investment in mainland Norway. Reduced availability of external funding, measured by a higher margin on corporate loans, curbs investment growth. There is a significant

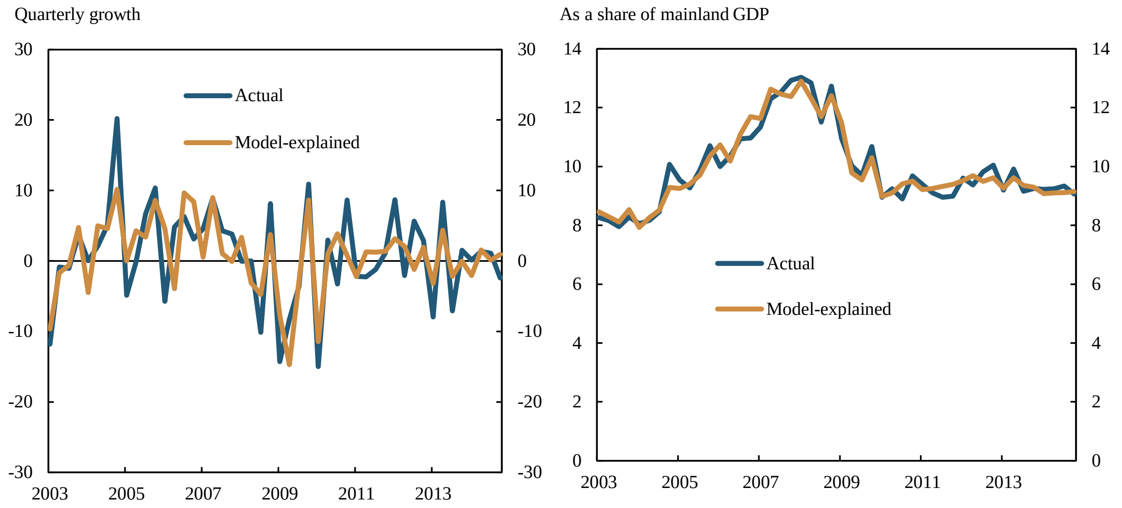
[7] We have tested the significance of the error correction term using values from Ericson and MacKinnon (2002) since the coefficient does not follow a normal t-distribution under the null hypothesis of no cointegration.

positive effect on firms' profitability, measured by return on equity. This indicates that ample access to internal funding owing to high profitability, helps to pull up investment growth.

The model supports the assumption that future prospects are important for business investment. We use different equity price indicators as measures of the expected profitability of future investment. The ratio between the equity price of companies on Oslo Børs and their book value per share (price-to-book ratio), which is a measurement of Tobin's Q, is included with a significant, positive effect. This corresponds with Banerjee et al., who find that future prospects have a bearing on developments in business investment. Firms' profitability and GDP growth are also included with significant, positive effects. This may support the importance of future prospects for firms' investment decisions, if firms assume that the current situation is persistent. The model also shows that a lower interest rate level pulls up investment activity in mainland Norway. The corporate lending rate is included with a significant, negative sign.

With explanatory power of 79 percent, the preferred model captures most of the fluctuations in investment (see Chart 7). The investment share has been approximately at the level explained by the model in 2014.

Chart 7. Actual and model-explained developments in business investment. Seasonally adjusted. Constant prices. Percent. 2003 Q1 – 2014 Q4

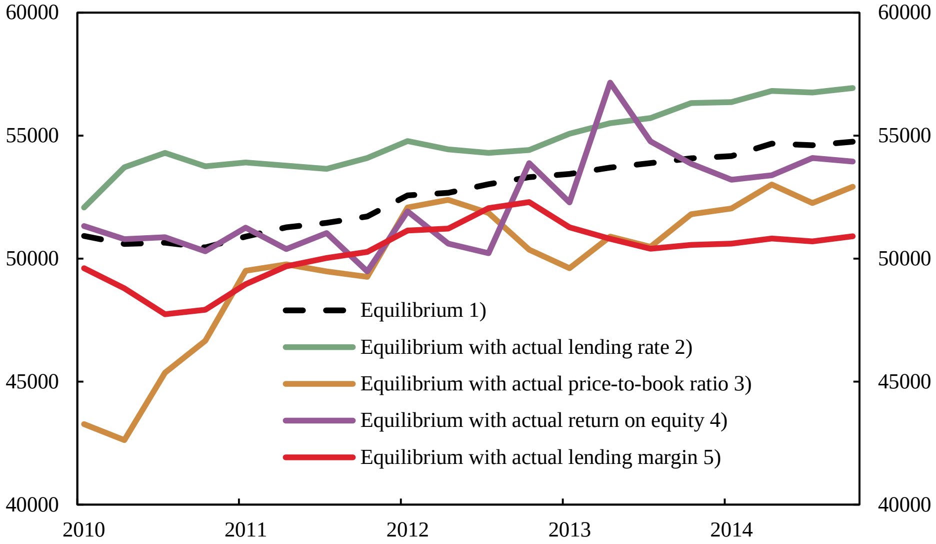


Sources: Norges Bank and Statistics Norway

According to the model, investment was restrained by weak future prospects (price-to-book, GDP growth and return on equity) and limited access to funding (margin and return on equity) post-crisis. We use the model's long-term solution[8] and average values of the explanatory variables to calculate an equilibrium path for the investment share (see broken line in Chart 8). The equilibrium path is lower using actual values for price-to-book, margin and return on equity, but the equilibrium path is higher when the effect of the low interest rates is included.

[8] We find the long-term solution by setting the difference terms equal to zero and then solve the model with respect to the error-correction term. The long-term solution is given by: $\frac{investment}{gdp} = -2.28 + 0.30pb + 0.002RETURN\ ON\ EQUITY - 0.045LENDING\ RATE - 0.18margin$

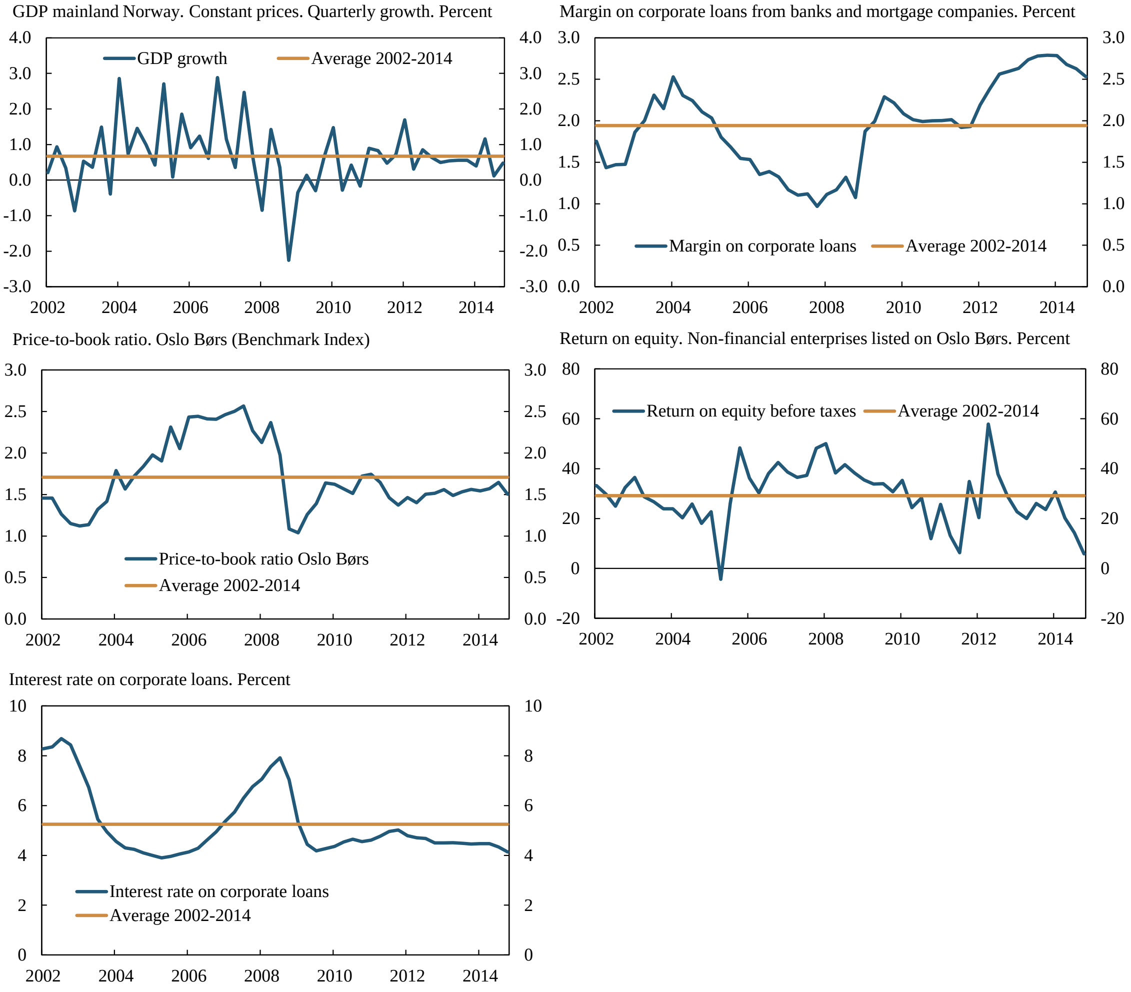
Chart 8. Equilibrium paths for business investment. Seasonally adjusted. Constant prices. In millions of NOK. 2010 Q1 – 2014 Q4



1) Calculated with average values as from 2003 Q1 for all explantory varaibles
2) As 1), but with actual values for the lending rate
3) As 1), but with actual values for the price-to-book ratio
4) As 1), but with actual values for the return on equity
5) As 1), but with actual values for the lending margin
Source: Norges Bank

Chart 9 shows developments in the explanatory variables since the financial crisis. Since the crisis erupted, the price-to-book ratio fell from 2.4 to 1.5, which indicates weaker future prospects. In the same period, GDP growth was moderate and Norwegian firms' profitability, measured by the return on equity, was declining. Both moderate GDP growth and low profitability may lower firms' expectations of future developments. Low profitability also reduces the availability of internal funding. At the same time, the margin on corporate loans has risen by 1.5 percentage points since 2009 Q3. To the extent the margin on corporate lending captures changes in the availability of funding, investment growth was also dampened by somewhat reduced access to bank funding in the post-crisis period.

Chart 9. Explanatory variables in the model of business investment in mainland Norway. 2002 Q1 – 2014 Q4



Sources: Bloomberg and Statistics Norway

6. Forecasting properties

Norges Bank draws up projections of business investment four times a year as part of its work on the *Monetary Policy Report*. Models with good forecasting properties may be useful in the work of projecting business investment. We therefore assess the forecasting properties of the models estimated in Sections 4 and 5. First we estimate the models with data between 2003 Q1 and 2012 Q4 inclusive. Then we let the models predict investment growth in 2013 and 2014 using actual values for the explanatory variables. We use the deviation between actual and forecasted investment growth to compare the forecasting properties of the three models.

The model using variables from more recent theories (Preferred) shows better forecasting properties than the accelerator model and the neoclassical model (see Table 1 below). The preferred model has a forecast error (RMSFE[9]) of 3.3 percent in the period 2013-2014, which is lower than the corresponding values for the accelerator model (6.3 percent) and the neoclassical model (5.5 percent). The preferred model also shows better forecasting properties than a random walk assumption, i.e. that investment growth will be the same as in the previous quarter. The preferred model also achieves a lower forecast error (4.1 percent) than the other models if we

[9] RMSFE = $\sqrt{\left[\frac{1}{n}\sum_{i=1}^{n}(X_i - Y_i)^2\right]}$, where n is the number of projected quarters, X_i is actual quarterly growth in quarter i, and Y_i is predicted quarterly growth in quarter i.

estimate the preferred model over the same period as the accelerator model and the neoclassical model (see “Preferred*” in Table 1).[10]

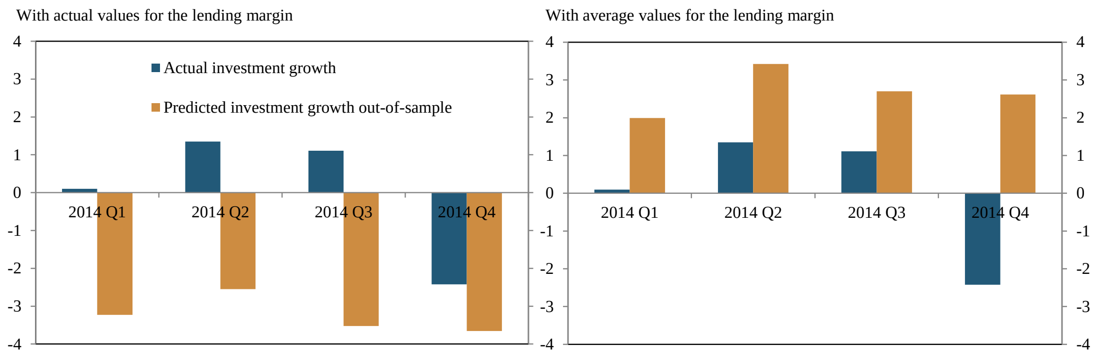
Table 1. Forecast error (RMSFE) for various models. 2013 Q1 – 2014 Q4. Percent

	Preferred	Preferred*	Accelerator	Neoclassical	Random walk	Actual growth
2013 Q1	-7.5	-3.8	1.2	-5.5	2.9	-7.9
2013 Q2	2.5	4.6	-1.2	11.4	-7.9	8.4
2013 Q3	-7.2	-1.4	3.6	-2.9	8.4	-7.1
2013 Q4	-0.4	6.3	-0.9	1.3	-7.1	1.5
2014 Q1	-3.2	2.3	2.8	-9.0	1.5	0.1
2014 Q2	-2.6	5.1	-0.5	12.2	0.1	1.3
2014 Q3	-3.5	3.4	2.0	-2.1	1.3	1.1
2014 Q4	-3.7	2.8	0.8	-2.4	1.1	-2.4
RMSFE	**3.3**	**4.1**	**6.3**	**5.5**	**9.4**	**-**

Sources: Norges Bank and Statistics Norway

Predicted investment growth from the preferred model is too low in 2014. Developments in the margin on corporate loans may explain why the preferred model underpredicts investment growth in 2014. In 2013, the margin on corporate loans was between 0.7 and 0.8 percentage point above its average value of 2 percent (see Chart 9). This pulls down investment growth in the model. If instead, we use the average value for the lending margin, predicted investment growth in 2014 is higher than actual investment growth (see Chart 10).

Chart 10. Actual and predicted investment growth. Percent. 2014 Q1 – 2014 Q4

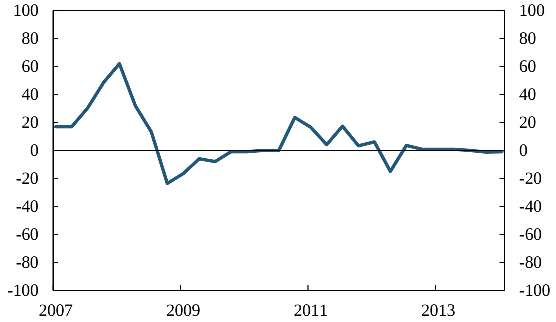


Sources: Norges Bank and Statistics Norway

Changes in the lending margin do not necessarily only reflect changes in the availability of external funding. Banks increased their margins on corporate loans by 0.9 percentage point in the period 2012-2013, among other reasons to improve their capital adequacy. In the same period, banks reported only slightly tighter credit standards in Norges Bank’s lending surveys (see Chart 11). In addition, issuance activity in the Norwegian bond market was high in 2013. This may indicate that not all of the increase in the margin in 2013 necessarily reflected reduced availability of external funding. The preferred model attains a lower forecast error (2.0 percent) if we only assume half of the effect of the higher lending margin in 2013 and 2014.

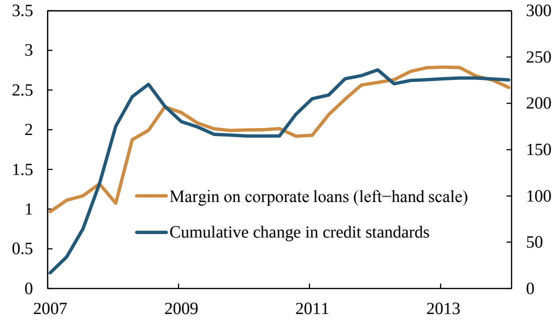
[10] Data for price-to-book and return on equity are only available back to 2001 Q2 and 2002 Q1, respectively. We therefore set price-to-book and return on equity in the prior periods equal to their average values.

Chart 11. Change in credit standards for enterprises. Net figures.[1)] Percent. 2007 Q4 – 2014 Q4



1) Positive figures denote tighter credit standards
Source: Norges Bank

Chart 12. Margin on corporate loans from banks and mortgage companies. Cumulative change in credit standards for enterprises.[1)] Percent. 2007 Q4 – 2014 Q4



1) Positive figures denote tighter credit standards
Sources: Norges Bank and Statistics Norway

Over time, the lending margin is a satisfactory measure of bank credit standards. The lending margin captures most of the fluctuations in bank credit standards (see Chart 12). In the period in which the lending survey has been conducted (since 2007), the correlation between the margin and cumulative changes in credit standards is very high (0.86). Banks reported continually reported tightening between 2007 Q4 and 2009 Q2. Over the same period, the margin more than doubled. After a period of easing credit standards and decline in the lending margin, banks again reported tightening in the period between 2011 Q3 and 2012 Q4. The lending margin increased over the same period by 0.7 percentage point.

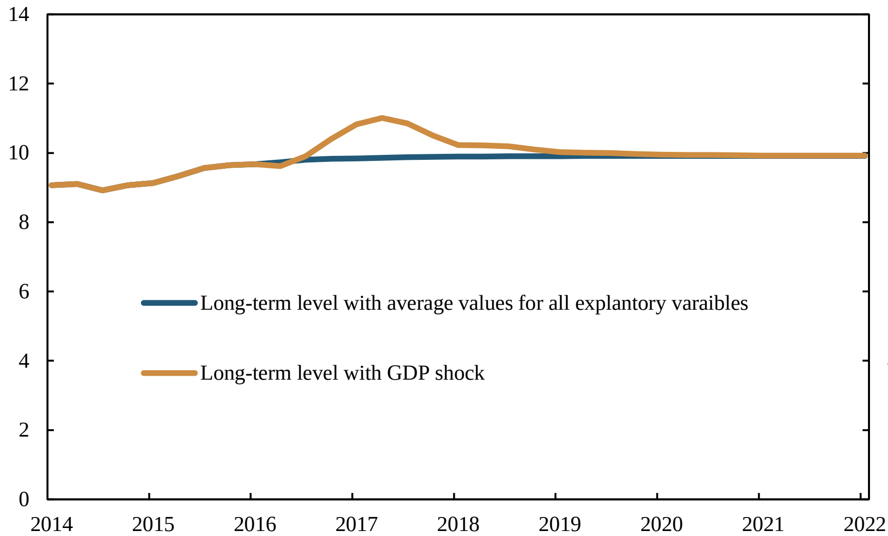
To assess whether the relationships in the preferred model are stable over time, we investigate whether the estimated coefficients change over the estimation period. Table 6 in Appendix 2 shows recursive estimates of the coefficients in the preferred model. The coefficients become generally stable after approximately six years of data and remain relatively stable from 2008 until the end of the estimation period. This suggests that the relationships in the preferred model are stable over time.

7. Long-term equilibrium level

We also assess the long-term properties of the preferred model by projecting the investment share up to 2020. We first project the investment share by setting future values of the explanatory variables equal to their average values for the estimation period 2003-2014. The investment share first declines slightly through 2015, because the effects of a falling return on equity and GDP growth are time-lagged. In the period to 2019, the investment share trends towards a long-term level of around 10 percent (see Chart 13). This indicates that the investment share will increase by nearly 1 percentage point from the current level as fundamental factors normalise.

In the next step, we assess how the investment share reacts to a shock in GDP growth. We assume a 5 percentage point rise in annual GDP growth in the course of 2017 before it returns to its average value during 2018. The positive shock reduces the investment share somewhat in 2017 Q1, because higher GDP growth (denominator) increases investment (numerator) with a time lag of between one and three quarters (see Chart 13). The shock then gradually increases the investment share to 11 percent in 2018 Q1, before the share returns to the equilibrium of 10 percent over the subsequent four years. The correction back to the equilibrium value of 10 percent shows that the long-term elasticity for GDP is equal to 1 in the preferred model.

Chart 13. Business investment as a share of GDP mainland Norway. Predicted share with and without GDP shock in 2017. Percent. 2014 – 2022



Sources: Norges Bank and Statistics Norway

Finally, we compare the long-term equilibrium value in the preferred model of 10 percent with other points of reference:

1. The level resulting from theoretical relationships
2. Historical averages for different periods in Norway
3. Historical averages for other comparable countries

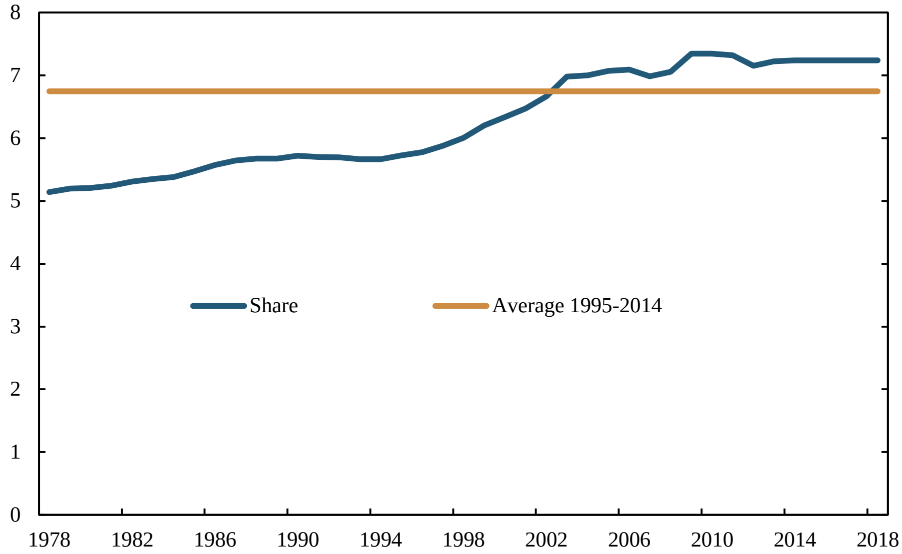
7.1 Theoretical relationships

Relationships in theoretical models may be used to derive a long-term equilibrium level for the investment share. We begin by assuming the existence of a long-term equilibrium level for firms' capital stock as a share of GDP (capital share). We assume that this capital share is constant in the long run and that it only changes with changes in the user cost of capital. The estimated equilibrium level for the capital share, along with the depreciation rate and long-term potential GDP growth, may be used to approximate the long-term equilibrium level for the investment share. The long-term equilibrium level of the investment share (i^*), which is necessary for attaining an equilibrium level for the capital share, is given by the following relationship (Lewis et al.):

$$(5) \quad i^* = \frac{k(g+\delta)}{1+g}$$

where k is firms' capital stock as a share of GDP in long-term equilibrium, while g is potential growth in the economy and δ is the depreciation rate. We assume that g is just above 2 percent. In addition, we assume that δ remains constant at the 2014 level from the national accounts, i.e. slightly above 7 percent. This is broadly at the level of what the depreciation rate has been since the beginning of the 2000s (see Chart 14).

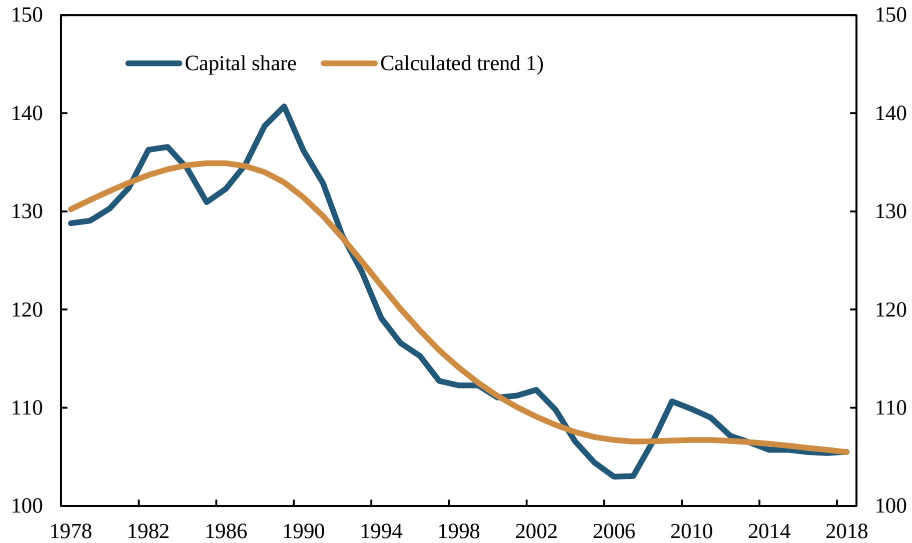
Chart 14. Depreciation as a share of mainland firms' capital stock. Constant prices. Percent. 1978 – 2018. Projections for 2015 – 2018



Sources: Norges Bank and Statistics Norway

Firms' capital share (k) has been at around 107 percent during the past decade (see Chart 15). We project k up to 2018 using a constant depreciation rate of just over 7 percent and projections from *Monetary Policy Report* 1/15 of investment and GDP. The capital share is projected to decline slightly to 106 percent in 2018.

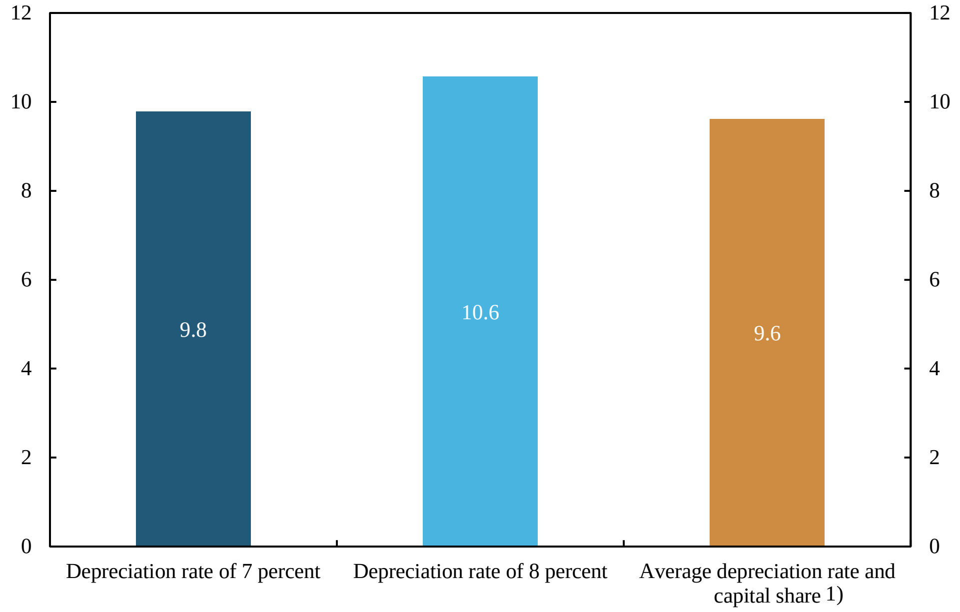
Chart 15. Mainland firms' capital stock as a share of mainland GDP. Constant prices. Percent. 1978 – 2018. Projections for 2015 – 2018



1) Two-sided Hodrick-Prescott (HP) filter. Lambda = 100.
Sources: Norges Bank and Statistics Norway

We assume that k is at equilibrium in 2018 and remains constant at 106 percent. With these assumptions for k, g and δ, equation (5) yields a long-term level for the investment share of slightly below 10 percent (see Chart 16).

Chart 16. Long-term equilibrium level of mainland firms' investment as a share of GDP mainland Norway. Estimated under different assumptions regarding depreciation and capital share. Percent



1) With average values for k og δ in the period 1995-2014 (109 and 6.7 percent, respectively)
Sources: Norges Bank and Statistics Norway

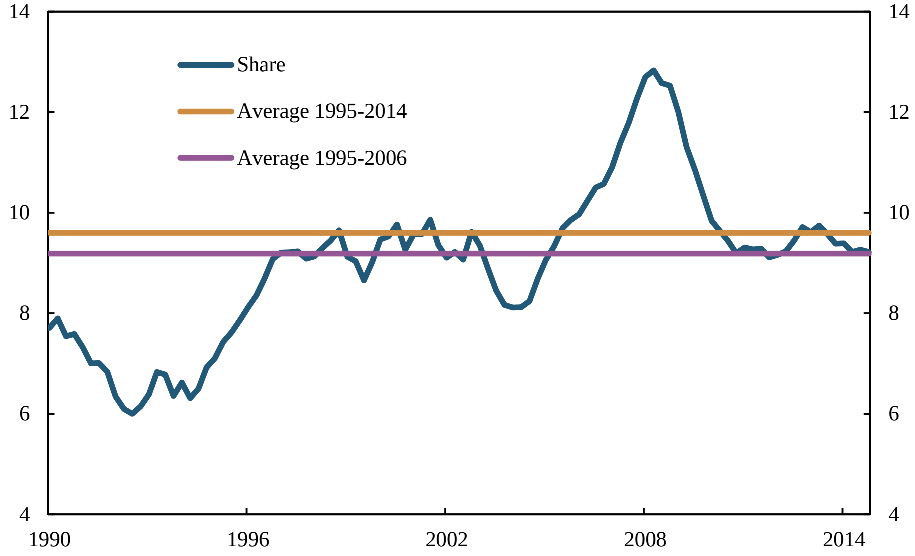
There is considerable uncertainty regarding the projections of k, g and δ, and the estimated equilibrium level is sensitive to changes in these assumptions. With a depreciation rate of 8 percent, the equilibrium level rises to close to 11 percent. If we use the average for the capital share and depreciation rate in the period 1995-2014, the result is a long-term equilibrium level for the investment share below 10 percent.

7.2 Historical averages for Norway

Historical averages may also provide indications of the investment share's long-term equilibrium level. Over the period 1978-2014, the average investment share was 9.3 percent. However, owing to structural changes, previous periods may be less representative for the investment share's current equilibrium level. The tax reform in 1992[11] may have considerably changed the incentives to invest. This suggests that the average after the tax reform in 1992 is more representative for the investment share's current equilibrium level. Over the period 1995-2014, the average investment share was 9.6 percent. If we look at the period 1995-2006, the average share falls to 9.2 percent (see Chart 17).

[11] Prior to the tax reform in 1992, the Norwegian tax system featured high formal tax rates, but extensive allowance and tax credit arrangements that resulted in tax deferrals (Norwegian Government, 2000). In certain cases, investments that were unprofitable before tax became profitable after tax. With the tax reform, many rules that stimulated investment were removed effective from 1992. On the other hand, the tax rate on companies' taxable profits was lowered considerably, from a maximum of 50.8 percent to 28 percent. The ability to make an allocation to the consolidation fund was the most extensive arrangement that was abolished under the tax reform. With a maximum allocation to the consolidation fund, the company could, in isolation, reduce its real tax rate from 50.8 percent to 39.1 percent.

Chart 17. Mainland firms' investment as a share of GDP mainland Norway. Constant prices. Percent. 1990 – 2014

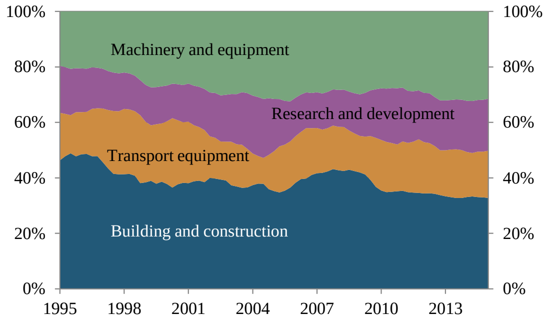


Source: Statistics Norway

A change in the composition of investment may have raised the equilibrium level of the investment share over the past two decades. Business investment in machinery and equipment has increased in importance over the past decades, whereas investment in building and construction has declined relative to other investment. Investment in machinery and equipment accounted for around 20 percent of total investment in 1995 (see Chart 18). This share had risen to over 30 percent in 2015 Q1. Part of this rise likely reflects an increase in the scope of ICT investment since the 1990s. Machinery and equipment depreciate faster than building and construction, for example. In recent years, the depreciation rate for building and construction has been just under 3 percent, while the depreciation rate for machinery and equipment has been close to 16 percent. The higher share of investment in machinery and equipment may thus explain the increase in the total depreciation rate over the past decades (see Chart 14). This may have boosted ongoing investment demand in the Norwegian economy. The average investment share of 9.6 percent over the period 1995-2014 may therefore underestimate the current long-term level of investment.

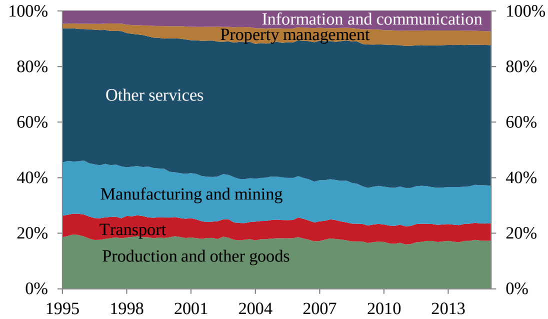
A change in industry composition has likely had less bearing on the equilibrium level of the investment share. In terms of value added by industry, the transport and manufacturing and mining have become somewhat smaller relative to the other industries included in mainland enterprises (see Chart 19). At the same time, these industries have become more capital-intensive over time (see Chart 21). Other industries' capital-intensiveness has remained relatively stable.

Chart 18. Share of business investment by type of capital. Percent. 1995 Q1 – 2015 Q1



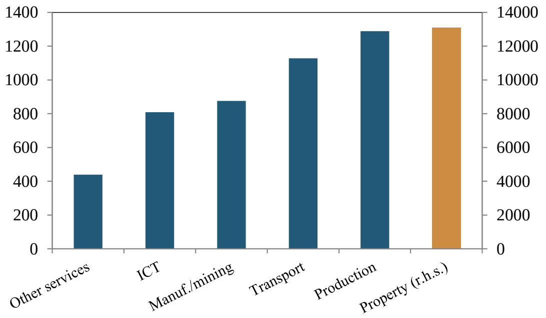
Source: Statistics Norway

Chart 19. Share of value added by industry. Mainland firms. Percent. 1995 Q1 – 2014 Q1



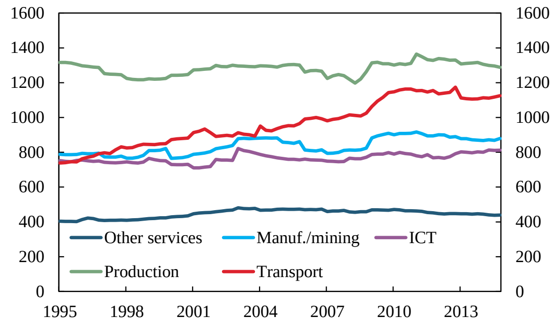
Source: Statistics Norway

Chart 20. Capital stock per hours worked in various industries. In billions of NOK. Constant prices. End of 2014



Source: Statistics Norway

Chart 21. Capital stock per hours worked [1)] by industry. In billions of NOK. Constant prices. 1995 Q1 – 2015 Q1



1) Hours worked are seasonally adjusted and annualised
Source: Statistics Norway

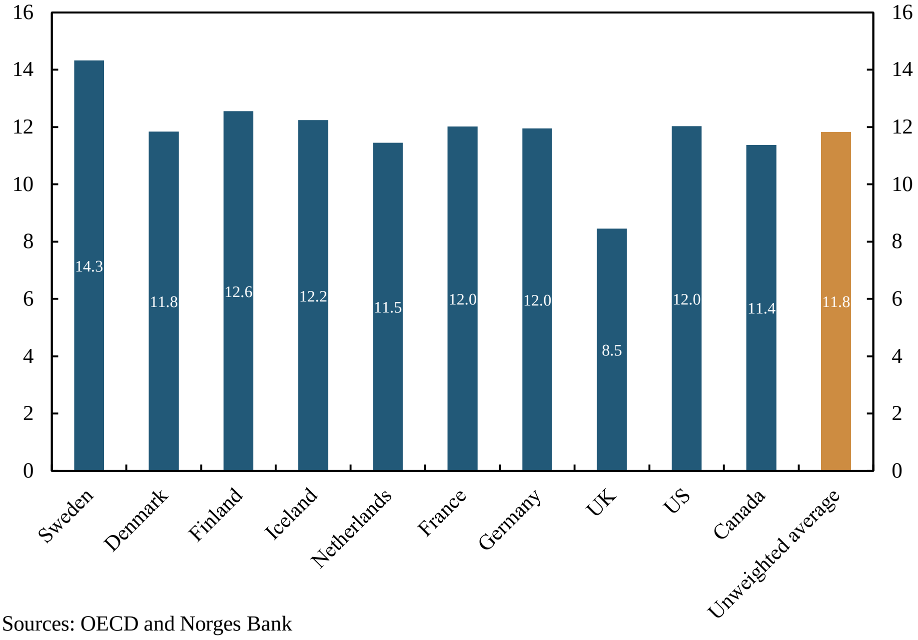
The property management industry appears to have increased in importance for GDP (see Chart 19). In addition, the industry is highly capital-intensive (see Chart 20). The property sector's greater importance probably reflects the fact that property management has been spun off into separate companies from firms in other industries or that many firms lease premises instead of investing in their own. Mainland firms' total investment in building and construction has declined from nearly half of total investment in 1995 to below a third in 2015 Q1 (see Chart 18).[12] [13] Thus, the property sector's increased importance for Norwegian GDP probably merely represents a reclassification from other industries that does not have a bearing on the total capital level in Norway.

7.3 Historical averages for other comparable countries

It is also useful to compare the estimated equilibrium levels with historical averages in other countries. Chart 22 shows firms' average investment share in 10 comparable countries over the period 1995-2014. The average investment share varies from below 9 percent in the UK to above 14 percent in Sweden. Cross-country variation in investment share may reflect differences in industry composition, tax systems and the size of the public sector, for example. Therefore, the figures are not necessarily comparable. Nevertheless, average investment share in other comparable countries may provide an indication of a long-term equilibrium level for Norway. The unweighted average for the 10 countries in Chart 22 is slightly below 12 percent, somewhat higher than the estimated equilibrium levels in Sections 7.1 and 7.2.

[12] In the mainland economy as a whole, investment in building and construction continues to be the largest component of the total.
[13] The decline in mainland firms' investment in building and construction may also reflect firms' more efficient utilisation of premises and thus a reduced need to invest in building and construction.

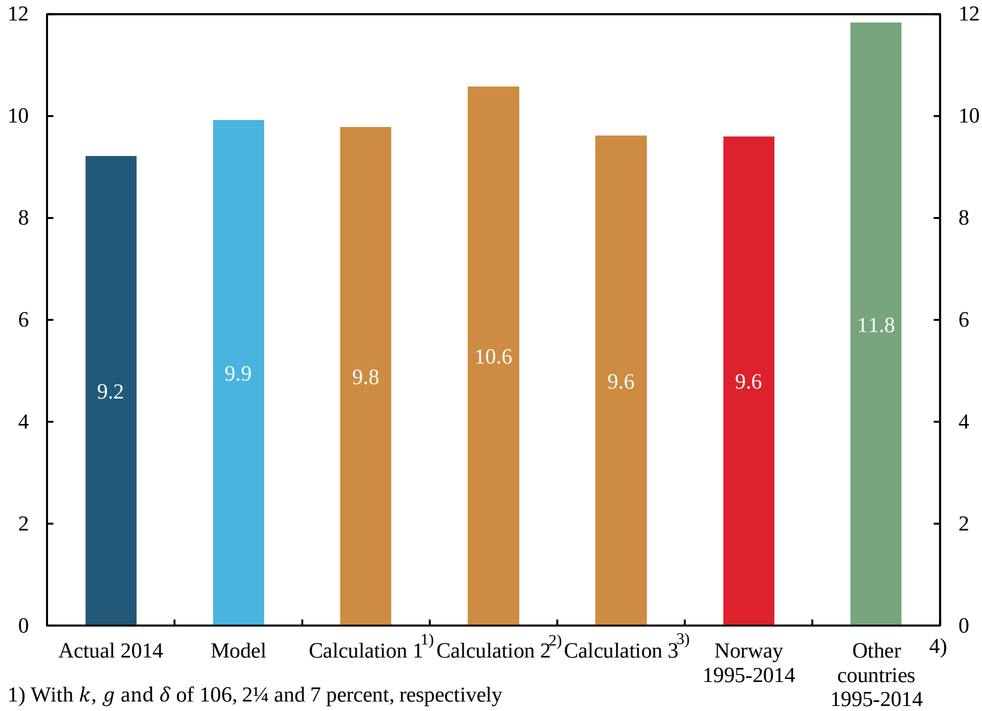
Chart 22. Business investment as a share of GDP in various countries. Percent. Average over the period 1995-2014.



Sources: OECD and Norges Bank

The various points of reference indicate that the long-term equilibrium level of the investment share is between 9 and 12 percent (see Chart 23). This is approximately at the same level as the long-term equilibrium level in the preferred model. Overall, this suggests that the investment share may rise by approximately 1 percentage point from the current level when fundamental factors normalise.

Chart 23. Estimated long-term equilibrium level of investment as a share of GDP mainland Norway on the basis of different approaches. Percent



1) With k, g and δ of 106, 2¼ and 7 percent, respectively
2) With k, g and δ of 106, 2¼ and 8 percent, respectively
3) With average values for k og δ in the period 1995-2014 (109 and 6.7 percent, respectively)
4) Sweden, Denmark, Finland, Iceland, Netherlands, France, Germany, UK, US and Canada
Sources: Norges Bank and Statistics Norway

8. Conclusion

Business investment plays a crucial role in cyclical developments in the Norwegian economy. Historically, investment has fluctuated widely, with business investment often accounting for a large portion of cyclical fluctuations. Mainland business investment has been relatively weak since the financial crisis erupted in autumn 2008, even though the key policy rate in Norway has been reduced to a historically low level. Sluggish business investment may have restrained both short- and long-term growth in the Norwegian economy. In addition to the short-term weakness in economic activity owing to lower investment, the growth capacity of the economy in the long term may also be reduced if the size of the capital stock declines. This article analyses developments in business investment with the aid of an empirical model and analyses the factors that have weighed on business investment in the post-crisis period.

Modelling over the period 2003-2014 indicates that the most important drivers of developments in Norwegian business investment are output levels, future prospects, the interest rate level and access to funding. Future prospects are measured by Norwegian firms' equity price compared with their book value per share (price-to-book ratio), while access to funding is approximated by the margin on corporate loans.

The model explains developments in business investment well. The model shows that the decline in the interest rate level has supported investment in the post-crisis period. According to the model, weak future prospects have weighted on investment in the post-crisis period. Since the financial crisis, equity prices of Norwegian firms have been weak compared with their book value per share, which may indicate weak future prospects. In addition, moderate GDP growth and falling profitability in Norwegian firms, measured by the return on equity, pulled down investment. Both moderate GDP growth and low profitability may lower firms' expectations of future developments. Low profitability may also indicate reduced availability of internal funding. Moreover, the margin on corporate loans has been higher post-crisis than the average since 2003.To the extent that the margin on corporate loans captures changes in access to funding, somewhat reduced access to bank funding post-crisis also had a dampening effect on investment growth.

When future prospects improve, investment may rise considerably faster than mainland GDP. In the model, the investment share trends towards a long-term equilibrium level of around 10 percent when the explanatory variables are set equal to their average values. Other calculations based on theoretical relationships and historical averages indicate that the long-term equilibrium level of the investment share may be higher than 10 percent. Overall, this suggests that the investment share may rise by approximately 1 percentage point from the current level when fundamental factors normalise.

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10. Appendix 1

Business investment	Business investment for mainland Norway. 1978 Q1 – 2014 Q4. Quarterly data. NOK
Capital stock	Capital stock for mainland Norway. 1978 Q1 – 2014 Q4. Quarterly data. NOK
Depreciation rate	Depreciation mainland Norway. 1978 Q1 – 2014 Q4. Quarterly data. Percent. Share of the capital stock
GDP	GDP mainland Norway. 1978 Q1 – 2014 Q4. Quarterly data. NOK
Output gap	Output gap mainland Norway. Real time. 1994 Q1 – 2014 Q4. Quarterly data. Percentage deviation between estimated actual and estimated potential mainland GDP
Relative labour costs	Relative labour costs in common currency. 1970 – 2014. Annual data interpolated to quarterly data. Index
User cost of capital	User cost of capital estimated using the standard formula from Hall and Jorgensen (1967).[14] See description of data under depreciation, equity ratio and lending rate. 1979 Q3 – 2014 Q4. Quarterly data. Percent
Lending rate	Interest rate on corporate loans from banks and mortgage companies. 1986 Q1 – 2014 Q4.[15] Quarterly data. Percent
Equity prices	Oslo Børs Benchmark Index. January 1996 – December 2014. Monthly data converted to quarterly data. Index. Smoothed four-quarter moving average
Price-to-book	Price-to-book, equities. Oslo Børs Benchmark Index. May 2001 – December 2014. Daily data converted to monthly data. Ratio
Term premium	Spread between the 10-year government bond yield and three-month Nibor. 1986 Q1 – 2014 Q4. Daily data converted to quarterly data. Percent
Uncertainty regarding economic policy	Policy uncertainty index[16] for Europe. 1997 Q1 – 2014 Q4. Monthly data converted to quarterly data. Index
Market volatility	Volatility Index (VIX). January 1990 – December 2014. Daily data converted to quarterly data. Index
Metal prices	The Economist Commodity Price Index Metal Industrials. January 1989 – December 2014. Weekly data converted to quarterly data. USD

[14] See Section 4.2 for a detailed description of the formula. The required return on equity is calculated on the basis of movements in the equity prices of mainland non-financial enterprises and movements in Oslo Børs Benchmark index and the five-year government bond yield.
[15] Prior to 2002 Q1, banks' average lending rate on all loans is used to approximate the average lending rate on corporate loans from banks and mortgage companies.
[16] See Baker et al. (2013).

Goods prices	Producer prices for goods. Total domestic and export market. 2000 Q1 – 2014 Q4. Quarterly data. Index
Commercial property prices	OPAK. 1980 Q4 – 2014 Q4. Half-year data interpolated to quarterly data. Price per square metre in NOK. Smoothed four-quarter moving average
Expected profitability	Opinion Perduco. Profitability next year. All enterprises. 2002 Q2 2014 Q4. Quarterly data. Index. Expectations survey of business leaders
Expectations regarding the Norwegian economy	TNS Gallup. Norwegian economy next year. 1992 Q3 – 2014 Q4. Quarterly data. Index. Consumer expectations barometer. Seasonally adjusted
Change in credit standards next 3 months	Bank Lending Survey. 2007 Q4 – 2014 Q4. Quarterly data. Percent. Index
Change in credit standards past 3 months	Bank Lending Survey. 2007 Q4 – 2014 Q4. Quarterly data. Percent. Index
Credit growth	Quarterly and 12-month growth in domestic credit to non-financial enterprises (C2). 1975 Q4 – 2014 Q4. Quarterly data. NOK
Lending margin	Margin on corporate loans from banks and mortgage companies. 1986 Q1 – 2014 Q4. Quarterly data. Spread in percent between lending rate and three-month Nibor
Net profit ratio	Net profit ratio for Norwegian-registered non-financial enterprises listed on Oslo Børs. 2002 Q1 – 2014 Q4. Quarterly data. Percent
Return on total capital	Return on total capital for Norwegian registered non-financial enterprises listed on Oslo Børs. 2002 Q1 – 2014 Q4. Quarterly data. Percent
Return on equity	Return on equity for Norwegian-registered non-financial enterprises listed on Oslo Børs. 2002 Q1 – 2014 Q4. Quarterly data. Percent
Equity ratio 1	Equity ratio for mainland non-financial enterprises (limited companies). 1988-2014. Annual data interpolated to quarterly data. Percent
Equity ratio 2	Equity ratio for Norwegian-registered non-financial enterprises listed on Oslo Børs. 2002 Q1 – 2014 Q4. Quarterly data. Percent
Share of current assets	Share of current assets for mainland non-financial enterprises (limited companies). 1999 – 2014. Annual data interpolated to quarterly data. Percent
Share of bank deposits	Share of bank deposits for mainland non-financial enterprises (limited companies). 1999 – 2014. Annual data interpolated to quarterly data. Percent

11. Appendix 2

Table 1. Accelerator model

Dependent variable: IK
Method: Least squares
Date: 06/09/15 Time: 14:36
Sample: 1989Q1 2014Q4
Included observations: 104

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	0.034699	0.001588	21.84605	0.0000
α	-37048.02	2825.177	-13.11352	0.0000
β1	0.182041	0.110590	1.646089	0.1032
β2	0.421671	0.111048	3.797192	0.0003
β3	0.325978	0.112722	2.891874	0.0048
β4	0.349189	0.113514	3.076165	0.0028
β5	0.401081	0.110542	3.628320	0.0005
β6	0.419112	0.111361	3.763549	0.0003
β7	0.136106	0.110599	1.230626	0.2217
β8	0.144054	0.110681	1.301521	0.1964
β9	0.246064	0.112365	2.189858	0.0311
β10	0.433955	0.112272	3.865224	0.0002
β11	0.387271	0.108555	3.567504	0.0006
β12	0.277817	0.107425	2.586149	0.0113

R-squared	0.839781	Mean dependent var	0.020270
Adjusted R-squared	0.816638	S.D. dependent var	0.005030
S.E. of regression	0.002154	Akaike info criterion	-9.318398
Sum squared resid	0.000418	Schwarz criterion	-8.962422
Log likelihood	498.5567	Hannan-Quinn criter.	-9.174182
F-statistic	36.28689	Durbin-Watson stat	0.891097
Prob(F-statistic)	0.000000		

Table 2. Neoclassical model

Dependent variable: IK
Method: Least squares
Date: 03/25/15 Time: 14:04
Sample: 1989Q1 2014Q4
Included observations: 104

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	0.045186	0.001764	25.60943	0.0000
α	-33140.42	3956.665	-8.375846	0.0000
β1	-0.506663	0.497214	-1.019003	0.3114
β2	-0.039992	0.503602	-0.079411	0.9369
β3	-0.147525	0.496310	-0.297244	0.7671
β4	0.417071	0.518237	0.804787	0.4234
β5	0.461734	0.507907	0.909092	0.3661
β6	0.560420	0.499605	1.121727	0.2655
β7	0.820089	0.507089	1.617249	0.1099
β8	1.439416	0.537330	2.678829	0.0090
β9	0.678907	0.545647	1.244224	0.2172
β10	0.545665	0.538630	1.013060	0.3142
β11	0.711841	0.524541	1.357075	0.1787
β12	0.804046	0.534087	1.505458	0.1363
FC0	-0.001673	0.000579	-2.890131	0.0050
FC1	0.000112	0.000696	0.160617	0.8728
FC2	-0.001523	0.000688	-2.212745	0.0299
FC3	-0.000404	0.000683	-0.590900	0.5563
FC4	-0.000601	0.000671	-0.895587	0.3733
FC5	-0.000108	0.000678	-0.159569	0.8736
FC6	-0.000671	0.000672	-0.999852	0.3205
FC7	-0.000452	0.000676	-0.669019	0.5055
FC8	0.000239	0.000692	0.345456	0.7307
FC9	-3.55E-05	0.000680	-0.052222	0.9585
FC10	0.000277	0.000667	0.415595	0.6789
FC11	0.000160	0.000663	0.241970	0.8094
FC12	0.000839	0.000532	1.576697	0.1190

R-squared	0.828012	Mean dependent var	0.020270
Adjusted R-squared	0.769938	S.D. dependent var	0.005030
S.E. of regression	0.002413	Akaike info criterion	-8.997517
Sum squared resid	0.000448	Schwarz criterion	-8.310993
Log likelihood	494.8709	Hannan-Quinn criter.	-8.719386
F-statistic	14.25790	Durbin-Watson stat	0.842326
Prob(F-statistic)	0.000000		

Table 3. Preferred model

Dependent Variable: D(LOG(I))
Method: Least Squares
Date: 04/13/15 Time: 15:05
Sample (adjusted): 2003Q1 2014Q4
Included observations: 48 after adjustments

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	-1.343345	0.228472	-5.879693	0.0000
DLOG(I(-1),0,3)	-0.241289	0.094951	-2.541193	0.0153
LOG(I(-1))-LOG(GDP(-1))	-0.590179	0.107449	-5.492637	0.0000
LOG(PB(-5))	0.177680	0.041341	4.297883	0.0001
ROE(-4)	0.001349	0.000563	2.395316	0.0216
LENDING RATE(-4)	-0.026596	0.008037	-3.309178	0.0021
LOG(MARGIN(-4))	-0.109172	0.050563	-2.159129	0.0372
DLOG(GDP(-1))	2.301181	0.770512	2.986562	0.0049
DLOG(GDP(-2))	3.800072	0.815781	4.658203	0.0000
DLOG(GDP(-3))	2.803486	0.707705	3.961378	0.0003

R-squared	0.788375	Mean dependent var	0.006271
Adjusted R-squared	0.738253	S.D. dependent var	0.068362
S.E. of regression	0.034975	Akaike info criterion	-3.685337
Sum squared resid	0.046483	Schwarz criterion	-3.295503
Log likelihood	98.44808	Hannan-Quinn criter.	-3.538018
F-statistic	15.72918	Durbin-Watson stat	1.996346
Prob (F-statistic)	0.000000		

Table 4. Preferred model. Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.593294	Prob. F(9,38)	0.1524
Obs*R-squared	13.15070	Prob. Chi-Square(9)	0.1559
Scaled explained SS	7.528667	Prob. Chi-Square(9)	0.5823

Table 5. Preferred model. Stationarity test

Null hypothesis: FEILLEDD has a unit root
Exogenous: Constant
Lag length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.782313	0.0000
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Table 6. Preferred model. Recursive estimates of coefficients