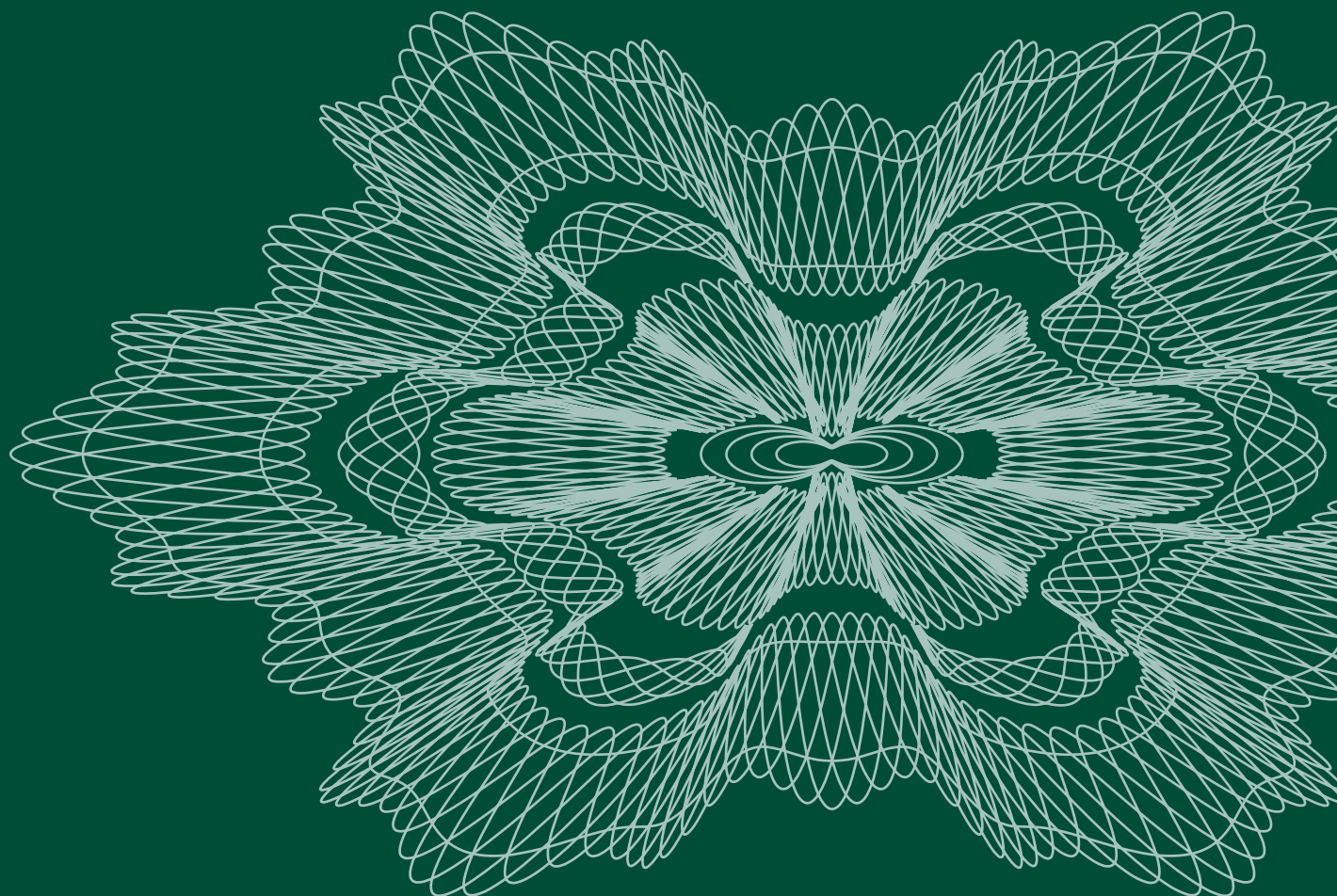




# Economic Bulletin

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# Norges Bank's Printing Works – 190 years of banknote production

Peter Ravnsborg-Gjertsen, production manager at Norges Bank's Printing Works, and Jens Olav Sporstøyl, adviser in the Communications Department

At the end of June 2007, Norges Bank's Printing Works was shut down and banknote production in Norway came to an end. The decision to discontinue operations was made by the Executive Board in 2002. The first banknotes were delivered the year after the establishment of Norges Bank in 1816. Thus, banknotes have been produced in Norway for 190 years. As of 2008, Norwegian banknotes will be delivered by commercial security printers in France and the UK. Closures or transferral to private operators have previously been implemented among state-owned/central bank-owned printing works in the UK, Germany, Sweden and Finland, and there are signs that other countries will follow suit.

## *The first banknotes*

Norges Bank's Printing Works started its activities in 1816, using manual printing presses and private printers to perform the task on the Bank's premises in Christiania (now Oslo). Initially, only the printing of the form took place here. Numbers, dates and signatures (3–5 depending on denomination) were written by hand at the Bank's head office, which was located in Trondheim at the time. Transporting these notes with military escort was a complicated and time-consuming operation, using horse and carriage along the roads of that time, over the Dovre Mountains – and back when the signing was completed and the forms had become notes. It often took twelve days one way. In the first years, the quality was not always up to standard – neither when it came to the print, nor the paper. Norway lacked experience in banknote printing and replacing the old notes was a matter of urgency.

The first notes had the denominations 1 and 5 specie-daler and were issued in 1817. 10, 50 and 100 specie-daler notes were issued the following year. In 1822, 1/2 and 1/5 specie-daler notes were also issued as a result of a shortage of coins – the last of these were withdrawn in 1850. The notes were simple printed material with one-sided, black print on coloured paper and without any

particular security features. However, the watermark was already in place and has kept its position to this day. The main colours on the notes have also remained virtually unchanged from that time through all the later series: 100 notes (speciedaler and the krone) red, 50 notes green, 10 notes yellow and 5 notes blue. (The exception is the 10-krone note from 1972, which was printed in blue tones when the 5-krone note was discontinued.) The small denomination notes were printed on white paper. From 1822, banknote printing was transferred to Trondheim and production became more efficient with a new, in-house press.

## *Two-colour and multicolour printing*

The next banknote series, from 1841, had two-coloured print (i.e. one colour in addition to black), but were still only printed on one side. The design had been improved, partly in order to combat counterfeiting (counterfeit notes were largely hand-drawn) and partly for artistic reasons. Numbers, dates and signatures were still written by hand, but printed numbers were eventually introduced.

In the 1860s, when Norges Bank wanted to produce notes with better paper quality and more modern production techniques (based on galvanoplasty and



Above: The first banknote type. One speciedaler, signed 1822.  
Right: Print plate for the 100 speciedaler note.  
The larger denominations had the same format (123 x 190 mm), the 1- and 5-speciedaler notes were slightly smaller, and the 1/2- and 1/5-notes about half the size





The first krone notes were issued in 1877 with the 1000-krone note as the highest denomination. Converted to today's value using the consumer price index, this corresponds to nearly NOK 50 000

mechanised engraving), Saunders, a paper and banknote manufacturer in London, offered to print the notes. The two parties entered into an agreement and in 1866 a new banknote series was introduced. The notes were printed and completed in London, with two colour prints, on both the obverse and the reverse, in addition to black intaglio print on the obverse. The obverse had a vignette with four men symbolising the main industries in Norway: mining, fishing, farming and shipping. However, after a short period, Norges Bank procured new equipment and all colour printing was gradually transferred to Trondheim, while the intaglio printing for this series continued to take place in London.

### *Krone banknotes*

In 1875, the Storting (Norwegian parliament) decided to join the Scandinavian monetary union, which was based on the gold standard and the denominations krone and øre. One speciedaler was converted to NOK four. The first krone-notes were issued in 1877 with six denominations: 5, 10, 50, 100, 500 and 1000. The 1000-krone note was quite a fortune at the time – corresponding today to about NOK 50 000 when using a consumer price index. This series has later been referred to as Series I. The same colour code was used, but the new denominations 500 and 1000 included rainbow printing (gradually changing colours). In this series, the notes no longer had the same size. The 5- and 10-krone notes were of identical size, measuring 135 x 78 mm, the 50- and 100-krone notes were double the size, and the 500- and 1000-notes triple the size. The notes were printed on white paper with black intaglio print and two-coloured letterpress print on the obverse and letterpress print in one colour on the reverse. Initially, Saunders produced the obverse while the reverse was printed in Trondheim. From 1889, after the procurement of new equipment, the letterpress printing of the obverse was carried out in Trondheim, as was the intaglio printing from 1891. In the same year, the Bank switched to paper from Sveriges Riksbank's paper mill in Tumba, south of Stockholm. Series I is also the only Norwegian banknote series on

which the portrait of a monarch, King Oscar II (in a Swedish admiral's uniform), has been used. (As a result of the union between Norway and Sweden from 1814 to 1905, the Swedish king was also king of Norway.)

In 1894, a galvanoplasty workshop was established at the Printing Works, allowing the Bank to produce its own printing plates for both letterpress and intaglio printing. However, the originals were still engraved in England.

### *Moving, postage stamp printing and the end of gold redemption*

From the year 1900, banknote Series I was replaced by Series II, in which the format was slightly smaller, but the relative size remained the same. The tradition of portraying prominent figures on the obverse began when Christie (former president of the Storting and chairman of the committee that achieved independence for Norway within the union with Sweden through negotiations in 1814) appeared on the 5-, 50- and 500-krone notes (alone), while Admiral Tordenskjold accompanied him on the 10-, 100- and 1000-krone notes. Apart from a small shipment delivered by Bradbury, Wilkinson & Co. Ltd. during the years 1900–1901, the notes were printed in Norway. The paper was supplied from Austria until 1907, when a switch was made to Alvøens paper mill close to Bergen. In 1907, banknote printing was moved to Oslo where the Bank's head office had been located since 1897. The Printing Works was then located in the Bank's new building which was inaugurated in 1906. In 1934, as both the Bank's and the Printing Works' activities had increased in volume over the years, the Printing Works moved to a separate building in Oslo.

During this period, Norges Bank's Printing Works produced its first postage stamps, using intaglio print. One stamp was produced for the centennial celebration of the Constitution in 1914 and another in 1930 commemorating Holy King Olav and the battle of Stiklestad which took place 900 years earlier.

Among the banknote series issued by Norges Bank, Series II is the one with the longest life. The series was not replaced until after the end of the war in 1945,



From the new head office at Bankplassen in Oslo when the Printing Works had moved in on the first floor in 1907. Many of the employees from Trondheim moved to Oslo with the Works.

although it was scheduled for replacement in the 1930s. The Bank's archives contain design drafts made by external designers, but due to turbulent times and the outbreak of World War II, they were never used. It was also during the life of this series that the Bank's duty to redeem banknotes for gold came to an end (1932), but the text "will pay the bearer [...] KRONER GOLD" was not removed.

### *War history, small denomination notes and monetary reform*

During World War I, there was a shortage of coins and coin metals. In 1917, Norges Bank was again permitted by law to issue small denomination notes. These were unpretentious one- and two-krone notes which ceased to be legal tender in 1925/1926. Influenced by the upheaval in Russia, the red two-krone note was nicknamed "Red Guard" while the green one-krone note was called "Bolshevik". A shortage of coins quickly arose again during World War II and small denomination notes were produced as early as 1940. These notes were legal tender until 1950. This time, the nicknames were "usling" for the one-krone note and "quisling" for the two-krone note, as "it took two uslings to make a quisling."<sup>1</sup>

In autumn 1942, a few trusted men at the Printing Works received a message through the resistance fighter Gunnar "No 24" Sønsteby, stating that the Norwegian Government in London requested printing plates in order to produce "counterfeit" Norwegian banknotes as a means of financing the resistance in Norway. When the message had been reassuringly confirmed from London, the stock manager and his supervisor set to work and Sønsteby managed to smuggle the plates over to Sweden in a sack of charcoal. When the material arrived in London, Waterlow & Sons Ltd. Printing Works produced NOK 20 million. However, the notes were not perfect enough for the Government to take the risk of letting the resistance movement use them. Later, about NOK 2 million was allegedly brought into the liberated areas of Finnmark in Northern Norway, replacing genuine notes from the local Norges Bank branch which then could be smuggled down to southern Norway.

Commissioned by Norges Bank's London Board, Waterlow & Sons Ltd. also printed both war notes, intended for the troops to use during a possible military reconquest of Norway, and replacement notes for a monetary reform after the war. However, the latter notes never entered into circulation and the war notes were only used to a limited extent during the first days after the liberation. Norges Bank in Oslo had in fact secretly started producing replacement notes as the war

<sup>1</sup> "Usling" is a despicable person: a louse, trash, scum. "Quisling" refers to the Norwegian fascist politician and traitor Vidkun Quisling, who led a coup d'etat on the day of the Nazi invasion of Norway, April 9, 1940.



*Norges Bank's Printing Works in 1989. One of two printing presses*

was drawing to a close – a very risky operation in those days, with several Nazi representatives both on the Board and the Supervisory Council.

During the war the occupational authorities requisitioned large quantities of Series II notes, and the Bank's management realised at an early stage that a monetary reform would be necessary when the war had come to an end. Thus, when the replacement of notes started on 9 September 1945, it was the notes from the Bank's in-house Printing Works that were to be used. These notes resemble a simplified version of Series II, with fewer colours and fewer prints and with the Norwegian national coat of arms and various rosettes instead of portraits and historical buildings. However, the 1000-krone note had the same motif, but the text GOLD had been printed over. This series, which has been designated Series III, did not include the 500-krone note.

### *Modernisation with trade and industry, women and "nynorsk" (New Norwegian) on the notes*

Series III was very short-lived and the first notes in Series IV were ready as early as the end of the 1940s. This banknote series was very thoroughly prepared and the motifs on the reverse illustrated the main areas within Norway's industrial and community life. These were notes showing activities in fishing, trade and shipping, agriculture, forestry, manufacturing industry and cultural life, respectively. The notes still had the large

format from Series II (216 x 127 mm for the two highest denominations). They were costly to produce since only a few notes on each printing sheet resulted in inefficient utilisation of the printing presses. Large notes also required considerable space in people's wallets.

From the early 1960s the Bank began issuing Series V, in which the notes, especially in the higher denominations, were markedly reduced in size. In spite of this, the Printing Works gradually reached its maximum capacity. In order to keep pace with the increasing need for banknotes, Norges Bank's Printing Works introduced a web press in the early 1970s. This was a new technology in banknote production which was also introduced in the UK, Sweden and Denmark around the same time. The notes were completed and numbered in a single operation, as opposed to the earlier process which might require up to six or seven printing operations. This resulted in a radical reduction in requirements for space, operators and work in progress. The first note produced using this method was the 10-krone note from 1972 which carried a portrait of Fridtjof Nansen and which took over the blue tones when the 5-krone note was replaced by a coin.

At the end of the 1970s the Bank started producing a new series, Series VI, and this entire series is printed on the web presses. This series marked some particular milestones. For the first time in history, a Norwegian banknote carried the portrait of a woman, author Camilla Collett on the 100-krone note, and the 50-krone note (with the portrait of author Åsmund Olavson

## Norges Bank's Printing Works – historical events:

1817	First banknotes printed at Norges Bank in Christiania (renamed Oslo in 1925)
1822	Printing is transferred to the head office in Trondheim
1842	The notes are pegged to silver at par
1841	New banknote series
1866	New banknote series
1873	Gold standard adopted
1875	Norway enters into the Scandinavian Mint Union
1877	Krone denominations are introduced along with a new banknote series (Series I)
1897	The Bank's head office is transferred to Christiania, the Printing Works remains in Trondheim
1900	The krone Series II is issued
1907	The Printing Works is moved to the new head office in Christiania
1932	Gold standard abolished
1934	The Printing Works moves into a separate building in Oslo (in Nedre Slottsgate)
1944	Series III, the replacement notes, printed in secrecy
1948	Production of Series IV begins
1962	Production of postage stamps printed in intaglio begins
1964	Production of Series V begins
1969	The Printing Works procures its first web press
1977	Production of Series VI begins with the 100-krone note, and eventually the whole series, printed on the web press
1980	A second web press is procured
1987	The Printing Works moves into the new head office, a third web press and a new web press for stamps are procured
1988	Production in Nedre Slottsgate is discontinued
1993	Printing and binding of a new passport form begins
1994	Production of Series VII begins with a 200-krone note
1996	All Norwegian stamps are printed at the Printing Works, new press procured
2000	Automatic quality control of banknotes introduced
2000	Production of postage stamps is discontinued
2002	Decision to discontinue operations at the Printing Works in 2007
2003	Passport production is discontinued
2007	The last sheet is printed (200-krone note) 28 February
2007	The Printing Works is shut down 29 June

Vinje) was the first note carrying the name of the central bank in “nynorsk”: Noregs Bank. (Nynorsk - New Norwegian - is one of the two official forms of written Norwegian, officially recognised through a parliamentary resolution in 1885 and currently used by 10-15 % of the population as their primary written language.)

The 10-krone note was replaced by a coin in 1983 and Series VI therefore only has four denominations.

### *Expanded range of products after the war*

The post-war period was also marked by considerable activity with regard to other security printed material. There was extensive production of various tax and duty stamps, for instance to be used on tobacco and radio sets, stamps for holiday pay, the Norwegian Postal Savings Bank stamps and the like. Government premi-

um bonds (or so-called “goldfish”) were one of the largest products, along with cheques, traveller's cheques, primary capital certificates and shares. Norwegian passport printing was also begun during this period, a task which was performed until 2003. The Printing Works developed a new passport in 1992 when they also started producing the complete book, including cover and binding. In 1999, a new machine-readable passport was introduced and issued centrally. Until 2003, this was a joint project with the Ministry of Justice.

Norwegian stamps printed in intaglio represented another large product at the time. A separate web press was procured for this purpose and the first stamps were issued in 1962. In 1987, a new press was procured and for a period from 1996 Norges Bank's Printing Works was the sole supplier of all types of stamps to Norway Post. The Printing Works and Norway Post received



several international design awards for postage stamps printed in intaglio, engraved by the Printing Works' graphic designers. In 2000, production was discontinued as a result of decreasing volumes and a transition to self-adhesive stamps. At the same time, Norway Post decided to hold an international tender for the contract.

### *Moving to a new head office and measures to combat modern counterfeiting*

In 1985, the Printing Works had over 140 employees and had long since outgrown its premises. For a long period, it was the intention to move the Printing Works out of Oslo. However, when the new head office was built in Oslo, it had room for a modern printing works. The move took place in 1987 and, at the same time, the machinery facilities were modernised and the working conditions were improved considerably. The basic machinery consisted of two large web presses for banknotes, one new web press for postage stamps and two machines for sorting and packaging, together with new equipment for the production of the Bank's other printed material and periodicals.

As the 1990s progressed, the need for a more efficient combination of denominations arose, one that could reduce the number of notes needed on a daily basis, especially with a view to the market for ATMs and payment terminals. This led to the introduction of a 200-krone note in 1994. This note became the first one in the present Series VII with a total of five denominations. This series has been through some upgrades as developments in computer technology, along with easy access to colour photocopiers, printers and scanners, provided new possibilities for counterfeiting. The Printing Works represented Norges Bank in an international collaboration project with a number of other central banks in order to combat this threat. Among other things, this has led to specific solutions which make copying, scanning and printing of banknote designs extremely difficult. In addition to this, Norges Bank's Printing Works was among the first to start using a holographic foil strip on banknotes. Thanks to the combined effect of these measures, the number of counterfeit notes in Norway has been very low in recent years.

### *The Printing Works is closed down*

In the 1990s, Norges Bank's Printing Works attempted to utilise its spare capacity through involvement in the international banknote market. A few larger contracts were won and completed, but Norges Bank's discussions of strategic plans and core responsibilities concluded that this would not be pursued any further. As a result of similar assessments, The Royal Norwegian Mint was organised as a limited company and was later sold. In 2002, it was decided to discontinue operations at Norges Bank's Printing Works in 2007, and thus an

extensive reduction of the workforce has been completed. In the last couple of years, just over twenty employees have carried out a far more elaborate production programme than for many years, before the transition to purchasing banknotes from other countries. The last banknote was printed on 28 February this year and the last notes were inspected and packaged at the end of May. And so, 190 years of banknote printing in Norway is a closed chapter.

### *Literature:*

Bang, Per and Jon Petter Holter (1991): *Norges Bank 175 år – mennesker og begivenheter (Norges Bank 175 years – people and events)*. Aschehoug. Oslo 1991

Erlandsen, Hans Christian (1992): *Penger av papir (Paper money)*. Grøndahl Dreyer. Oslo 1992

Jahn, Gunnar, Alf Eriksen and Preben Munthe (1966): *Norges Bank gjennom 150 år (Norges Bank through 150 years)*. Norges Bank, Oslo

Norges Bank (1996): *Banknotes in Norway*. Brochure

Norges Bank (1989): *Pengehistorie – Norges Bank-historie (Monetary history – the history of Norges Bank)*. Brochure

Norges Bank (1965): *Vår Bank nr. 2, (Our Bank no.2)1965* (Employee magazine for the Central Bank of Norway)

Norges Bank's web pages on banknotes: <http://www.norges-bank.no>. The pages contain descriptions and illustrations of all the banknote series since 1877, including information on those designers that have been involved in the design and production of the notes

Rygg, Nicolai (1918): *Norges Banks historie, første del (Norges Bank's history, Part I)*. Norges Bank, Oslo

Rygg, Nicolai (1954): *Norges Banks historie, annen del (Norges Bank's history, Part II)*. Norges Bank, Oslo

The University of Oslo Coin Cabinet (1975): *Den norske krone i hundre år (The Norwegian krone through 100 years)*. Brochure, Universitetsforlaget

# Modelling credit risk in the enterprise sector – further development of the SEBRA model

Eivind Bernhardsen, adviser, and Kai Larsen, special adviser, Financial Markets Department, Norges Bank<sup>1</sup>

Since 2001, Norges Bank has used an empirical model, the SEBRA model<sup>2</sup>, to estimate bankruptcy probabilities for Norwegian limited companies. The model is also used to estimate banks' expected losses on loans to enterprises in different industries. This article presents two new versions of the model: an extended version of the original model, and a basic version which makes less use of variables which correlate with the size of the enterprise. We show that the basic version is better suited to predicting and projecting banks' overall loan losses. However, the accuracy rate for bankruptcies is slightly lower at enterprise level. The extended version is better suited to analyses where the emphasis is more on bankruptcies than on aggregate loan losses.

## 1. Introduction

Norges Bank's SEBRA model estimates bankruptcy probabilities using key figures calculated on the basis of enterprises' annual accounts, and information on their age, size and industry classification. Multiplying these bankruptcy probabilities by each enterprise's bank debt and then adding up the figures for all enterprises gives us an estimate of banks' expected loan losses due to bankruptcy, assuming that the entire loan amount is lost. Analyses based on such estimates are published regularly in Norges Bank's report *Financial Stability* and are included in its continuous assessment of the outlook for banks' financial strength. In analyses of enterprises' credit risk, we look at the situation both in different industries and in different regions. The SEBRA model is also used for projecting and stress testing banks' loan losses in various macro scenarios, for analyses of banks' pricing of loans to enterprises, and for assessing the potential effects of changes in the capital adequacy rules.<sup>3</sup> Kredittilsynet (the Financial Supervisory Authority of Norway) uses bankruptcy probabilities from the model in its on-site supervision of banks and in its analyses of the state of financial markets.

This broad use of the SEBRA model has over time provided useful experience and ideas for further development over the years. In addition, access to data has improved since the model was developed. The original SEBRA model's accuracy rate for bankruptcy at enterprise level has been high and stable over time. The model also captures the surge in banks' recorded loan losses during the banking crisis of the early 1990s. However, the next increase in banks' loan losses, which came in 2002 and 2003, is not captured to the same extent.

In this article, we look more closely at various needs for the further development of the SEBRA model. We present two new versions of the model: an extended

version of the original model, and a basic version which uses a smaller number of explanatory variables. After evaluating the accuracy and predictive power of these models, we describe briefly how banks' recorded loan losses can be projected. The article concludes with a summary.

## 2. The original SEBRA model in brief

In the original SEBRA model, the probability of bankruptcy is modelled mainly using key figures for an enterprise's earnings, financial strength and liquidity, see Eklund et al. (2001). Thus, the model's predictions are driven by quantities that reflect key business economic conditions at the individual enterprise. These will always be crucial for an enterprise's capacity to service its debt. Besides key financial figures, the model includes measures of an enterprise's size and age, and industry variables based on aggregates of the key financial figures. It is useful to differentiate between variables which reflect financial conditions and variables which are more indirectly related to these conditions but still contribute to the model's overall explanatory power. Examples of the latter are the level of tax payable, trade accounts payable and dividend provisions.

The model does not include additional information such as negative credit history, absence of auditor approval, or late or non-filing of annual accounts. This ensures that the model attaches more importance to the financial factors behind movements in risk, which is important given that the model's main purpose is to contribute to an understanding of movements in credit risk. Furthermore, it would be very difficult to project such variables. The model is also more stable, as experience shows that the registration quality of this additional information varies from year to year. The model does not take explicit account of historical variations in bank-

<sup>1</sup> We would like to thank Kåre Hagelund, Kjell Bjørn Nordal, Snorre Evjen, Arild Lund, Bjørn Helge Vatne and Bjørne Dyre Syversten for useful comments and contributions.

<sup>2</sup> The acronym SEBRA derives from the Norwegian for "System for EDP-based Accounts Analysis".

<sup>3</sup> See, for example, Frøyland and Larsen (2002), Bernhardsen and Larsen (2002), and Larsen and Bjerkeland (2005).

ruptcy frequency between industries. These differences are instead represented through variables for industry averages and variances of basic key variables based on a detailed industry classification. In this way, changes in risk levels in different industries over time can be captured, and the model becomes less retrospective.

### 3. The need to further develop the SEBRA model

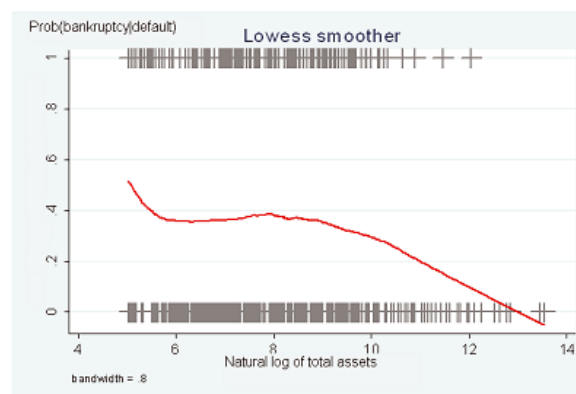
Long experience of the use of the SEBRA model has meant that we have discovered various weaknesses in it. In this section, we discuss the most important needs for improvement. There are also other reasons to reassess the model. For example, the way in which the explanatory variables are measured in enterprises' annual accounts may have evolved over time, due in part to new accounting rules. There may also have been changes in the registration of bankruptcies over time. Access to new and more data is another factor which makes the further development of the model desirable.

#### *Better prediction of the risk of losses on loans to large enterprises*

The risk of losses is not the same as the risk of bankruptcy. The original SEBRA model's accuracy rate for bankruptcy at enterprise level has generally been high and stable over time. In the original SEBRA model, size (measured as the logarithm of total assets) is included as an explanatory variable. It appears that small enterprises go bankrupt more often than large enterprises for given values of the explanatory variables. If this size effect applies less to the probability of a loan loss, it will be problematic using bankruptcy as a substitution variable for losses in a model that uses size as an explanatory factor. Such a model will overestimate the effect of size on defaults and losses. Small enterprises often have little bank debt in NOK. In many cases, therefore, it is the tax authorities or suppliers who file bankruptcy petitions for these enterprises. In the event of problems with larger loan exposures, however, banks often play an active negotiating role. This may result in all or parts of the exposure being recognised as a loss while the enterprise avoids bankruptcy petition and proceedings.

Defaults are probably a better indicator of losses than bankruptcies. We have information on defaults for only a limited sample of enterprises and cannot, therefore, use defaults to estimate the model. This sample can, however, be used to investigate our hypothesis concerning the size of an enterprise. The grey bars in Chart 1 show non-bankruptcy observations (0) and registered bankruptcies (1) for enterprises of different sizes, all of which have had their loans classified as in default. The red curve is an estimate of the probability of bankruptcy given default. We see that the probability of bankruptcy given default is stable at around 40 per cent for enter-

Chart 1 Probability of bankruptcy given default and firm size



Source: Norges Bank

prises with total assets below NOK 10 million.<sup>4</sup> After this, the probability begins to fall significantly.

The original SEBRA model includes explanatory variables which are either directly or indirectly related to an enterprise's size. This means that an enterprise with weak earnings and financial strength will nevertheless be assigned a low bankruptcy probability if it is sufficiently large. According to our hypothesis about the importance of size, which is supported by Chart 1, the actual risk of loss may be considerably higher for such enterprises. Systematic underestimation of the risk of loss on loans to large enterprises is particularly problematic in analyses of financial stability, as large enterprises are heavily weighted when calculating expected loan losses. Since the model is non-linear, underestimation of this risk will lead to underestimation of all the explanatory variables in the model.

By developing a model which attaches less weight to variables related to an enterprise's size, the underestimation of the risk of loss associated with large enterprises can be limited. Examples of variables in the SEBRA model which are directly or indirectly related to an enterprise's size include total assets, trade accounts payable, and government taxes payable relative to total assets.

The original SEBRA model largely captures the surge in banks' recorded loan losses during the banking crisis of the early 1990s. However, the next increase in banks' loan losses, which came in 2002 and 2003, is not captured to the same extent. In these years, there was a temporary dip in the competitiveness of many large exporters. Smaller – and often sheltered – enterprises are more dependent on domestic purchasing power, which deteriorated only slightly. Underestimation of the risk of loss on loans to large enterprises may have contributed to the increase in banks' overall loan losses being captured by the model only to a limited extent during this period. In Section 4 below, we present a simplified version of the SEBRA model which attempts to take account of these factors.

<sup>4</sup> In other words, the logarithm of total assets (measured in thousands of NOK) is less than approx. 9 in Chart 1.

## Avoiding undesirable effects of changes in dividend taxation

The original SEBRA model includes an indicator variable for dividend provisions to capture expectations of future earnings. Dividend taxation has changed over time. In 2006, for example, tax was introduced on dividends to private shareholders over a stipulated risk-free deduction. This change was announced several years in advance and probably impacted on enterprises' dividend provisions ever since their 2003 accounts.<sup>5</sup> When dividends reflect adaptations to tax changes rather than earnings expectations, the dividend variable will make undesirable contributions to the model estimates. We have not, therefore, included the dividend variable in the two new variants of the model.

## Improved system for projections and stress tests

Projections and stress tests of banks' loan losses are becoming increasingly important in analyses of financial stability. In recent years, Norges Bank has used an accounts-based projection and stress testing method together with the SEBRA model. This method was used, for example, in the work on the IMF's stress testing of the Norwegian financial sector, see Hagen et al. (2005), and for stress test analyses in Norges Bank's report *Financial Stability*.

One important challenge in analyses of this kind is to find a good way of projecting key figures. A model which includes large numbers of explanatory variables is more difficult to project than a model with few variables. It is also easier to project basic key figures for the risk drivers earnings, financial strength and liquidity than variables which reflect these drivers more indi-

rectly. Furthermore, it will be easier to explain what is happening in the projections. The need for a more suitable projection method is an important reason why we have chosen to develop a simplified version of the original SEBRA model.

## 4. Two new versions of the SEBRA model

We have developed two new versions of the SEBRA model: SEBRA Basic and SEBRA Extended (see Table 1). The table shows which explanatory variables are included in the two models.

### SEBRA Basic

The basic version includes the original basic key figures for earnings, financial strength and liquidity. Like the original model, it also includes the enterprise's age and a modified indicator variable for impaired equity.<sup>6</sup> We have also introduced a set of industry variables based on basic key figures for earnings and financial strength which vary more over time than in the original model. Previously the industry variables were calculated for the entire estimation period. We now calculate most of the industry variables on an annual basis.

The bankruptcy probabilities for large enterprises produced by SEBRA Basic are consistently higher than with the original SEBRA model and SEBRA Extended. This is primarily a result of SEBRA Basic including fewer size-related variables, which – other things being equal – serve to reduce the bankruptcy probability for large enterprises (see discussion above). However, the average bankruptcy probability is the same in the various versions of the model.<sup>7</sup>

**Table 1.** Variables included in SEBRA Basic (darker shaded areas) and SEBRA Extended (entire table)

Variable definition	Variable type	Varies by
<i>Ordinary profit before depreciation and write-downs as a percentage of total debt</i>	Key figure Average Standard deviation Correlation with Norway portfolio	Enterprise/year Industry/year Industry/year Industry
<i>Equity as a percentage of total assets</i>	Key figure Average	Enterprise/year Industry/year
<i>Book equity less than paid-in equity</i>	Indicator	Enterprise/year
<i>Liquid assets less short-term debt as a percentage of operating revenues</i>	Key figure	Enterprise/year
<i>Age (years) = 1, 2, 3 ... 8</i>	Indicators	Enterprise/year
<i>Total assets in fixed NOK</i>	Key figure	Enterprise/year
<i>Trade accounts payable as a percentage of assets</i>	Key figure	Enterprise/year
<i>Unpaid taxes and dues as a percentage of assets</i>	Key figure	Enterprise/year

<sup>5</sup> Dividends set aside in the accounts for year t are paid and taxed in year t+1.

<sup>6</sup> When calculating this variable, we adjust paid-in equity for historical write-downs. This is done to counteract the effects of enterprises' adjustment to the introduction of tax on dividends to private shareholders on 1 January 2006. Provided that various criteria are met, shareholders can still take out dividends tax-free by writing down paid-in equity.

<sup>7</sup> In the logit model, the average predicted bankruptcy probability will always coincide with the overall bankruptcy frequency in the estimation sample. An increase in the risk at large enterprises leads to a (marginal) decrease in the risk at (the large number of) small enterprises, so that the average probability is unchanged.

## SEBRA Extended

The extended version is the same as the basic version but also includes variables for trade accounts payable, government taxes payable and size. These variables are either directly or indirectly related to an enterprise's size. The dividend variable is excluded from both of the new variants of the model.

## Data and methodology<sup>8</sup>

We use key financial figures based on enterprises' annual accounts and information on their age, size and industry classification to estimate the models. In principle, all Norwegian non-financial limited companies with total assets in excess of NOK 500 000 are included in the sample. However, some enterprises drop out as a result of accounting shortcomings. The estimation period is from 1990 to 2002. The variable that is explained is defined by the coincidence of the events: "Enterprise stops filing accounts the following year" and "Bankruptcy filed". In around 20 per cent of cases, bankruptcy is filed three years after the last set of accounts is submitted. This means that the model can only be tested and re-estimated on accounts two to three years ahead of the last available set of accounts. In all, there are about a million sets of annual accounts in the estimation sample, of which around 20 000 represent

bankruptcy observations. As in the original SEBRA model, we use a generalised logit model to estimate the probability of an enterprise filing for bankruptcy.<sup>9</sup>

## 5. Accuracy of the SEBRA models

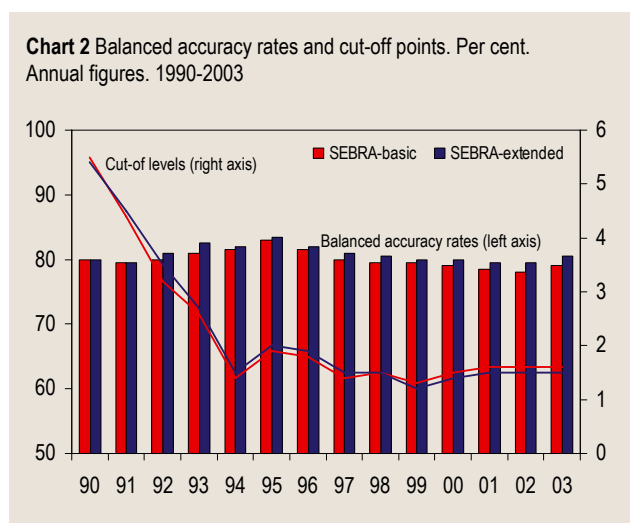
### Accuracy at enterprise level

When evaluating bankruptcy prediction models, it is normal to determine a cut-off level for predicted bankruptcy probabilities, so that all observations above this level are classified as bankrupt, and all those below this level are classified as non-bankrupt. The cut-off level can, for example, be set in a way that the proportions of correctly predicted bankruptcy and non-bankruptcy observations are the same for both variables (balanced accuracy) (see Chart 2).

Accuracy rates are consistently lower for SEBRA Basic than for SEBRA Extended, but the differences are small.<sup>10</sup> This does not mean that the different variants of the model assign each enterprise the same bankruptcy probability or identify the same bankruptcies. The estimates for individual enterprises can be very different. Accuracy rates for SEBRA Extended are approximately the same as for the original model.

Which of the two new versions of the model best approximates actual loss probabilities depends on how good a substitution variable bankruptcy is for defaults and losses. If bankruptcy is viewed as a good substitution variable for both small and large enterprises, we should attach the most weight to the classification in SEBRA Extended. Otherwise, we should attach the most weight to the classification in SEBRA Basic.

Charts 3 and 4 show average bankruptcy probabilities and actual bankruptcy frequencies for 1990 and 2002 for enterprises divided into eight risk groups on the basis of high or low bankruptcy probability (see Table 2 for the distribution criteria). We have chosen 1990 and 2002 because these are the first and last years in the estimation sample, but equivalent results are obtained for all of the years in the sample. There is generally a good match between predicted bankruptcy probabilities and actual bankruptcy frequencies for the different risk groups throughout the estimation period.



**Table 2.** Proportion of bank debt in different risk groups. Per cent.

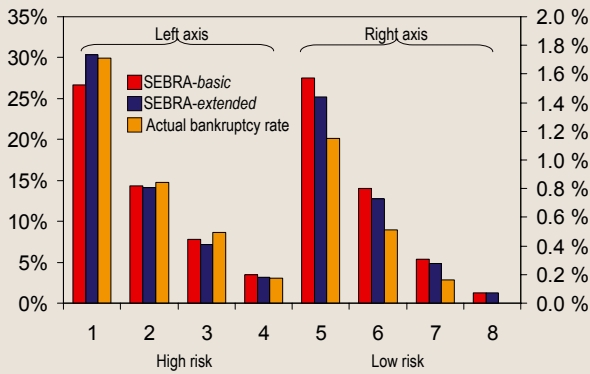
Risk group	1	2	3	4	5	6	7	8
Bankruptcy probability ( <i>P</i> ), percentage	$P > 20$	$20 > P > 10$	$10 > P > 5$	$5 > P > 2$	$2 > P > 1$	$1 > P > 0.5$	$0.5 > P > 0.1$	$P < 0.1$
SEBRA Basic	0.01	0.10	0.35	3.60	4.74	15.96	66.81	8.44
SEBRA Extended	0.01	0.06	0.21	0.93	1.83	4.42	23.75	68.79

<sup>8</sup> A technical paper presenting the new variants of the model in greater detail will be available at a later date.

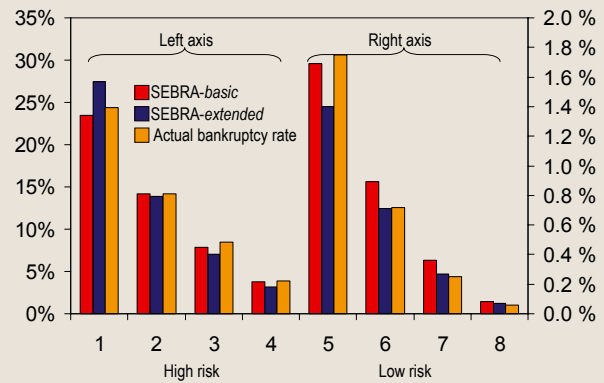
<sup>9</sup> The method is classified as a parametric generalised additive model (GAM). This model is described in Bernhardsen (2001) and Eklund et al. (2001). Berg (2007) estimates a non-parametric GAM for bankruptcies in Norway based in part on key figures from SEBRA.

<sup>10</sup> The models' accuracy can also be evaluated for all cut-off levels using an ROC analysis. The accuracy rates for bankruptcy and non-bankruptcy observations are plotted against one another, and the area under the resulting curve is calculated. A completely arbitrary classification will give an ROC value of 50 per cent for large samples, while a value of 100 per cent shows perfect classification. The ROC values for SEBRA Basic and SEBRA Extended are 88 and 89 per cent respectively.

**Chart 3** Predicted probability of bankruptcy and actual bankruptcies in various risk groups. 1990



**Chart 4** Predicted probability of bankruptcy and actual bankruptcies in various risk groups. 2002



### Accuracy at aggregate level

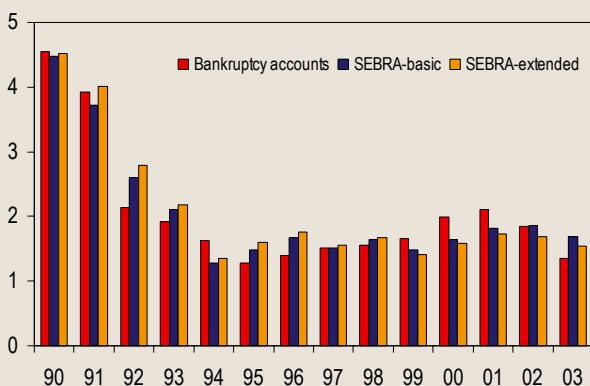
The analysis above indicates that the two new SEBRA models have good predictive power at enterprise level. The charts also suggest that the differences between the two model variants are small. The differences between the models are larger when we weight bankruptcy probabilities with the amount of debt at each enterprise (see Table 2). We see here that most bank debt is in the low-risk groups in both models. However, as large companies are assigned a higher bankruptcy probability in SEBRA Basic, a larger share of bank debt is in the high-risk groups in this model.

Chart 5 shows the average predicted bankruptcy probabilities for the two models and actual bankruptcy rates for each year in the estimation period. Actual bankruptcies are represented by the last set of accounts submitted for enterprises that go bankrupt, hereafter referred to as bankruptcy accounts. Up to three years can elapse between the last set of accounts being submitted and bankruptcy being filed. This means that, in the last available accounts year *t*, we can only perform a complete count until year *t-3*. (Thus, for example, with 2006 data available, we can count which accounts in 2003 are

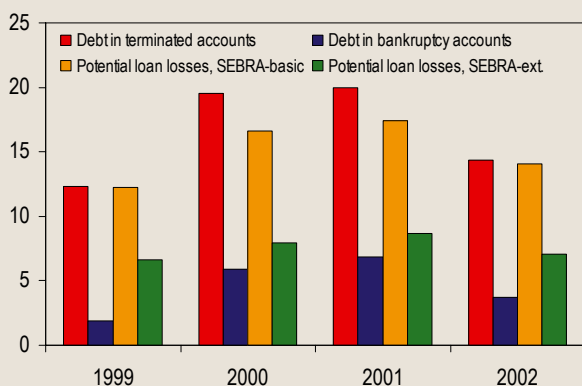
bankruptcy accounts.) With the exception of 1992 and 2000–2001, when the predicted bankruptcy probabilities are higher and lower respectively than actual bankruptcy accounts, there is close accord between predicted and actual bankruptcy accounts. This indicates that both SEBRA models are successful in predicting aggregate bankruptcy rates in the enterprise sector.

Banks' recorded loan losses are determined by the size of bad loans (potential loan losses) and the proportion of each bad loan actually lost (loss given default). We do not have information on bad loans at enterprise level and so cannot measure potential loan losses directly. However, we know that they will be larger than the amount of debt in bankruptcy accounts, because banks will also have losses on loans to enterprises that do not go bankrupt. We can also add up the debt in all terminal accounts – in other words, the accounts of all enterprises that go bankrupt, are wound up for some other reason, or are taken over (see Chart 6). Many of the enterprises that stop filing statements without going bankrupt settle their debt before being wound up or taken over. On the other hand, there may also be losses on loans to enterprises that continue operations. In our

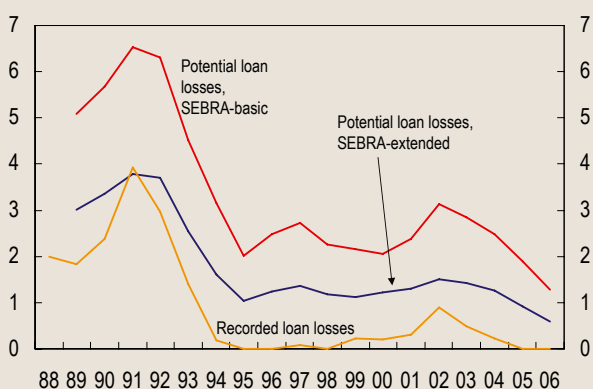
**Chart 5** Actual bankruptcy accounts and average predictions. Per cent of total and probabilities. 1990-2003



**Chart 6** Debt in terminated and bankrupt firms. Billions of NOK. 1999-2002



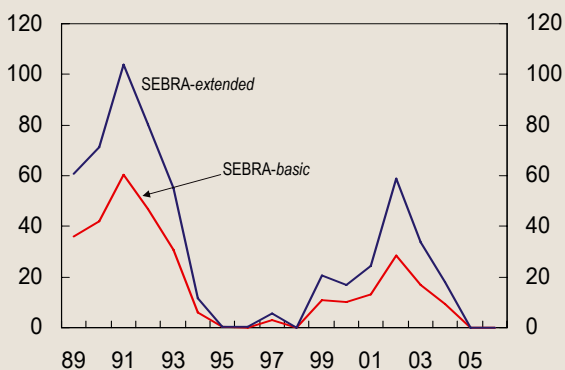
**Chart 7** Estimates of potential loan losses and banks' recorded loan losses.<sup>1)</sup> Per cent of lending. Annual figures. 1988-2006



<sup>1)</sup> Potential loan losses are defined as expected losses with a 100% loss given default

Source: Norges Bank and Statistics Norway

**Chart 8** Implied measures for loss given default. Per cent of defaulting loans. 1989-2006



Source: Norges Bank

opinion, potential loan losses are closer to the sum of the debt in all terminal accounts than to debt in bankruptcy accounts alone.

By weighting the bankruptcy probabilities with debt at each enterprise and then adding all of the enterprises together, we obtain an estimate of expected potential loan losses due to bankruptcy. To take account of actual losses being higher than losses due to bankruptcy, we have chosen to scale up the bankruptcy probabilities.<sup>11</sup> In Chart 6, we show expected potential loan losses following this upscaling. We see that the estimates from SEBRA Basic are close to total debt in bankruptcy and terminal accounts, while the estimates from SEBRA Extended are relatively close to the debt in bankruptcy accounts. Since debt in bankruptcy accounts represents an absolute minimum for potential loan losses, we have greater confidence in the estimates from SEBRA Basic.

Chart 7 presents estimates of potential loan losses from the two models and banks' recorded loan losses.<sup>12</sup> In banks' accounts, recorded loan losses are calculated as changes in loss provisions plus new losses less recoveries on loans previously written off.<sup>13</sup> For our purposes, it is more appropriate to consider recorded loan losses as a product of the size of bad loans and the proportion of each bad loan that is not recovered (loss given default). By dividing recorded loan losses by estimates of potential loan losses, we obtain a measure of loss given default at macro level (see Chart 8). In the literature, loss given default in different countries is rarely reported to be higher than 60 per cent and rarely lower than 10 per cent.<sup>14</sup> Based on this, loss given default from SEBRA Basic seems more realistic than that from SEBRA Extended. The reason for loss given default in Chart 8 being estimated at zero in some years is recoveries on loans previously written off. A better match with movements in recorded loan losses over time is also obtained with SEBRA Basic (see Chart 7).

The main reason why SEBRA Basic is more accurate in terms of both the level of and changes in banks' aggregate loan losses is that it attaches less weight to the enterprise's size (see discussion above). This suggests that we should use SEBRA Basic when projecting banks' loan losses. However, since it is slightly less accurate when it comes to bankruptcies at enterprise level, we should use SEBRA Extended instead for analyses where the emphasis is more on bankruptcies than on aggregate loan losses.

## 6. Projecting banks' loan losses

The key figures in the original SEBRA model can be projected using macroeconomic scenarios from Norges Bank's macro models (see Frøyland and Larsen (2002)). This makes it possible to calculate estimates of potential loan losses in the future. Such estimates can be produced both for a baseline scenario and for various stress test scenarios.

Norges Bank is currently further developing the models for projecting and stress testing banks' losses on loans to enterprises. Use of SEBRA Basic will make it easier to project enterprises' accounts, because we need only project the items included in the calculation of the basic key figures for earnings, liquidity and financial strength. The changes in the model and projection tool will probably result in better estimates of banks' loan losses.

In this work on further developing projections and stress tests, we have found that loss given default can be projected accurately using a simple dynamic model where changes in commercial property prices are included as an explanatory factor. This is not surprising

<sup>11</sup> There is a limited basis for how best to scale up the probabilities of bankruptcy from SEBRA into probabilities of loss or default. A factor of 2 was estimated in a simple statistical model for mis-classification as in Bernhardsen (2001).

<sup>12</sup> We have lagged the model estimates by one year here. This is intuitive because the bankruptcy probabilities are calculated on the basis of enterprises that have not yet gone bankrupt (see the definition of the bankruptcy event in Section 4).

<sup>13</sup> See pages 31–32 of Financial Stability 2/01 for a more detailed discussion of banks' loan losses and loss provisioning practice.

<sup>14</sup> See, for example, Dermine and de Carvalho (2006).

as banks' lending to enterprises is often secured against commercial property. A reduction in the value of the collateral gives banks poorer cover for the balance on a bad loan when the collateral is sold. It is also likely that other types of security may be closely correlated with commercial property prices.

In *Financial Stability 2/06*, we estimated a relationship for loss given default based on the original SEBRA model.<sup>15</sup> According to the estimated model, a 10 per cent drop in commercial property prices leads, in isolation, to an increase in loss given default of around 11 percentage points. Loss given default also tends towards a constant level of 35 per cent over time. Given actual movements in commercial property prices, dynamic estimates for loss given default show very good approximations both two and three years ahead. This indicates that we can produce good estimates of banks' loan losses provided that we are able to project the key figures in the model.

## 7. Summary

We have discussed various reasons for further developing the SEBRA model. The most important reasons are to improve estimates of banks' loan losses and to obtain a model which makes it easier to make projections and perform stress tests. We have estimated and tested two new versions of the SEBRA model: SEBRA Basic and SEBRA Extended. These two versions of the model are, respectively, a simplification and a refinement of the original model. SEBRA Basic has a marginally lower accuracy rate than SEBRA Extended for bankruptcies at enterprise level, but is better suited to estimating banks' potential loan losses. Furthermore, the basic version is easier to project using different scenarios for macroeconomic developments. We have shown that SEBRA Basic provides good estimates of banks' recorded loan losses. In the future, we will use SEBRA Basic in analyses of banks' loan losses, but SEBRA Extended in analyses where the emphasis is more on bankruptcies than on aggregate loan losses. Norges Bank will continue its work on further developing the projection and stress test module for banks' losses on loans to enterprises.

## References:

- Berg, D. (2007): "Bankruptcy prediction by generalized additive models". *Applied Stochastic Models in Business and Industry*, Vol. 23, No. 2, pp. 129–143
- Bernhardtsen, E. (2001): "A model of bankruptcy prediction". *Working Paper 2001/1*, Norges Bank
- Bernhardtsen, E. and K. Larsen (2002): "Banks' pricing of risk associated with corporate lending". *Economic Bulletin 1/2003*, Norges Bank
- Dermine, J. and N. de Carvalho (2006): "Bank loan losses-given-default". *Journal of Banking and Finance*, Vol. 30, Issue 4, pp. 1219-1243
- Hagen, J., A. Lund, K.B. Nordal and E. Steffensen (2005): "IMF stress testing of the Norwegian financial sector". *Economic Bulletin 4/2005*, Norges Bank
- Eklund, T., K. Larsen and E. Bernhardtsen (2001): "Model for analysing credit risk in the enterprise sector". *Economic Bulletin 3/2001*, Norges Bank
- Frøyland, E. and K. Larsen (2002): "How vulnerable are financial institutions to macroeconomic changes? An analysis based on stress testing". *Economic Bulletin 3/2002*, Norges Bank
- Larsen, K. and K.M. Bjerkeland (2005): "Are unexpected loan losses lower for small enterprises than for large enterprises?" *Economic Bulletin 3/2005*, Norges Bank
- Norges Bank, *Financial Stability 2/06*

<sup>15</sup> Loss given default (t) = 0.085 + 0.76loss given default (t-1) - 1.09 Δln(commercial property prices).



# Payment systems – a potential source of risk. The need for oversight and supervision

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Since the early 1990s, there has been increased attention on the risk banks incur through their role in the payment system. The primary focus has not been on the individual bank's risk exposure but on the possibility of problems spreading from one bank to another through the payment system. This type of domino effect is called systemic risk and can at worst threaten financial stability. Central banks oversee the payment system in order to limit this risk. This article explains the concepts oversight and supervision as well as the performance of Norges Bank's tasks in this area.

## 1. Introduction

On an ordinary day, the Norwegian payment system processes more than three million payment transactions. On some days, for example the last days before Christmas, the number of transactions can be far higher. The average value of all transactions is approximately NOK 300 billion per day. This means that in less than one week, turnover in the Norwegian payment system is comparable to mainland GDP.

Most payment transactions are between individuals and public or private enterprises. For example, when an individual pays rent by credit transfer or purchases goods by payment card, the transaction will result in an obligation for the payer's bank to withdraw the amount from the payer's account and transfer it to the payee's bank, which in turn must credit the same amount to the payee's bank account. Therefore, an ordinary payment transaction results in a settlement between the payer's and payee's banks. This is accomplished by debiting and crediting the two banks' accounts in a settlement bank.

Most retail payments involve small amounts and it is not efficient to send these transactions individually to settlement. Instead, they are totalled and netted in a clearing house. The clearing house calculates the result of all payments to and from customers in the participating banks. The result is a sum per bank either a net obligation or a net receivable from all the other banks. The individual banks or their data processing centres send payment information to the Norwegian Interbank Clearing System (NICS) which is responsible for netting. NICS has subcontracted this operation to the processing centre BBS (Banking and Business Solutions). The netting result is then sent to the settlement bank. In Norway, retail payments of this kind are settled twice daily, in the morning and in the afternoon.

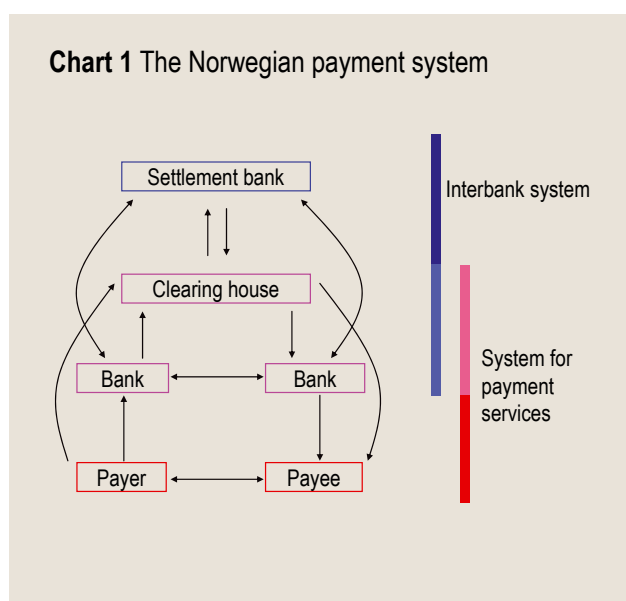
If netting results are to be settled, all participating banks must have cover in their accounts at the settlement bank, either in the form of deposits or drawing rights. The settlement will not be completed as expected

if there is insufficient cover. Because the settlement comprises many individual transactions between many banks, insufficient cover at one bank will have consequences for all other participating banks. If a bank expects to receive a substantial amount in the settlement, and it fails to be settled, the impact on the bank's liquidity could be considerable. This liquidity shortage can also spill over to other banks, which in turn expected to receive liquidity from the bank that did not receive settlement.

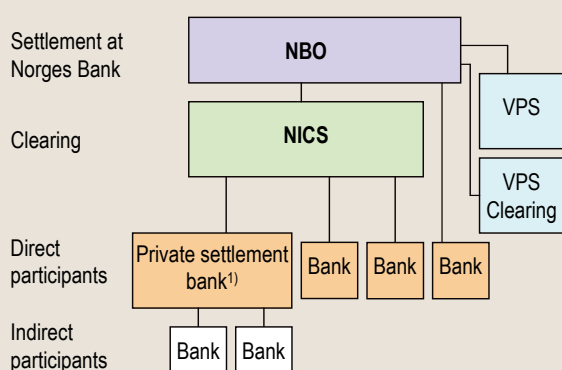
In order to reduce the risk of such spillover effects due to a failure to settle, the largest transactions will not be included in this type of netting but will be sent individually to settlement. The large-value transactions may for example relate to securities or foreign exchange transactions between financial institutions.

Norges Bank is the most important settlement bank in terms of the total amount settled. The majority of banks do not settle their transactions directly at Norges Bank but use private settlement banks. The most important of these is DnB NOR Bank ASA, which operates an authorised system and acts as the settlement bank

Chart 1 The Norwegian payment system



**Chart 2** Interbank systems in Norge



<sup>1)</sup> Private settlement banks are banks that settle transactions on behalf of indirect participants.

## 2. Norges Bank and payment systems in Norway

Norges Bank has played a key role in the payment system since the Bank was established in 1816. In the early years, Norges Bank provided ordinary banking services such as payment services in addition to its primary function of issuing banknotes and coins. The number of private banks increased sharply in the course of the 1800s. On the one hand, this meant that it became less relevant for Norges Bank to offer banking services to the corporate and household sectors, while on the other hand there was a need for clearing and settlement of interbank balances. Kristiania Bankavregningskontor (a clearing house) was established in 1898 to clear outstanding balances of cheques and money orders. The amount to be cleared was settled over an account held at Norges Bank. The main features of this solution survived for many years, but since the 1960s these processes have been automated to a large extent and have gradually replaced the old solutions. The current system for central bank settlement was established in the 1990s.

The Norges Bank Act of 1985 states that the Bank shall "...promote an efficient payment system domestically as well as vis-à-vis other countries..." On the basis of this, Norges Bank has worked to promote efficiency both in the interbank system and in the customer-oriented parts of the payment system. The systems have been designed under the auspices of the banking industry. Norges Bank has supported the banks' work on implementing a common infrastructure that facilitates the settlement of payment transactions between customers of all banks. As part of its work on promoting efficiency in the Norwegian payment system, Norges Bank has gathered statistics and other information on developments in the payment system since 1987. The results and assessments have been published in *Annual Report on Payment Systems* (Norges Bank 2006, Norges Bank 2007).

Under the Payment Systems Act of 1999, Norges Bank has responsibility for authorising and supervising banks' clearing and settlement systems, i.e. Norwegian interbank systems. The object of the Act is "to ensure that interbank systems are organised in such a way as to ensure financial stability." Norges Bank defines financial stability as follows:

"Financial stability implies that the financial system is robust to disturbances in the economy and is capable of channelling capital, executing payments and redistributing risk in a satisfactory manner."

An interbank system cannot be established or operated without authorisation from Norges Bank. However, interbank systems may be exempted from the authorisation requirement if Norges Bank finds that their opera-

for more than 100 small and medium-sized banks. Sparebank 1 Midt-Norge provides settlement services for almost 20 savings banks. Total obligations and receivables from each of these settlement banks and from the banks whose transactions they settle are sent to NICS for netting and subsequent settlement at Norges Bank. The participating banks receive settlement from the private settlement bank after final settlement at Norges Bank.

Systems for clearing and settlement of interbank payment transactions are called interbank systems. The customer-oriented part of the payment system is called the system for payment services (see Chart 1).

In addition to the transactions from NICS, Norges Bank receives netted transactions from the securities settlement at the Norwegian Central Securities Depository (VPS) and from the financial derivatives settlement at VPS Clearing ASA (see Chart 2). Banks can send individual transactions to Norges Bank directly or via NICS.

In their quest for customers, banks have strong incentives to offer safe, swift and user-friendly payment solutions at a reasonable price. Such solutions also benefit the economy as a whole. Problems at one bank can spill over to other banks through the payment system. Individual banks do not have the same incentives to cover the costs of limiting systemic risk. This is an important reason for central bank oversight of the payment systems. Because the payment system plays a very important role in the economy, it is essential that interbank systems are operative even if one or more participating banks encounter problems. Central bank oversight will place emphasis on identifying and containing systemic risk in the interbank systems.

tions are so limited in scope that they have no significant effect on financial stability. The general background material for the Payment Systems Act makes it clear that the Act is a supplement to and not a replacement of the industry's own regulation of the systems.

### 3. Oversight and supervisory activities<sup>1</sup>

The Payment Systems Act states that an interbank system shall have an operator that is responsible for its establishment and operation. Norges Bank may stipulate more detailed requirements for the systems. The application for system authorisation must contain information on ownership, participants, criteria for participation, measures to safeguard technical operations and measures to limit systemic risk resulting from liquidity and solvency problems among system participants or members.

The Act uses the term "supervision" to describe Norges Bank's follow-up of authorised systems. According to the Act, Norges Bank may require that the system operator provides information. If the system is not organised or operated in accordance with the provisions set out in or pursuant to legislation, Norges Bank may instruct the operator to implement measures to remedy the situation. Supervision shall ensure that the systems fulfil the purpose of the Act. Therefore, Norges Bank has a statutory duty to supervise the systems and to require changes that are deemed necessary to fulfil the purpose of the Act. Thus, Norges Bank exercises supervision within defined limits and formal requirements.

Authorised operators shall notify Norges Bank before making changes with respect to ownership, organisation or operations. Changes may be implemented without further delay unless otherwise decided by Norges Bank within two months after notification has been received. Norges Bank may stipulate more detailed rules about which changes require notification.

"Oversight" is a term that usually refers to the activity performed by most central banks in relation to payment and settlement systems. Oversight is broader in scope than supervision and is less precise than the Payment Systems Act's concept of supervision. Oversight has no legal basis in the Payment Systems Act and is based on cooperation with the system proprietors.

Oversight varies from one central bank to another. The report "Central bank oversight of payment and settlement systems" (BIS 2005) recommends that central banks base their oversight on the "Core Principles for Systemically Important Payment Systems" (BIS 2001) (see Box 1). The report was prepared by the Committee on Payment and Settlement Systems (CPSS). The committee comprises representatives from G10 central banks. The Bank for International Settlements (BIS) serves as secretariat to the committee and is respon-

sible for publishing the committee's reports. In cooperation with the International Organization of Securities Commissions, the committee has also prepared recommendations for securities settlement and central counterparty settlements (BIS/IOSCO 2001, 2004).

NICS Operatørkontor<sup>2</sup> and DnB NOR Bank ASA have the only authorised systems that are subject to supervision pursuant to the Payment Systems Act. Norges Bank, however, oversees the entire Norwegian payment system. This includes authorised systems, systems that are exempted from the authorisation requirement and systems that fall outside the provisions of the Payment Systems Act. Knowledge of how the different systems function, both individually and in relation to other systems, and whether they can pose a threat to financial stability in a crisis situation is essential to oversight.

Norges Bank's own settlement system, NBO, is the largest and most important system that is subject to oversight.<sup>3</sup> This is in line with normal practice at other central banks. Norges Bank has established internal reporting routines to ensure that the department responsible for oversight of NBO has an independent position in relation to the department that is responsible for operating NBO.

Oversight also covers the cash leg of securities settlements at the Norwegian Central Securities Depository as well as the settlement of financial derivatives through VPS Clearing ASA. Sparebank 1 Midt-Norge and EDB Business Partner ASA<sup>4</sup> operate interbank systems according to the Payment Systems Act, but they are exempted from authorisation because the systems are limited in size. However, due to their link to the rest of the payment system they will be subject to Norges Bank's oversight.

Settlement of freight derivatives through NOS Clearing ASA and settlement of energy derivatives at Nord Pool ASA have a special position. While financial derivatives diversify risk in financial markets, freight and energy derivatives are aimed primarily at diversifying risk in commodity markets. Whereas financial derivatives are settled at Norges Bank, commodity derivatives are settled at private banks, partly outside Norway and in foreign currency. They are of limited importance to financial stability, but it is conceivable in certain situations that an individual bank's positions can have a spillover effect on the payment systems. Therefore, Norges Bank has established a dialog with these two institutions to keep abreast of their activities.

Continuous Linked Settlement (CLS) is a system for the settlement of foreign exchange transactions (Andersen and Bakke, 2004). CLS was established by the international banking industry. The purpose of CLS is to remove credit risk linked to foreign exchange transactions. Norges Bank, in cooperation with the Norwegian banking industry, has provided for the inclusion of NOK in CLS, which has an account at

<sup>1</sup> See *Economic Bulletin* 1/02: "Norges Bank's oversight and supervision of the payment system"

<sup>2</sup> NICS Operatørkontor was established by the Norwegian Financial Services Association and the Norwegian Savings Banks Association.

<sup>3</sup> Norges Bank's own operations in this area are exempted from the provisions of the Payment Systems Act.

<sup>4</sup> EDB Business Partner ASA provides system solutions for settlement banks.

Norges Bank and is thus a participant in the Norwegian payment system. Norges Bank, together with the other central banks whose currencies are included in the CLS system, participates in the oversight of CLS. CLS Bank headquarters are in New York. Hence, the Federal Reserve Bank of New York leads the central banks' coordinated oversight.

SWIFT (The Society for Worldwide Interbank Financial Telecommunication) provides messaging services to financial institutions worldwide and thus constitutes an important part of the financial infrastructure both nationally and internationally. SWIFT has its head office in Belgium and the Belgian central bank oversees the system together with the G10 group in the BIS. The oversight work focuses on safety, operational stability, vulnerability and contingency arrangements. Norges Bank does not exercise oversight of SWIFT's activities in Norway.

The BIS report of 2005 looks at three key activities of oversight (BIS 2005):

- Monitoring
- Assessment
- Inducing change

Norges Bank also uses these categories in its supervision activities.

### *Monitoring*

Norges Bank gathers information from authorised systems and from Norges Bank's Settlement System (NBO) through meetings with the operators and from operators' reports. Such reports are prepared four to five times yearly and describe among other things deviations, e.g. information about the reasons for and consequences of deviations. Information on the results of vulnerability analyses, system tests and contingency exercises and measures is an important aspect of the reporting.

Oversight of systems that are not authorised pursuant to the Payment Systems Act is also based on reports from and meetings with operators. The formal reporting requirements are not as strict, however, as the requirements pertaining to authorised systems.

### *Assessment*

Norges Bank will stay abreast of the functioning of the interbank systems by gathering information from the operators. On the basis of this information, the Bank will acquire an overview of risk and efficiency in the interbank system and decide which aspects should be followed up more closely. The information will also provide a basis for assessing whether the system satisfies relevant international recommendations, and – for systems that fall within the scope of supervi-

## Box 1: Core principles for systemically important payment systems (BIS 2001)

1. The system should have a well-founded legal basis under all relevant jurisdictions.
2. The system's rules and procedures should enable participants to have a clear understanding of the system's impact on each of the financial risks they incur through participation in it.
3. The system should have clearly defined procedures for the management of credit risks and liquidity risks, which specify the respective responsibilities of the system operator and the participants and which provide appropriate incentives to manage and contain those risks.
4. The system should provide prompt final settlement on the day of value, preferably during the day and at a minimum at the end of the day.
5. A system in which multilateral netting takes place should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single settlement obligation.
6. Assets used for settlement should preferably be a claim on the central bank; where other assets are used, they should carry little or no credit risk and little or no liquidity risk.
7. The system should ensure a high degree of security and operational reliability and should have contingency arrangements for the timely completion of daily processing.
8. The system should provide a means of making payments which is practical for its users and efficient for the economy.
9. The system should have objective and publicly disclosed criteria for participation, which permit fair and open access.
10. The system's governance arrangements should be effective, accountable and transparent.

sion – whether they comply with the provisions of the Payment Systems Act and the terms of authorisation.

A difficult question is how far Norges Bank should go in its efforts to gather information on system details. In general, this will depend on which issues are to be assessed. The scope of oversight must be adapted to the system's importance to financial stability. Oversight includes assessment of system design, system compliance with the legal framework, routines, operating procedures and operating environment. The purpose of the work will be to identify risk factors. It is the operator,

however, that is responsible for establishing the system and ensuring that it is operated in a manner that does not threaten financial stability. Norges Bank's task is to oversee that these conditions are safeguarded.

### *Inducing change*

The result of Norges Bank's assessment may in some cases be that it is desirable to make changes to the system. Norges Bank may also conclude that the system does not comply with statutory requirements or the terms of authorisation. As a rule, the operator and Norges Bank will agree on a solution after having discussed the matter. This assumes, of course, that the operator recognises the need for change and that the requests from Norges Bank are well founded.

The Payment Systems Act gives Norges Bank the statutory authority to instruct authorised system proprietors to make changes in their system or system routines. This authority has only been used once, in 2004. At that time, Norges Bank required authorised system proprietors to prepare an annual report on risk and vulnerability analyses, contingency testing and routines for dealing with deviations and changes.

Within the limits pursuant to the duty of confidentiality, Norges Bank places emphasis on full transparency with respect to goals and tools in the supervision and oversight work. The most important elements of this work are described on Norges Bank's website under "Payment Systems". Norges Bank's assessment of individual systems on the basis of international recommendations is published in *Annual Report on Payment Systems*.

## 4. Cooperation with Kredittilsynet (The Financial Supervisory Authority of Norway)

Pursuant to the Payment Systems Act, Kredittilsynet is responsible for ensuring that systems for payment services are organised and operated in a way that promotes secure and efficient payment and effective and coordinated execution of payment services. Norges Bank has been given responsibility for interbank systems. Kredittilsynet and Norges Bank have regular meetings and exchange information on incidents and developments in the two parts of the payment system.

In their follow-up of operational risk, Norges Bank and Kredittilsynet have agreed to exchange information concerning planned follow-up of systems for which both institutions are responsible as well as information (test reports and the like) of mutual interest. If one institution plans on-site IT supervision/supervisory meeting where IT contingency arrangements are discussed, the other institution will be informed and may also be invited to participate as an observer.

Kredittilsynet is responsible for the securities settle-

ment systems. Such systems comprise two elements: the transfer of ownership of the security from the seller to the buyer and the cash transfer from buyer to seller. Norges Bank is responsible for oversight of the cash leg of the security settlement in Norwegian Central Securities Depository (VPS) since this settlement is executed through accounts at the central bank. Therefore, Norges Bank and Kredittilsynet cooperate closely. The cooperative framework and the division of responsibility are based on an agreement between the two institutions providing for mutual exchange of information and consultation before making important decisions. Norges Bank and Kredittilsynet have monthly contact meetings where the agenda includes a discussion of the situation in financial institutions and securities markets. These meetings also cover current topics related to security settlement systems, including international recommendations, structural changes, risk assessment and contingency arrangements.

## 5. Future challenges

In 2005, the International Monetary Fund (IMF) assessed parts of the Norwegian payment system.

The IMF report (IMF 2005) stated, among other things:

"Norway fulfils all prerequisites for effective payment clearing and settlement systems. The private sector plays an important role both in the provision of payment instruments and in payment clearing services. Cooperation between banks is well established and the common infrastructure is the basis for the individual bank's supply of payment services to the market. The relationship between Norges Bank and the banking sector is well-structured and cooperative."

The IMF also suggested some improvements. Further details are available in *Annual Report on Payment Systems* (Norges Bank 2006).

At present, it appears therefore that the industry's self-regulation, central bank oversight and supervision and cooperation between the industry and the authorities have resulted in sound solutions.

The financial system, however, is undergoing continuous change. Payment and settlement systems are being internationalised. This affects all parts of the economy that use deposit money to settle accounts.

For a number of years the EU has been working to achieve a common agreement for financial services in Europe and build an infrastructure to support this. The background for this can be found in the Lisbon Agenda of 2000, which aims to make Europe, by 2010, the most competitive and the most dynamic knowledge-based economy in the world. One means of achieving this is to enhance the efficiency of the European financial indus-

try through the revision of infrastructures for payments and use of payment instruments in Europe. The EU Commission is of the opinion that such a revision will lead to substantial savings. One directive<sup>5</sup> has recently been adopted by the EU Parliament. The directive will probably be EEA relevant, which means that the regulations must be incorporated into Norwegian legislation. In tandem with this, the European banking industry is working on a new and single platform for the use of payment instruments in Europe.<sup>6</sup>

In financial markets cross-border securities trading is increasing. Stock exchanges are being acquired and merged. This is also the case for securities depositories, which register ownership of securities. Investors are demanding new financial products and the cross-border market for commodities derivatives is growing. Financial institutions are being internationalised and want to be able to move liquidity quickly and inexpensively between the countries in which they operate. The European Central Bank has recommended the development of a new system for securities settlement in euro - possibly other currencies as well. The operation of the IT systems that underpin financial transactions will be outsourced to data processing centres in other countries.

These developments will significantly affect the infrastructure for payment settlements. Central banks and supervisory authorities are now facing new challenges in their oversight and supervisory work. In its oversight work, Norges Bank's goal will be to continue to cooperate to ensure that tomorrow's payment systems remain efficient and contribute to financial stability.

## References

BIS (2001): "Core Principles for Systemically Important Payment Systems", Committee on Payment and Settlement Systems (CPSS), January 2001

BIS (2005): "Central Bank Oversight of Payment and Settlement Systems", Committee on Payment and Settlement Systems (CPSS), May 2005

BIS/IOSCO (2001): "Recommendations for Securities Settlement Systems", Committee on Payment and Settlement Systems (CPSS) and Technical Committee of the International Organization of Securities Commissions (IOSCO). Bank for International Settlement (BIS), November 2001

BIS/IOSCO (2004): "Recommendations for Central Counterparties", Committee on Payment and Settlement Systems (CPSS) and Technical Committee of the International Organization of Securities Commissions (IOSCO). Bank for International Settlement (BIS), November 2004

Husevåg, Vigdis and Kristin Bjerkeland (2003): "Securities settlement in Norway - How will developments in Europe affect the Norwegian system?", *Economic Bulletin* 4/03

IMF (2005): "Norway: Financial system stability assessment, including reports on the observance of standards and codes on the following topics: banking supervision, insurance regulation and payment systems", *IMF Country Report* No 05/200, June 2005

Act relating to Payment Systems etc. 17 December 1999 (*Odelsting Proposition no. 96 (1998-99)*)

Lund, May Helle and Kjetil Watne: "New act relating to payment systems etc.", *Economic Bulletin* 3/00

Norges Bank (2006): *Annual Report on Payment Systems* 2005, June 2006

Norges Bank (2007): *Annual Report on Payment Systems* 2006 June 2007

Norges Bank (2002): "Norges Bank's oversight and supervision of the payment system", *Economic Bulletin*, 1/02

<sup>5</sup> Directive on Payment Services

<sup>6</sup> Single European Payments Area - SEPA

# An analysis of financial ratios for the Oslo Stock Exchange

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Share prices are driven by companies' operations, funding and the risk premium required by investors. This article examines financial ratios that may reflect these three variables for the Oslo Stock Exchange in the period 1997 to 2007. The operating profits of listed companies are high at present. However, there are indications that earnings are levelling off. Listed companies have increased their equity ratios and appear to be very robust. However, much of the increase in equity consists of intangible assets. Still, even with increased book value, profitability has remained at a historically high level. Valuation multiples provide a somewhat mixed picture of the pricing of equities on the Oslo Stock Exchange. We argue that it may be useful to use multiples that adjust for cyclically high earnings, and perhaps also for changes in the composition of equity.

## 1. Introduction

Norges Bank monitors the Norwegian equity market for three reasons. First, developments in share prices, share issues and the financial reports of listed companies may provide us with information about cyclical developments. Second, this information provides indications of general developments in the Norwegian corporate sector. This is important for banks' earnings and therefore for financial stability. Third, developments on the Oslo Stock Exchange may also have a direct bearing on financial stability. Financial institutions derive income from the sale and issue of shares, and price changes affect the value of the shares on the institutions' balance sheets. The Stock Exchange is also a source of funding for both financial institutions and other enterprises.

This provides motivating factors for analysing the forces driving share prices. According to financial theory, share prices reflect the present value of the expected cash flow from companies to shareholders. Five factors are crucial for determining present value:

- Value added
- Labour costs
- Funding
- Taxation
- Required rate of return / cost of capital

The most important is value added in companies. Value added can be defined as operating income less operating costs excluding labour costs. Non-labour operating costs represent value added outside the company. Much of the value added in companies accrues to employees in the form of wages (and to the state in the form of income tax). *Operating profit* is operating income less all operating costs, including wages. Operating profit is *the share of the value added that accrues to the investors* (and the state in the form of corporate and capital taxes). Employees often have a clearly defined contractual claim. It is therefore the investors that run the greatest risk and have the greatest potential gain from variations in value added.

Financing determines how operating profits are distributed among investors. More debt financing increases potential value added for equity holders. At the same time, changes in the interest rate level will have greater consequences for return on equity (ROE).

The purpose of this article is to discuss key figures that can shed light on developments in operating profit, financial conditions and risk premiums (the market's valuation of the shares). Current developments in financial ratios are discussed on the basis of an internally developed data set.

The article is structured as follows: Section 2 provides the theoretical basis for studying the accounts and financial ratios that are discussed later. The data set is described in Section 3. This is followed by a discussion of how fundamentals can be aggregated across companies. Developments in corporate operating profits and financing are discussed in Sections 4 and 5, and their collective effect on ROE is considered in Section 6. Section 7 considers assessments of equity valuation relative to fundamentals. A key question is whether valuation multiples reflect the risk premium on shares. Section 8 provides a summary of the article.

## 2. Share prices, earnings and risk premium

The relationship between share prices, earnings and risk premium can be illustrated by means of simple share pricing models. Both Gordon's formula and the EVA model are based on the assumption that the value of shares is equal to the present value of shareholder cash flow.

### *Gordon's formula*

In Gordon's formula, the price of a share is assumed to be equal to the present value of all future dividends. At time  $t$  the share price is  $P_t$  and the dividend  $D_t$ . Shares are expected to generate annual dividends that grow at

<sup>1</sup> The views expressed in the article are the author's own and are not necessarily those of Norges Bank. I would like to thank Jesper Hein, Knut Sandal, Børnø Dyrre Syversten and other colleagues at Norges Bank for helpful comments and contributions.

a constant annual rate of  $g$ . If the cost of capital (the required rate of return) is equal to  $k$ , the relationship between share price, dividend, dividend growth rate and cost of capital can be expressed as follows:

$$P_t = \frac{D_t(1+g)}{(k-g)} \quad (1)$$

It is reasonable to assume that the cost of capital for shares is higher than for risk-free investment alternatives. It is therefore usual to split the cost of capital into long-term risk-free interest rate ( $r$ ) and a risk premium ( $rp$ ). The risk premium is an extra compensation investors get when they carry systematic market risk.

$$k = r + rp \quad (2)$$

The fact that the dividend in equation (1) grows at a constant rate ( $g$ ), means that in this model there is no uncertainty associated with future dividends. This is an assumption that simplifies the expression. In reality, there is uncertainty associated with the dividend, which is the reason that investors require a risk premium ( $rp$ ) as in equation (2). If a constant percentage ( $b$ ) of earnings ( $E$ ) is retained, while the remainder is paid as dividends, we have the following relationship between earnings and dividends:

$$D_t = E_t(1-b) \quad (3)$$

Equation (1) can then be expressed as:

$$P_t = E_t \frac{(1-b)(1+g)}{(r+rp-g)} \quad (4)$$

This means that share prices and earnings must covary. Or that the share price must be given by companies' earnings multiplied by a constant factor - the P/E multiple<sup>2</sup> (the fraction in equation (4)). This variable will be discussed in Section 6 in connection with valuation.

However, it is useful to note the significance of uncertainty for equity valuation. It is reasonable to assume that the factors in the denominator in equation (4) will be most important for the P/E level. If short-term variations are disregarded, it appears that both the interest rate level ( $r$ ) and earnings growth for the equity market as a whole ( $g$ ) will depend to some extent on nominal growth in the economy. If the effect on P/E of changes in the interest rate level and growth offset one another to some extent, variations in the risk premium ( $rp$ ) will affect the P/E level more strongly. A high (low) P/E may then reflect a low (high) risk premium.

### The Economic Value Added (EVA) model and abnormal return

The EVA model is an alternative means of calculating the present value of equity. The basis of this model is that the present value of the cash flow to shareholders

is equal to the book value when the return on equity is equal to the cost of capital. The equity value can then be calculated as book value ( $B$ ) plus the present value of the difference between the return on equity and the cost of capital.

$$P_t = B_t + \frac{B_t(r_t^{EQ} - k)}{(1+k)} + \frac{B_{t+1}(r_{t+1}^{EQ} - k)}{(1+k)^2} + \frac{B_{t+2}(r_{t+2}^{EQ} - k)}{(1+k)^3} + \dots \quad (5)$$

$r_t^{EQ}$  is return on equity in year  $t$ , or the result as a percentage of book capital ( $r_t^{EQ} = E_t / B_{t-1}$ ). The difference between return on equity and cost of capital is the Economic Value Added or abnormal return. The advantage of the EVA model over Gordon's model, which requires a perception of (the constant) dividend growth in perpetuity, is the basis in known accounting variables ( $B_t$ ) and the need to be forward-looking for only the next few years. The model is also more flexible, as it can capture short-term variations in earnings which may have a substantial positive or negative value. Abnormal return is assumed not to be sustainable over time, partly because over time investors will move capital from poor to good projects.

Assume that earnings and book value grow at a constant rate ( $g$ ), and that the difference between return on equity and required rate of return is constant for  $n$  periods. With these simplifications, the relationship between share price, book value, required rate of return and return on equity can be found by means of the formula for a finite series.<sup>3</sup>

$$P_t = B_t + B_t(r_{t+1}^{EQ} - k) \frac{1 - \left(\frac{1+g}{1+k}\right)^n}{k-g} \quad (6)$$

A price level higher (lower) than the book value is due to the fact that the return on equity in a period is assumed to be higher (lower) than the required rate of return. This may be a result of variation in earnings and/or cost of capital. It will be seen later that the return on equity varies considerably - much more than it is reasonable to assume that the cost of capital varies. However, a given variation in the cost of capital will have a stronger effect than a corresponding variation in return on equity, because the cost of capital also affects the fraction in equation (6).

The valuation ratio P/B (share price/book value) is discussed in Section 6, and a slight rewrite of equation 6 shows that use of the ratio P/B may be consistent with the EVA model:

$$\frac{P_t}{B_t} = 1 + (r_{t+1}^{EQ} - (r+rp)) \frac{1 - \left(\frac{1+g}{1+r+rp}\right)^n}{r+rp-g} \quad (7)$$

Whereas application of the Gordon model showed that a high (low) P/E could be related to a low (high) risk premium, equation (7) shows that the EVA model indicates that a high (low) P/B can also be related to a low (high) risk premium. It is true that both numerator and denominator in the fraction in equation (7) will rise

<sup>2</sup> P/E = price/earnings.

<sup>3</sup> See for example Knut Boye: Verdiberegninger på grunnlag av kontantoverskudd og unormal avkastning (Value calculations based on cash surplus and abnormal return), *Praktisk økonomi & finans*, Year 15, no. 2, 1999.



with an increase in the risk premium, but the effect on the denominator will be stronger than the effect on the numerator.

### *Insights from the models and Oslo Stock Exchange data*

Both models show that there should be a positive long-term relationship between annual profits and the share price. This is also consistent with the picture in Chart 1, and provides the basis for the subsequent analyses in this article. In the short term, however, increased profits do not necessarily lead to a rise in share prices. Share prices are driven by new information. This means, among other things, that the publication of good results does not affect the share price if the results are in line with expectations. If good results are expected, earnings growth is priced in at the time of publication, and earnings growth for the previous year will therefore also be reflected in price movements in the course of the period.

Chart 1 shows price movements, after-tax earnings and book values for companies in the OBX index since 1997. Accounting variables are discussed in more depth in the next section. Here it suffices to note that after-tax earnings (black line) correspond to  $E$  in equation (4). If Gordon's formula had been consistent with reality, the price index and after-tax earnings should have covaried. The yellow and blue lines in Chart 1 would then have been superimposed. In theory, this is not the case because the cost of capital ( $k$ ) and/or earnings growth ( $g$ ) are not constant. More volatile profits than prices indicate that variation in P/E for the Oslo Stock Exchange largely reflects short-term variations in earnings, rather than variations in the risk premium. Periods of solid earnings tend to be followed by periods of weaker earnings.

Both valuation models provide an expression of the present value of future cash flows, but otherwise they

differ substantially from one another. Gordon's formula is a long-term growth model, while the EVA model focuses primarily on temporary earnings variations. The two models provide insight into different factors that influence the value of shares, but both are conducive to analysing the information in company accounts.

Gordon's formula provides a simple illustration of a possible relationship between P/E and required rate of return. The required rate of return may vary as a result of variations in risk-free interest rate and/or risk premium. Research provides little evidence of a stable relationship between risk-free interest and P/E<sup>4</sup>, but provides some support for a relationship between risk premium and valuation multiples such as P/E and P/B.<sup>5</sup> As mentioned, parallel changes in interest rate and growth may offset one another. The lack of correlation between the interest rate level and the P/E ratio may be because both earnings growth and interest rate level covary with the general level of activity in the economy. We will not pursue this further here, but empirical research to some extent supports that valuation multiples may provide information about risk premiums.

In the EVA model, the value of the shares is expressed as the value in a "normal situation" adjusted for the value of abnormal transitory income (or expenses). The model establishes a relationship between share prices and book values, but as long as the return on equity is expected to differ from the required rate of return, share prices and book values will develop differently. Book value (green line) in Chart 1 corresponds to  $B$  in equation (6). It appears that share prices may rise (fall) more than book values when profits rise (fall). This is consistent with the notion that variations in P/B may be due to temporary variations in ROE.

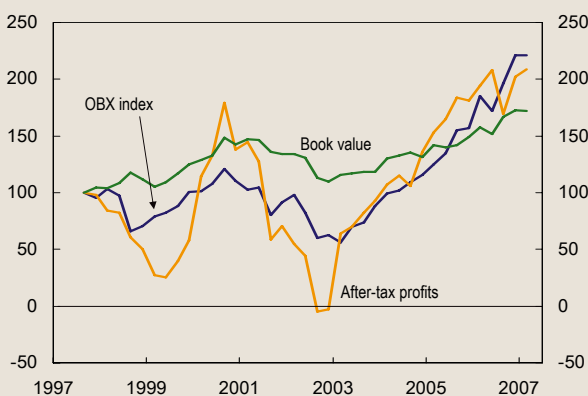
Both theory and empirical evidence indicate that variation in valuation ratios such as P/E and P/B may reflect variation in the cost of capital and risk premia. However, the multiples are also influenced by other factors, and must therefore be interpreted with caution.

### 3. The data set

An internally developed data set is used for the accounts of the companies in the OBX index on the Oslo Stock Exchange for the period 1996 Q4 to 2006 Q1. The OBX comprises the 25 most traded shares on the Oslo Stock Exchange. In 2006, the market value of the companies in the OBX index accounted for more than 70 per cent of the total market capitalisation of the Oslo Stock Exchange. Developments in these companies therefore provide a good picture of developments in listed companies.

Accounts data are derived from companies' quarterly reporting at group level. In some cases, where quarterly figures have not been available, data from annual reports have been used, and broken down to the best of our ability.

**Chart 1** Developments in share prices, earnings and book value. Indexed 30 September 1997. Quarterly figures



Source: Norges Bank

<sup>4</sup> See for example Clifford Asness: "Fight the FED Model", *The Journal of Portfolio Management*, Fall 2003.

<sup>5</sup> See for example J.H. Cochrane: "New facts in finance", *Economic Perspectives*, vol. 23, no. 3, Federal Reserve Bank of Chicago 1999, and Randi Næs and Johannes Skjeltop: "Har aksjepremien krympet?" (Has the equity premium shrunk?), *Økonomisk Forum* no. 5, 2005.

The data set consists of the following profit and loss account items: operating income, earnings before interest, tax, depreciation and amortisation (EBITDA), earnings before interest and tax (EBIT), net financial items, earnings before tax, taxes and net profit. EBITDA is adjusted for high extraordinary income and expenses in cases where such items are considered to distort the picture of underlying operations. Extraordinary income and expenses are included in EBIT. Where financial items have been adequately specified in the accounts, only interest income and expenses have been included.<sup>6</sup>

The following balance sheet items are used: assets, intangible assets, cash and short-term investments, interest-bearing debt, minority interests and equity. Some accounting concepts are explained in Box 1.

The data are aggregated at index level by converting all accounts figures into amounts per share. The amounts per share are then multiplied by the number of shares in the index for each company, and then aggregated over all the companies.

There are some problems associated with the use of

accounts figures. First, historical figures do not always apply to the future. For example, a group may change rapidly through the acquisition or disposal of subsidiaries. Moreover, accounts are based on principles intended to make them reliable. Book values, for example, are often based on cost of acquisition rather than best estimate of market value, because the cost of acquisition is indisputable, while estimates of market value normally require judgement. Accounting for income and expenses on an accruals basis is another source of uncertainty. Even if the framework provided by accounting legislation is adhered to, choices in connection with accruals may influence the results substantially. Nor can it be ruled out that some companies do not comply with the legislation, and engage in accounts manipulation.

## 4. Operations

Share prices are closely linked to developments in value added. Value added is created through operations. Properties of and developments in some financial ratios for companies' operations are discussed below.

### Box 1: Main items in the profit and loss account:

Operating income		
– Operating expenses		
= Earnings before interest, tax, depreciation and amortisation (EBITDA)		
– Depreciation		
– Amortisation		
= <u>Earnings before interest and tax (EBIT)</u>	=>	<i>to shareholders, creditors and the state</i>
+ Dividends from other companies		
+ Net financial items	=>	<i>to creditors (less tax on interest</i>
= <u>Pre-tax operating profit</u>		
– Taxes	=>	<i>to the state</i>
+ Net profit from discontinued operations		
= <u>Net profit</u>	=>	<i>to shareholders</i>

**EBIT** Earnings Before Interest and Tax is equal to operating profits. Operating profits is what the enterprise is left with after costs have been covered, and is what can be distributed among creditors, the state (tax) and shareholders.

**EBITDA** Earnings Before Interest, Tax, Depreciation and Amortisation. Depreciation and amortisation are two of the main noncash operating expenses. Thus EBITDA can virtually be regarded as cash flow from operations. However, EBITDA does not capture the need for reinvestment in order to maintain operations.

**EBI** EBIT less adjusted tax. By adjusted tax is meant tax on both income on equity (taxes) and borrowed capital (financial items times 28 per cent tax). It is usual to subtract tax from operating profits/loss when making comparisons across different tax regimes. EBI is commonly referred to as NOPLAT (Net Operating Profit Less Adjusted Tax).

**EBIDA** EBITDA less adjusted tax.

<sup>6</sup> In the financial sector, the distinction between 'operating' and 'financial' is an artificial one. In order to integrate the financial sector in the analysis, we have defined 'debt to other financial institutions', 'securities debt' and 'subordinated loans' as financing with borrowed capital (interest-bearing debt). Interest expenses on this debt are defined as financial items.

## Earnings before or after depreciation and amortisation?

Operating profits provide an expression of the result of companies' ordinary operations (before financial items). It is a commonly used measure of a company's operations. It appears that there may be less variation in operating profits before than after depreciation and amortisation. The question is whether this is due to noise or information, and hence which of the two concepts is the best measure of developments in operations. For example, the EBI of the OBX companies has increased by an annual rate of more than 40 per cent since 2002 Q3. During the same period, EBIDA has increased by an annual rate of less than 15 per cent.

The difference between the two variables is depreciation and amortisation. Depreciation is a calculated cost, and an accounting expression of the reduction in the value of a capital asset. In reality, depreciation may vary with the use of the asset, but in practice assets are depreciated gradually over time. There is therefore reason to believe that depreciation is not particularly cyclical in nature, and will gradually increase over time in pace with rising nominal values on companies' balance sheets. The data confirm this assumption.

Amortisation (write-down) is also a calculated cost, but of a more extraordinary nature than depreciation. Amortisation<sup>7</sup> represents a more unexpected reduction in the value of assets. The reduction may be explicit, as a result of damage to the assets. In other cases the reduction may be more implicit. For example, when the return on equity is too low to justify the value at which the assets are recorded, they will normally be written down. In practice it may be difficult to determine whether the return is temporarily low, for example as a result of a cyclical downturn, or permanently reduced. There may therefore be a tendency for write-downs to increase during a cyclical downturn, and for developments in operating profits (EBI or EBIT) to provide a distorted picture of developments in underlying operating conditions. Operational developments may then appear excessively weak in the period in which the write-downs are made, thereby erroneously implying that operations improve in the subsequent period. The accounting return on capital subsequently will also be permanently higher, because the write-downs reduce the book capital.

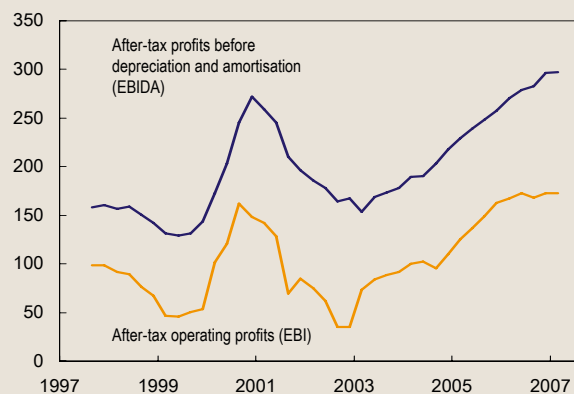
This source of error is reduced if developments in operating conditions are described in terms of operating profits before depreciation and amortisation (EBIDA or EBITDA). But if depreciation and amortisation are disregarded, so are substantial real costs like the reduction in the value of a capital asset and other assets. To the extent that these costs change over time, they will also represent a source of error in an assessment of operations. This is particularly relevant in view of the recent increase in the number of oil rig companies on the Oslo

Stock Exchange. These companies make substantial investments in oil rigs and thereby incur large depreciation costs. When the value of these companies increases as a share of the OBX, the weighted average depreciation for OBX companies also increases. This may be a reason why growth in operating profits has recently levelled off more than EBITDA (see tax-adjusted figures in Charts 2 and 3). When assessing developments in operations, operating profits both before and after depreciation and amortisation should therefore be monitored. The variables provide more information collectively than they do individually.

## Operating profits after tax

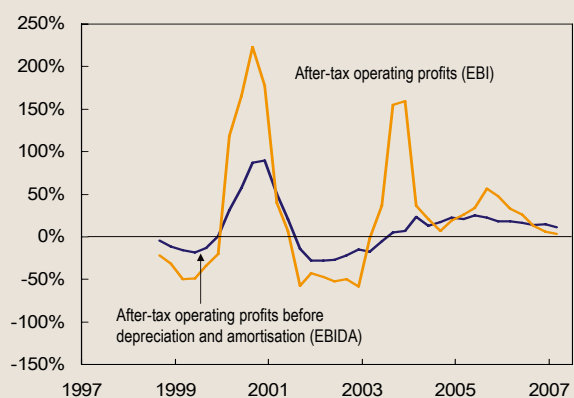
Data show that the average tax rate (tax as a percentage of earnings before tax) for companies in the OBX index has risen from around 30 per cent before 2000 to around 45 per cent since 2001. As tax rates vary considerably, it is not a given that developments in operating profits

**Chart 2** After-tax operating profits before and after depreciation and amortisation. NOK per share. Quarterly figures



Source: Norges Bank

**Chart 3** Annual growth in after-tax operating profits before and after depreciation and amortisation. Per cent. Quarterly figures



Source: Norges Bank

<sup>7</sup> Assets may also be written up, but as prudence is an important principle in accounting, this has not been common. Under the new IFRS accounting rules it may become more common.

(before tax) provide a reliable picture of developments in the value added that accrues to investors.<sup>8</sup>

The change in average tax rate is related to the change in the companies included in the index, and particularly an increase in the share of the index represented by oil companies. Variation in the size of the petroleum sector is due both to the listing of Statoil in 2001 and to cyclical fluctuations in the sector. The companies that produce petroleum on the Norwegian continental shelf pay more tax than other companies. The petroleum companies do not pay for government awarded licences, but the government collects economic rent through a supplementary tax of 50 per cent (petroleum tax) on petroleum recovered from the Norwegian continental shelf, in addition to ordinary corporate tax of 28 per cent. Variations in oil prices and oil companies' weighting in the index therefore influence average tax rates at index level.

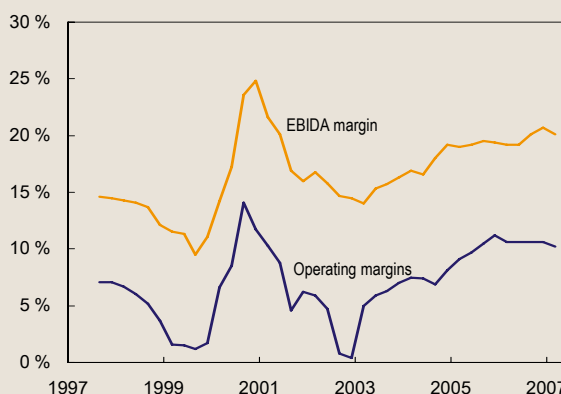
This creates a particular challenge with respect to accounting analysis at index level. Whether investors expect to be left with 55 per cent or 70 per cent of the profit after tax is fairly important to an assessment of profitability. This implies that operating profits should be tax-adjusted to ensure comparability over time. Another argument for tax-adjusting operating items is that the figures will otherwise overweight the economic importance of the petroleum sector relative to other sectors, from the investors' point of view. We therefore use EBIT and EBITDA *after tax* to describe developments in operations. The variables will be referred to as EBI and EBIDA, respectively. Chart 2 shows developments in these variables. Annual growth in operating profits (EBI) since 1997 has been about 6 per cent, and somewhat higher for EBIDA. There has been a sharp improvement in operating profits since the cyclical turnaround in 2003, but growth now appears to have slowed.<sup>9</sup> Chart 3 shows annual growth in EBIDA and EBI, and shows that earnings growth has weakened.

Solid earnings growth since 2003 has been underpinned by high operating margins (see Chart 4). Operating margins are operating profits (EBI and EBITDA are used) as a percentage of turnover (operating income). Although developments have been satisfactory and margins are high, there has been a tendency for margins to level off and decrease slightly in 2006. While the operating margin after tax peaked at almost 12 per cent in 2005 Q4, the operating margin before tax continued to rise up to 2006 Q3, and was then over 20 per cent. Because of petroleum tax, the operating margin before tax provides overly positive picture of profitability for investors.

### *Trends and cycles in operating profits*

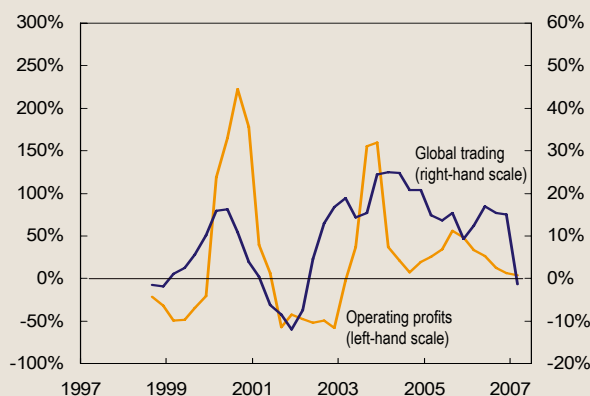
The companies on the Oslo Stock Exchange are concen-

**Chart 4** After-tax operating margins for the Oslo Stock Exchange (OBX) excluding financial sector. Per cent. Quarterly figures



Source: Norges Bank

**Chart 5** Annual growth in global trading and annual growth in operating profits on the Oslo Stock Exchange (OBX). Per cent. Quarterly figures



Sources: Reuters EcoWin and Norges Bank

trated in industries such as manufacturing, commodities, energy and shipping. All these industries benefit from increased global manufacturing output and trade. The operating profits of the companies on the Oslo Stock Exchange are therefore cyclically sensitive (see Chart 5).

By distinguishing between trend and cyclical paths, we obtain a better picture of underlying developments in operating conditions. Trend growth in operating profits should reflect developments in capital employed<sup>10</sup> and normal (or average) return on capital employed (ROCE). ROCE is operating profits as a percentage of capital employed. Chart 6 shows developments in current and average ROCE. We use ROCE based both on operating profits<sup>11</sup> and EBIDA. Chart 7 shows developments in the two operating profit variables EBIDA and EBI and trend growth calculated as capital employed multiplied by the five-year average rate of return.

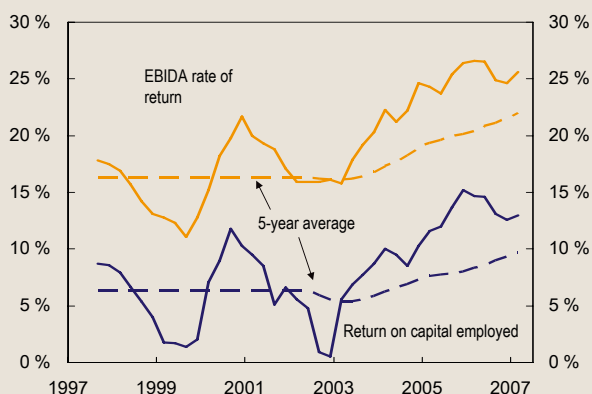
<sup>8</sup> See for example Knut Boye: "Verdsettelse av Statoil" (Valuation of Statoil), *Praktisk økonomi & finans*, Year 15, no. 2, 1999.

<sup>9</sup> The path of EBITDA growth differs from that of EBIT as a result of increases in tax rates in recent years. Average annual growth figures for EBITDA and EBIT have been 9 per cent and 10 per cent, respectively, since 1997.

<sup>10</sup> The sum of equity and interest-bearing debt. 'Capital employed' refers to capital that is invested in the enterprise.

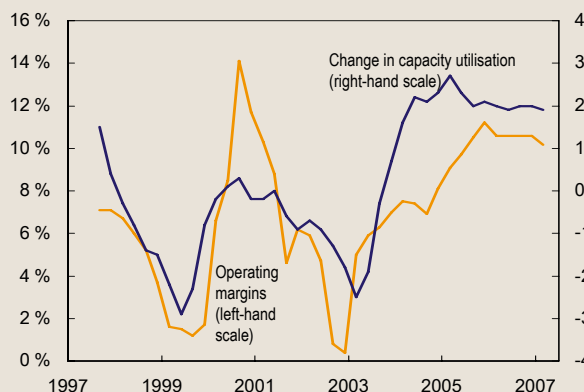
<sup>11</sup> Commonly abbreviated as ROCE.

**Chart 6** Measure of return on capital employed (after tax) for the Oslo Stock Exchange (OBX) excluding financial sector. Past year and 5-year average. Per cent. Quarterly figures



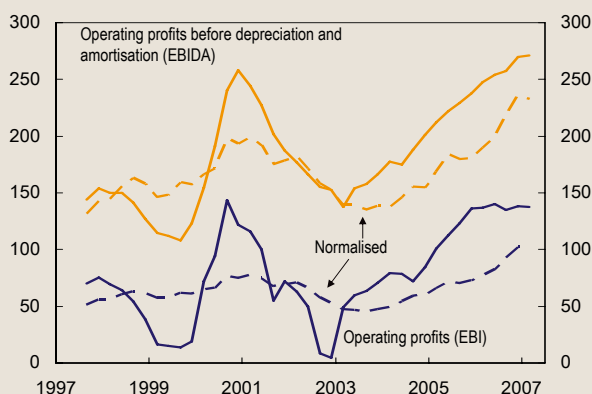
Source: Norges Bank

**Chart 8** Annual change in manufacturing capacity utilisation (per cent) and operating margins on the Oslo Stock Exchange (OBX) (percentage points). Quarterly figures



Sources: Statistics Norway and Norges Bank

**Chart 7** Operating profits and normalised operating profits (trend) for the Oslo Stock Exchange (OBX) excluding financial sector. NOK per share. Quarterly figures



Source: Norges Bank

Operating profits tend to lie above trend during cyclical upturns. Strong growth in operating profits often coincides with strong growth in the global economy (see Chart 5). Chart 8 shows how developments in operating margins and a change in capacity utilisation have coincided in the past ten years. The capacity utilisation rate in manufacturing<sup>12</sup> is an indicator of pressures in the economy, and indicates how large a share of manufacturing production capacity has been utilised. When capacity utilisation is high, pressures in the economy are high and cost inflation is high. Higher cost inflation exerts downward pressure on operating margins. Lower operating margins tend to be reflected in weaker operating profits. Given a high level of activity and high utilisation of production factors, there is little probability of a sustained rise in operating profits above trend in the immediate future.

<sup>12</sup> Figures based on questionnaires and published by Statistics Norway.

<sup>13</sup> The conclusion of Consensus Forecasts' questionnaire in May 2007 is also consistent with this, and indicates that forecasters expect operating profits in Norwegian companies to fall in 2007, 2008 and 2009.

<sup>14</sup> Unless otherwise specified, the financial sector is excluded from the analysis in this section because financial institutions have a completely different funding structure from other companies.

<sup>15</sup> Intangible assets include goodwill, deferred tax benefit and items specified as 'Other intangible assets'.

## Summary

Operating profits (both before and after depreciation and amortisation) after tax is the best measure of developments in the share of value added in listed companies that accrues to the investors. With high (low) operating profits, there will be a large (small) amount to distribute among the investors, and the value of capital employed will be similarly high (low). Operating profits are high at present. However, growth in profits is slowing, and the levelling off of operating margins and falling return on capital employed indicate slower growth in value added for investors.<sup>13</sup> If this is not fully priced, it may depress share prices ahead.

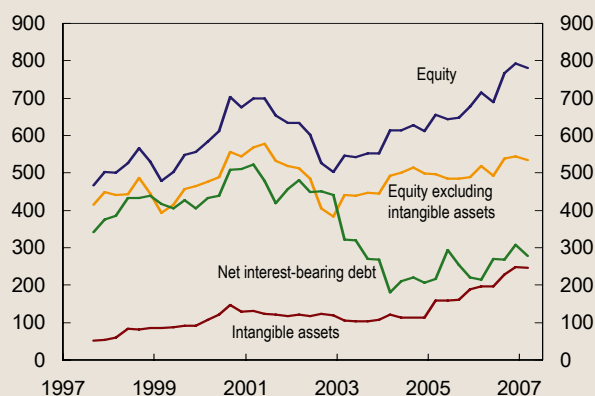
## 5. Financial factors and balance sheet robustness

Companies' value generation for investors was discussed in the previous section. Investors seek to maximise their share of value added, but the creditors (lenders of capital) have a contractual right to have their claims covered before shareholders. Corporate funding and financial expenses are decisive for the distribution of assets between investors and lenders of capital. If capital returns are higher than interest expenses, higher borrowing will increase the return on equity. Funding also determines how robust companies are to an increase in financing expenses and/or weaknesses in operating conditions.

In recent years, finances at OBX companies<sup>14</sup> have exhibited four trends:

- Financial costs have fallen considerably since 2003.
- Intangible assets increased sharply in 2005 and 2006.<sup>15</sup>

**Chart 9** Balance sheet items for the Oslo Stock Exchange (OBX) excluding financial sector. NOK per share. Quarterly figures



Source: Norges Bank

- Equity has grown by almost 10 per cent annually since 2003.<sup>16</sup>
- Net interest-bearing debt was halved in the course of 2003 and 2004 (see Chart 9).<sup>17</sup>

### *Falling financial costs*

The interest expenses of companies listed on the Oslo Stock Exchange (OBX) have fallen gradually since 2003, and are still at very low levels both historically and not least relative to operating profits (see Chart 10). The fall in interest expenses can be attributed to both a lower debt level and a lower average interest rate on debt (see Chart 11).

The fall in average interest rates on debt for the OBX (including financials) since 2003 is in line with developments in short-term interest rates and credit premia. If the financial sector is excluded, interest rates on debt increased in 2003 and 2004 and then fell sharply in 2005 and 2006. The lack of covariation with developments in short-term rates may reflect variations in the credit premium on the debt of companies in the index, more fixed-interest rate loans for these companies than for companies in the financial sector, and a portion of foreign currency debt at a different interest rate than NOK debt. Large variations in the debt level across companies and over time may also influence the figures.

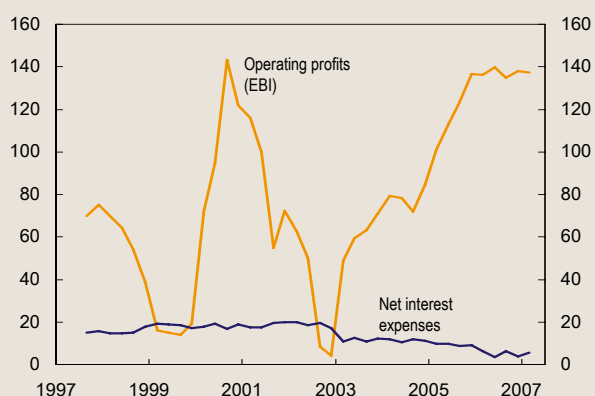
### *Growth in intangible assets*

Intangible assets are goodwill, deferred tax benefit<sup>18</sup> and other intangible assets (patents, licences, trademarks, balance sheet costs associated with the development of operating methods etc.).

In the period 2000 to 2005, intangible assets accounted for 6-8 per cent of OBX companies' total assets. Over the past two years, this share has risen to almost 12 per cent. The balance sheet value of assets shall in principle reflect their capacity to yield future returns. This applies whether the assets are tangible or intangible. Comparative advantages are often associated with intangible assets such as trademarks, patents or internally developed methods and models. Intangible assets can therefore contribute substantially to the return on capital. However, intangible assets are often difficult to value. Tangible assets often have alternative uses, while intangible assets are often idiosyncratic, and may by definition "lose their value" in pace with falling profitability at the company.

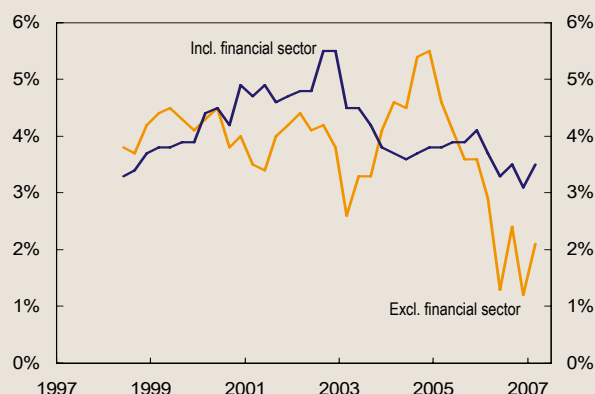
Goodwill often constitutes a substantial share of the intangible assets. When a company acquires another, the value of the assets of the acquired company must by definition be equal to the company's debt plus the price paid for the equity. When the assets are entered in the accounts, values must be assigned to the various

**Chart 10** Developments in operating profits and net interest expenses for the Oslo Stock Exchange (OBX) excluding financial sector. NOK per share. Quarterly figures



Source: Norges Bank

**Chart 11** Average interest rate on debt for the Oslo Stock Exchange (OBX) including and excluding financial sector. Per cent. Quarterly figures



Source: Norges Bank

<sup>16</sup> Shareholders' equity and minority interests are both counted as equity.

<sup>17</sup> Net interest-bearing debt is interest-bearing debt less cash and short-term investments.

<sup>18</sup> If the enterprise has suffered a loss in an accounting year, the loss is tax-deductible in later years. Deferred tax assets are primarily the balance sheet value of tax deductions that can be carried forward later (but it may also be due to other factors). Deferred tax expense is a tax obligation that has to be paid in a later accounting period.

assets. If it is not possible to link the whole value up to the individual assets, the residual is entered as goodwill. Goodwill reflects the fact that the purchaser has assessed the value as being higher than the sum of the assets that can be identified and entered on the balance sheet. Thus goodwill represents the buyer's expectations regarding future returns. Anything else would not be consistent with paying so much for the acquired company.

Acquisitions will, due to the definition of goodwill, quite often cause an increase in intangible assets. Take, for example, two identical companies, A and B, both with book value of 100. Both companies have issued 100 shares, which are traded on the stock exchange at a price of 2. Suppose that A acquires B at a price equivalent to the current market price of 200, by issuing 100 new shares that are exchanged for shares in B. For the sake of simplicity, suppose that A finds no reason to write up the value of B's assets, so that goodwill of 100 has to be entered for the merged company AB. AB's book value is 300 – in this case the sum of the book value of A and B plus goodwill. Total book value has increased by 50 per cent without any real change in the companies' financing.

In general, acquisitions take place at more than market value (before the public announcement). An increase in price will increase the book value (and goodwill) in the merged company. More acquisition activity may therefore lead to strong growth in intangible assets, a tendency that will be reinforced if the acquisitions are based on optimistic return expectations. If there are several bidders for a company, the sales price will always end up reflecting the expectations of the most optimistic bidder (winner's curse).

Companies in the OBX index have been involved in many major corporate transactions in recent years. This may well have contributed to the increase in intangible assets. Orkla, for example, incorporated Elkem and two other companies into its consolidated accounts in the first quarter of 2005. In the same quarter, however, a new accounting standard (IFRS) was also introduced, which has led to major changes in the accounting of corporate assets. A full overview of the effects of IFRS would require a more thorough analysis. Both factors may nevertheless be arguments for also analysing the effect of excluding intangible assets.

In the following we consider three types of ratios of developments in the financial features of companies on the Oslo Stock Exchange: gearing ratios, interest coverage ratios (ratio of financial costs to operating profit) and ratios of debt to operating income. The ratios say something about how robust companies are to negative economic shocks.

### Gearing<sup>19</sup> ratios

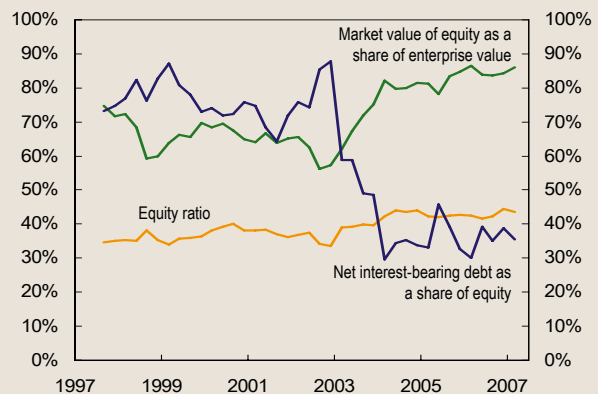
The debt level in the OBX companies fell markedly in the period 2003-2004 (see Chart 12). Measured as

net interest-bearing debt as a percentage of equity, the gearing has changed from 60-85 per cent before 2003 to 30-45 per cent afterwards. In parallel with this, the market value as a percentage of enterprise value (the sum of market value and net interest-bearing debt) rose to over 80 per cent. The equity ratio gradually increased from 35 per cent in 1998 to 44 per cent in 2004, and has since remained at a level of just under 45 per cent. If the equity ratio is adjusted for intangible values, the ratio shows a similar course up to 2004. Since then, however, this measure of the equity ratio has fallen by about 5 percentage points (see Chart 13).

### Interest coverage

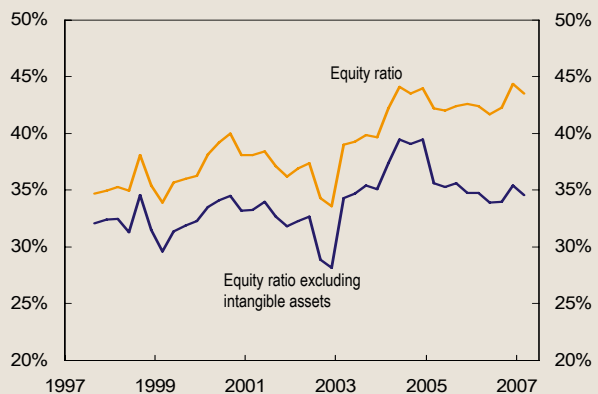
Interest coverage is equal to operating profits divided by interest expenses. The financial ratio indicates how many times operating profits cover annual interest expenses. When EBITDA divided by interest expenses equals 1, it can be interpreted, in a somewhat stylised

**Chart 12** Key figures for gearing on the Oslo Stock Exchange (OBX) excluding financial sector. Per cent. Quarterly figures



Source: Norges Bank

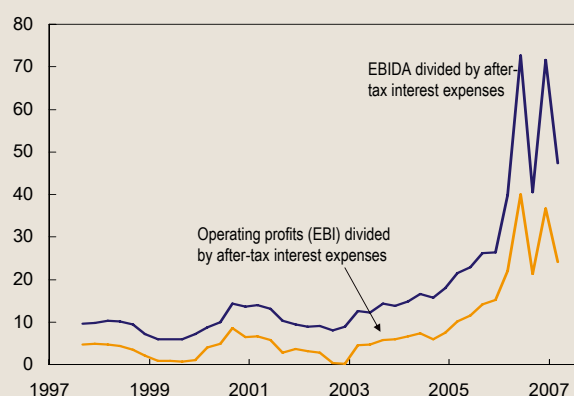
**Chart 13** Key figures for gearing on the Oslo Stock Exchange (OBX) excluding financial sector. Per cent. Quarterly figures



Source: Norges Bank

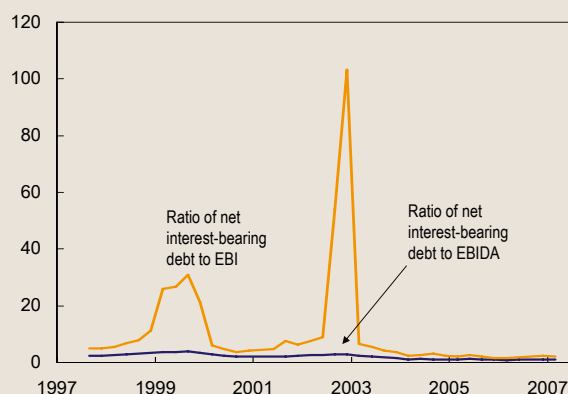
<sup>19</sup> In a situation where equity is more than 100 per cent exposed to a risk factor, it is usual to describe the exposure as geared. It is usual to achieve gearing through borrowing, but derivatives may also be used. If interest-bearing debt is equal to 50 per cent of equity, it means that the equity is exposed for 150 per cent of its own value, and hence geared 50 per cent.

**Chart 14** Interest coverage on the Oslo Stock Exchange (OBX) excluding financial sector. Quarterly figures



Source: Norges Bank

**Chart 15** Ratio of net interest-bearing debt to operating profits on the Oslo Stock Exchange (OBX) excluding financial sector. Quarterly figures



Source: Norges Bank

manner, as meaning that operations just cover interest expenses as long as there is no need for reinvestment to maintain operations. When EBIT divided by interest expenses is 1, it can be interpreted as indicating that operations just cover interest expenses plus reinvestments. In order to achieve greater consistency over time, these financial ratios are also calculated after tax. Although interest rate coverage cannot be interpreted as literally as indicated above, it is not likely to impair the information imparted by the ratio about developments in companies' capacity for absorbing higher interest expenses.

Not surprisingly, the combination of higher operating profit, lower debt-equity ratio and lower interest rate level has resulted in a pronounced improvement in companies' interest coverage (see Chart 14). Whereas interest coverage measured by EBI was less than 1 in early 2003, it is now almost 25 times the interest expenses of the non-financial companies in the OBX. In the same period, interest coverage based on EBIDA has increased from 8 to almost 50 times interest expenses.

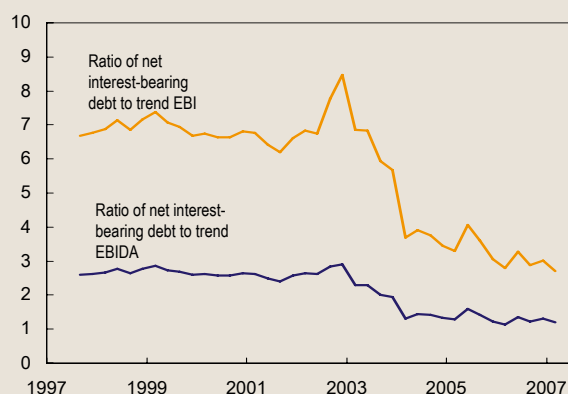
The financial ratio is clearly strongly affected by cyclical developments in operating profits. In this case, it is not a problem since interest coverage can be interpreted as an expression of companies' debt-servicing capacity *in the short term*. It is natural that short-term debt-servicing capacity varies with the business cycle.

### *Ratio of net interest-bearing debt to operating profit*

Net interest-bearing debt divided by operating profits also provides an indication of the debt-servicing capacity of companies. The financial ratio can (in stylised terms) be interpreted as the number of years it takes to repay the debt.

The ratios for the past few years show a sharp improvement in companies' debt-servicing capacity. As a result of lower debt and improved earnings, debt

**Chart 16** Ratio of net interest-bearing debt to operating profits on the Oslo Stock Exchange (OBX) excluding financial sector. Quarterly figures



Source: Norges Bank

is now only at about the level of the past year's EBIDA and equal to twice operating profits (after tax).

The ratio of interest-bearing debt to operating profit can be interpreted as an indicator for long-term debt-servicing capacity. A definite weakness of this financial ratio in such a context is that it is as sensitive to cyclical variations in operating profits as Chart 15 indicates. We have therefore also calculated an indicator that shows the ratio of interest-bearing debt to normalised (trend) operating profits (see Chart 16). In the period 1998 to 2002, debt was around 2½ times trend operating profits before depreciation and amortisation and 6-7 times trend operating profits. Since then debt has fallen to respectively 1¼ and 3 times the two trend operating profit variables.

### *Summary*

How the company is financed is crucial for the distribution of operating profits between creditors and



shareholders and may have a strong effect on how robust companies are to higher funding costs and deterioration in operating conditions. This comes to the same thing of course. As creditors have priority on cash flows and assets, the company will be insolvent if the creditor claims are not covered. In that case, the shareholders lose control of the company unless more equity is injected. The shareholders have the advantage that creditors only get a pre-determined amount, while the remaining assets accrue to shareholders. As long as ROCE is higher than borrowing costs, gearing (debt financing) pays off for equity holders. However, the vulnerability of the company increases with gearing.

At present, the companies on the Oslo Stock Exchange appear very robust. ROCE is high, gearing is low and financing costs are low. However, there has been unusually strong growth in intangible assets. Some of the growth is due to an increase in goodwill items. This can be interpreted as a decline in the substance of the equity. Equity ratios excluding intangible assets have declined substantially in the last two years, but are still high compared with the period 1998 to 2003.

## 6. Return on capital

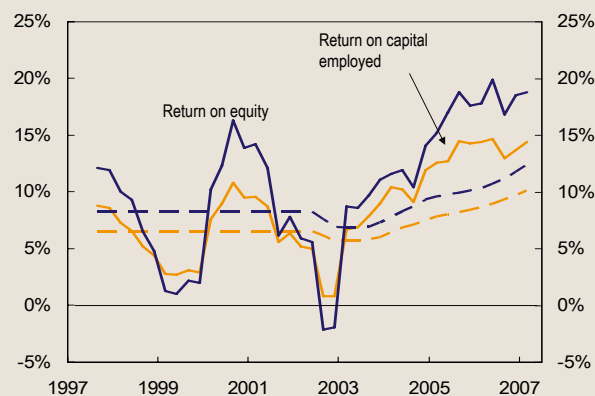
So far, we have seen that operating profits are a measure of the value added that accrues to investors, and that financing determines how operating profits are distributed. However, we have not yet presented a measure that enables us to assess whether the level of operating profits is high or low. Operating profits must be viewed in relation to the amount of capital tied up in the company.

Return on capital employed (ROCE) is operating profits as a percentage of capital employed, and is a measure of return on total capital invested in the company. Return on equity<sup>20</sup> (ROE) is net profit<sup>21</sup> as a percentage of equity. There is a close relationship between the two variables, and the difference is created by the financing. ROE is over time higher than ROCE of course, since equity is the most exposed to risk. When profitability has been at its weakest, ROE has been lower than ROCE (see Chart 17). This happens only when the average interest rate on debt is higher than the return on capital employed. If gearing is high during such periods, ROE may be negative even if the operating margin is positive.

Return on capital employed is the product of operating margin and capital turnover (see Box 2). The operating margin is very cyclical, which largely explains wide variations in profitability. The operating margin varies considerably because companies have fixed costs which accrue irrespective of the activity level.

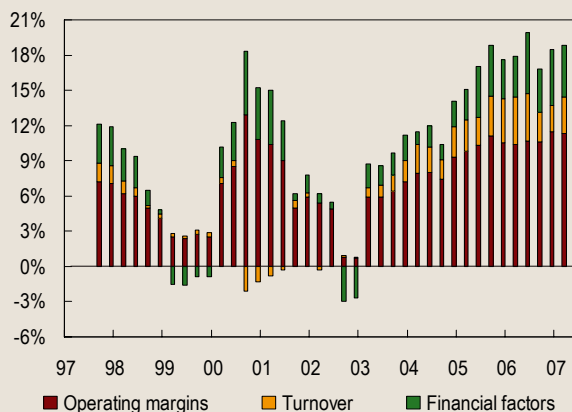
Chart 18 shows the contribution from three main factors to ROE: operating margin, capital turnover and equity gearing (financial factor). These variables are defined in Box 2.

**Chart 17** After-tax rate of return for the Oslo Stock Exchange (OBX) excluding financial sector. Past year and 5-year average. Per cent. Quarterly figures



Source: Norges Bank

**Chart 18** Effect of operating margins, capital turnover and financing on return on equity. Percentage points. Quarterly figures



Source: Norges Bank

Capital turnover can be regarded as a measure of capital efficiency. A higher turnover for a given operating margin indicates more efficient use of capital. In Chart 18, the contribution from turnover is positive when turnover is more than one, and negative when turnover is less than one.

The financial factor can be broken down into the contribution from the ratio of return on capital employed to the average interest rate on debt (ratio of rate of return on total capital employed to average interest rate on borrowed capital), and the contribution from the actual gearing ratio (see Box 2). Higher (lower) gearing results in increased (reduced) ROE if the interest rate on debt is lower than the return on capital employed (the normal case), and lower (higher) ROE if the interest rate on debt is higher.

The breakdown of the financial factor is not shown in Chart 18, but in those cases where the financial factor contribution is negative, we know that the average interest rate on debt has been higher than the return on capital employed. We have already mentioned that

<sup>20</sup> Total equity includes minority stakes in group companies.

<sup>21</sup> The net profit is the part of the value added that accrues to shareholders (see Box 1).

## Box 2: Relationship between ROE and ROCE

The following variables are used below:

$r$	return on equity (ROE)
$R$	return on capital employed (ROCE)
$E$	net profit
$EQ$	equity
$D$	interest-bearing debt
$F$	financial items (after tax)
$i = F/D$	(average) interest rate on corporate debt (after tax)
$S$	sales (operating income)

It can be shown that return on equity ( $r$ ) depends on the operating margin, capital turnover, the ratio of funding costs to ROCE (cost of capital factor) and the gearing of the companies. We can start with the following relationship between ROE and ROCE:

$$r = \frac{E}{EQ} = \frac{[R(EQ + D) - iD]}{EQ} = R + (R - i) \frac{D}{EQ}$$

This expression can be rewritten so that the four factors under discussion emerge from the formula:

$$r = R + (R - i) \frac{D}{EQ} = R \left[ 1 + \left( 1 - \frac{i}{R} \right) \frac{D}{EQ} \right]$$

$$r = \left[ \frac{E + F}{S} \right] \left[ \frac{S}{EQ + D} \right] \left[ 1 + \left( 1 - \frac{i}{R} \right) \frac{D}{EQ} \right] \quad (8)$$

The factors in equation (8) will be referred to as follows:

$$\left[ \frac{E + F}{S} \right] \quad \text{operating margin}$$

$$\left[ \frac{S}{EQ + D} \right] \quad \text{capital turnover}$$

$$\frac{i}{R} \quad \text{cost of capital factor}$$

$$\frac{D}{EQ} \quad \text{gearing}$$

$$\left[ 1 + \left( 1 - \frac{i}{R} \right) \frac{D}{EQ} \right] \quad \text{financial factor}$$

A lower operating margin, lower capital turnover and higher interest rates on debt relative to ROCE result in lower ROE. Lower gearing results in reduced ROE if the average interest rate on debt is lower than ROCE (the normal case), and higher return on equity if the average interest rate on debt is highest. The product of operating margin and capital turnover is equal to ROCE. The expression that we have called the financial factor combines the effect of the cost of capital factor and gearing, and can be regarded as the combined effect of debt financing on ROE.

gearing of companies on the Oslo Stock Exchange fell sharply in 2004. We can therefore say with certainty that a higher financial factor contribution in recent years was due to lower interest rates on debt and stable, high ROCE (see also Charts 16 and 17).

All three factors appear to contribute to making ROE cyclical. Variations in the operating margin contribute most to the variation in ROE. But in the periods when the operating margin was very low, capital turnover often fell as well, and the financial factor was negative. It might be expected that the strong growth in equity would have a negative impact on profitability. So far, profitability has remained high, although capital turnover has been slightly reduced.

## 7. Valuation multiples

High valuation of equities may indicate vulnerability to a fall in prices, while low valuation may indicate a potential for a price rise. As mentioned in Section 2, high (low) valuation may be synonymous with a low (high) risk premium. A theoretical rationale for the use of P/E and P/B ratios was provided in Section 2. However, there are many other related valuation multiples.

Valuation multiples often consist of a value variable (such as a share price) that is compared to a value driver (for example earnings per share – EPS). However, the real value driver for enterprises is expectations regarding future cash flows. Expectations cannot be observed, so substitutes have to be used for analysing valuation. It is not certain that they develop in the same way as the real value driver. Variation in valuation multiples may therefore be influenced by factors other than valuation or changes in risk premia. The objective is to find multiples that shed as much light as possible on developments in risk premia.

It is usual to distinguish between two groups of valuation multiples: total multiples and equity multiples. Equity multiples are generally used, not least because the value (market value) is easily available at the stock exchange. In theory, total multiples have a clear advantage in that they are influenced to only a minor extent by variations in the equity ratio. Any variations in risk premia, which are captured by the valuation ratio, will then be due to a general change in the risk premium and not due to a change in corporate gearing. The value variable, which is the enterprise value, is less readily available, however, and must be calculated as the sum of the market value of equity and debt.

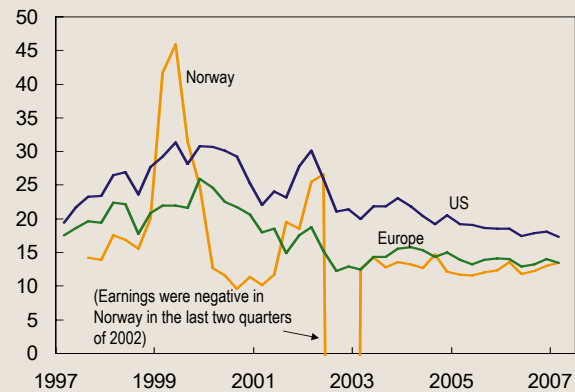
### P/E

The most widely used equity multiple is the price-to-earnings ratio (P/E). It is usual to calculate P/E on the basis of either historical accounts figures or analysts' average estimates for earnings one year ahead. Both

methods have advantages and drawbacks. Chart 19 shows P/E on the basis of historical earnings for US, European and Norwegian equities. Historically based P/E has varied considerably over time. In some cases, P/E is high because share prices have risen substantially, as they did in the US and Europe around 2000. In other cases, high P/E is due to extraordinarily low earnings. This was the situation in Norway in the first and second quarters of 2002. In the third and fourth quarters, earnings were marginally negative, and P/E therefore had a high negative value. This is a problem with traditional P/E multiples. If earnings are cyclical and volatile, the ratio may be high in cyclical downturns and low in cyclical upturns, and it may be very difficult to distinguish any variation in the ratio that is due to variation in the share risk premium. Today's moderate P/E level must be viewed in the light of cyclically strong earnings, as discussed below.

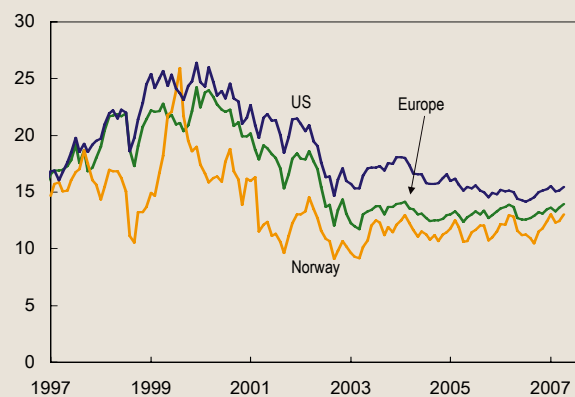
The advantage of using earnings estimates for calculating P/E is that analysts' estimates of future earn-

**Chart 19** P/E based on historical earnings in Norway, Europe and the US. Quarterly figures



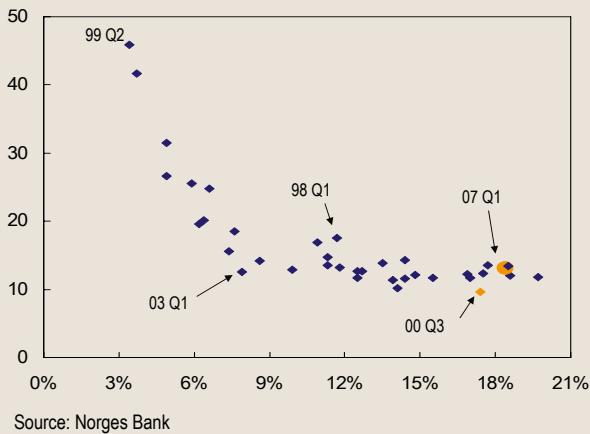
Source: Norges Bank

**Chart 20** P/E based on forward-looking earnings estimates in Norway, Europe and the US. Monthly figures

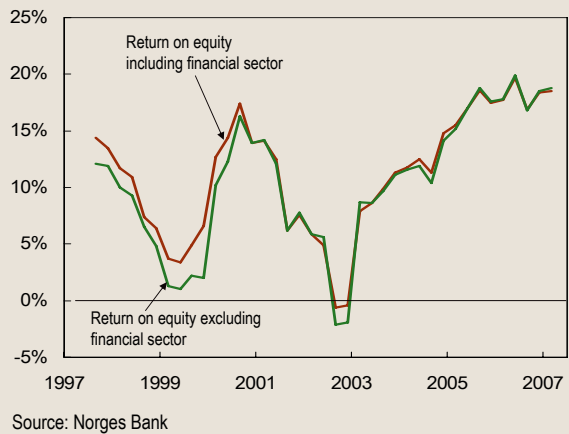


Source: Norges Bank

**Chart 21** Return on equity in per cent (x-axis) and valuation ratio P/E (y-axis). Oslo Stock Exchange (OBX). Quarterly figures. 1997 Q3 – 2007 Q1



**Chart 22** Return on equity on the Oslo Stock Exchange (OBX) including and excluding financial sector. Quarterly figures



ings are less influenced by past extraordinary events. Analysts can also take into account changes in the cyclical situation over the next 1-2 years. On the other hand, over- and underestimates may be made. In practice, forward-looking P/E's often present the same picture as historically-based P/E's. See Chart 20, which in the case of the US and Europe has many similarities with Chart 19.

If corporate earnings reflect the cyclical situation, a traditional P/E multiple may easily underestimate vulnerability to price falls during cyclical upturns, and overestimate vulnerability during downturns (see Chart 21). There is a tendency for P/E's to be low (high) when earnings per share are above (below) trend. This may indicate that investors disregard what they assume to be temporary peaks and troughs in earnings, and price shares on the assumption that earnings will revert to trend. It may therefore be appropriate to base calculations of P/E on normalised (trend) earnings. Trend earnings as calculated in Section 4 are used.

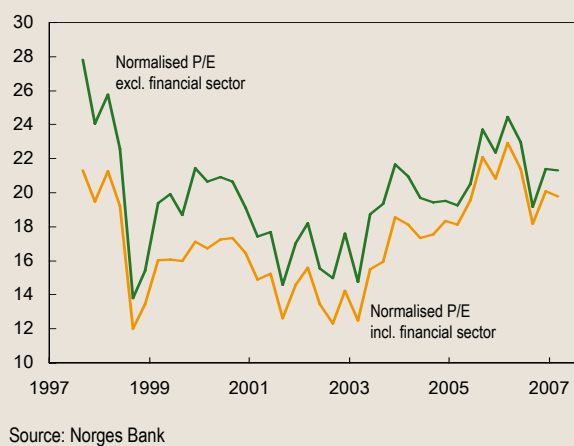
Profitability varies substantially over time, and has been extraordinarily high for the past 2-3 years (see Chart 22)<sup>22</sup>. P/E for the Oslo Stock Exchange based on normalised earnings<sup>23</sup> indicates that the valuation of the Oslo Stock Exchange may be fairly high (see Chart 23), when one takes into account that profitability over trend is not sustainable in the long run. The period of very high profitability has lasted a long time. A tight labour market and capacity constraints imply that profitability may decline.

## P/B

Another widely used equity multiple is that of market value to book value of equity (P/B). P/B has increased

substantially for Norwegian companies in recent years, and is historically high (see Chart 24). P/B and normalised P/E are closely related valuation multiples (see chart). The variable (P) is the same, and since normalised earnings are book value multiplied by 5-year average ROE, the ratios will follow a fairly similar trend. The two ratios have moved slightly apart in recent years. This is because sustained high profitability has raised average ROE and normalised earnings. The price of equity (P/B) has become unusually high in the Norwegian market. This has to some extent been justified by high ROE. Over time, increased investment in companies with high ROE may support continued earnings growth. However, more equity will make it difficult to maintain ROE, and any increase in debt

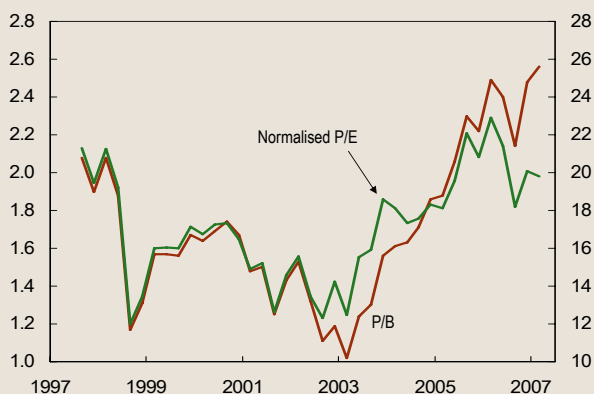
**Chart 23** Normalised P/E for the Oslo Stock Exchange (OBX) including and excluding financial sector. Quarterly figures



<sup>22</sup> Chart 22 shows ROE calculated on the basis of "pre-tax profit", less "tax" and not "net profit" (see Box 1). The effect of using "pre-tax profit" is to exclude the results of discontinued operations, and include the profits that accrue to minority shareholders. Return on equity based on "result before tax" therefore reflects the profitability of continuing operations for all shareholders. In this way one avoids erratic profitability due to one-off gains on the disposal of parts of the company.

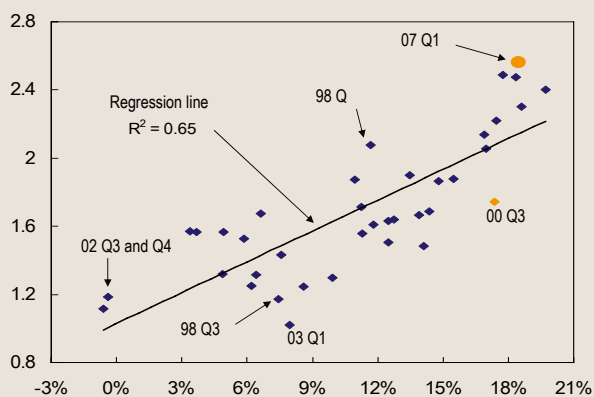
<sup>23</sup> Normalised earnings are estimated by first calculating annual ROE, which is obtained by dividing pre-tax profit by the book value of the equity (including minority shareholders' share of equity). We then calculate average ROE over 5 years and find normalised earnings by multiplying average ROE by book value.

**Chart 24** P/B and normalised P/E for the Oslo Stock Exchange (OBX). Quarterly figures



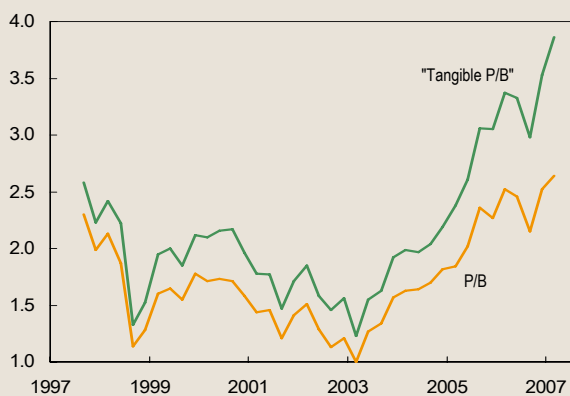
Source: Norges Bank

**Chart 25** Return on equity in per cent (x-axis) and valuation ratio P/B (y-axis). Oslo Stock Exchange (OBX). Quarterly figures. 1997 Q3 –2007 Q1



Sources: Norges Bank

**Chart 26** P/B for the Oslo Stock Exchange (OBX) excluding financial sector. Quarterly figures



Source: Norges Bank

financing will increase vulnerability in the event of an economic downturn.

The theory in Section 2 (see for example equation (7)), indicates that high P/B is not necessarily a danger signal as long as ROE is solid. The key figure may then be revised downwards as a result of equity growth, and not necessarily a price fall. However, P/B appears to be relatively high now, even taking into account the high level of ROE (see Chart 25). This can be interpreted as indicating that current stock prices are based on expectations that the current high earnings will persist. This possibility cannot be ruled out. For example, many oil rig companies are now signing long-term contracts with record-high rental prices. Historically, however, earnings on the Oslo Stock Exchange have always varied substantially with the business cycle, and P/B has always been high before a sharp fall in prices.

A special feature of developments in the book values of companies on the Oslo Stock Exchange is that the share of “intangible assets” has increased. In principle, the accounting of these assets should reflect the expected potential return to the same extent as the increased share of tangible assets. In practice, however, it is more difficult to estimate intangible assets. There is also a tendency in corporate acquisitions for overoptimistic pricing of acquired companies to be accompanied by growth in intangible assets (goodwill). One might estimate P/B on the basis of book value less intangible assets. Growth in P/B then appears even stronger (see Chart 26), and will make even greater demands on listed companies for high future profitability. However, this might be pushing this point to the extreme.

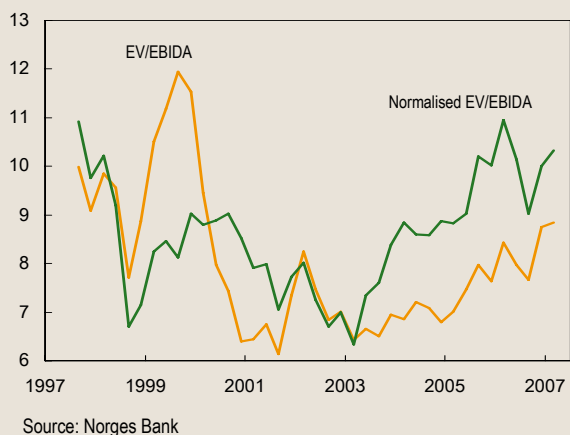
### *Equity multiples versus total multiples*

One disadvantage of equity multiples is that variations in debt-equity ratios will result in variations in the cost of equity and hence to variations in the “correct level” of the multiple. The value of the companies reflects all expected future value added that will accrue to investors and is affected to only a minor extent by funding. Total multiples are therefore more stable than equity multiples if the debt-equity ratio changes over time.

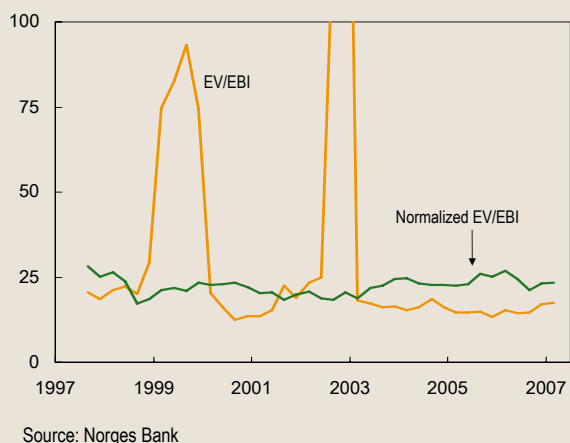
In practice, however, the main problem appears to be common to both types of valuation ratios: they fluctuate too much with the business cycle. Earnings fluctuate considerably through the business cycle, and since investors disregard cyclical variations in earnings, the valuation ratios may reflect the cyclical variations in the value driver more than changes in the risk premium. Charts 27 and 28 show the enterprise value (EV) viewed in relation to operating profits before (EBIDA) and after (EBI) depreciation and amortisation and after tax. Both EV/EBIDA and EV/EBI have been calculated for current profit and for a normalised (trend) profit level.

Chart 29 shows the equity ratio P/E and total asset ratios EV/EBIDA and EV/EBI based on trend earnings

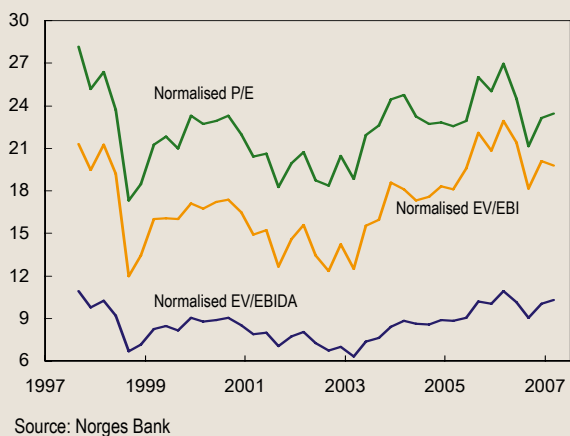
**Chart 27** EV/EBIDA for the Oslo Stock Exchange (OBX) excluding financial sector. Quarterly figures



**Chart 28** EV/EBI for Oslo Stock Exchange (OBX) excluding financial sector. Quarterly figures



**Chart 29** Valuation ratios for the Oslo Stock Exchange (OBX) based on trend earnings. Quarterly figures



figures. All three multiples appear to present the same picture of valuation developments. This may imply that there is not much to be gained in practice by changing from equity multiples to total multiples when assessing the valuation of the index level.<sup>24</sup> However, different types of multiples can be used as a cross check.

### Summary

On balance, there appears to have been a tendency to increased valuation of Norwegian shares. P/B, normalised P/E and normalised total multiples are at historically high levels. There has also been a considerable rise in historical EV/EBIDA.

Historical P/E and forward-looking P/E are at moderate levels. Earnings would have to fall for traditional P/E multiples to signal that the market is expensive. Earnings for the companies on the Oslo Stock Exchange have been strongly procyclical, however, and the economy is booming at present.

With reference to the discussion of the relationship between valuation multiples and risk premia on shares, developments in the multiples may, if anything, indicate that the risk premium on Norwegian shares may have fallen in recent years.

## 8. Conclusions

Developments in share prices on the Oslo Stock Exchange are related to developments in companies' operating profits, funding and market pricing (or the risk premium required by investors). We have given examples in the article of how these relationships can be analysed using financial ratios and shown relevant developments.

The companies' operating profits depend on cyclical developments. Market participants allow for this, but turning points in earnings are difficult to foresee. On balance, operations in the companies on the Oslo Stock Exchange have shown a very positive evolution, although developments in operating margins and ROCE may indicate slower growth going forward.

Interest-bearing debt has been reduced in the last decade, also as a share of invested capital. All else being equal, companies may be more robust to reduced growth in operating profits and any increase in funding costs and debt level. Intangible assets account for a large share of asset growth. To the extent that this is goodwill, balance sheet substance is reduced. The financial strength of listed companies nevertheless appears solid.

High valuation is synonymous with low risk premia. Low risk premia result in increased vulnerability to price falls in the event of weaker fundamentals. However, valuation multiples are not perfect measures of value. They are also affected by factors other than variation

<sup>24</sup> We have admittedly based the assessment of the enterprise value on book values of interest-bearing debt, since the market value of interest-bearing debt is not readily available. As long as the average period with a fixed interest rate on debt is short, this should not be a problem. However, the possibility that it influences ratios cannot be excluded.

in risk premia. The ratios nevertheless appear to point towards increased valuation and lower risk premia for Norwegian shares in recent years. Measured in relation to book values, and on the basis of valuation ratios with trend earnings, Norwegian shares tend to be fairly expensive in the light of historical valuation multiples.

Some total multiples have recently risen substantially. Traditional P/E measures have also increased recently, but are at moderate levels because market participants probably do not expect the cyclically high profitability of companies to persist.

## Tables previously published in *Economic Bulletin*

The Statistical Annex in Economic Bulletin has been reduced with effect from no. 1/06. The subsequent issues provided an overview of the statistics published up to and including no. 4/05, with website references. As from no. 1/07, the Statistical Annex has been removed entirely, partly because the majority of Norges Bank's statistics gathering activities have been transferred to Statistics Norway and partly because the statistics are updated more frequently on the Internet. The following is a list of tables published in Economic Bulletin up to and including 4/06, with website references.

1. Norges Bank. Balanse sheet  
<http://www.norges-bank.no/publisert/balanse/>
2. Norges Bank. Investments for Government Pension Fund – Global  
<http://www.norges-bank.no/petroleumsfondet/rapporter/>
3. Banks. Balanse sheet  
<http://www.norges-bank.no/front/statistikk/no/fiks/>  
<http://www.ssb.no/emner/10/13/10/orbofbm/>
4. Banks. Loans and deposits by public sectors  
<http://www.norges-bank.no/front/statistikk/no/fiks/>  
<http://www.ssb.no/emner/10/13/10/orbofbm/>
5. Banks. Profit/loss and capital adequacy data  
<http://www.ssb.no/emner/10/13/10/orbofrk/>
6. Banks. Average interest rates on NOK loans and deposits  
<http://www.ssb.no/emner/11/01/orbofrent/>
7. Securities registered with the Norwegian Central Securities Depository (VPS), by issuing sector, nominal value  
<http://www.ssb.no/emner/11/01/vpstat/>
8. Securities registered with the Norwegian Central Securities Depository (VPS), by holding sector, market value  
<http://www.ssb.no/emner/11/01/vpstat/>
9. Credit indicators and money supply  
<http://www.ssb.no/emner/11/01/k2/>  
<http://www.ssb.no/emner/11/01/m2/>  
<http://www.ssb.no/emner/11/01/k3/>
10. Financial accounts of the household sector  
<http://www.ssb.no/emner/09/01/finsek/>
11. Consumer price indices  
<http://www.ssb.no/emner/08/02/10/kpi/> (CPI for Norway only)

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