

Dahl, Geir Arne et al.

**Research Report**

## A Cobweb Model of Financial Stability in Norway

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No. 15 | 2011

# Staff Memo

## A cobweb model of financial stability in Norway

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*Edited by Magdalena D. Riiser*

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# A cobweb model of financial stability in Norway<sup>1</sup>

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Edited by Magdalena D. Riiser

## 1. Introduction<sup>3</sup>

Central banks have been supervising financial stability for several decades now. Most central banks publish reports providing an assessment of the financial sector and the risks to financial stability. However, quantifying financial instability has been a challenge. A number of methods have been used to assess financial stability.<sup>4</sup>

The first group of methods includes indicators of a specific segment of the financial system, for example indicators of equity, debt or currency markets, or indicators based on data from balance sheets or profit and loss accounts. The Financial Soundness Indicators that are coordinated by the IMF fall into this group. The analyses of financial stability in Norges Bank have featured such indicators since the middle of the 1990s. The indicators are a tool for monitoring developments in financial conditions and risks and are widely used. However, they are often lagged or contemporaneous. The general experience is that these indicators alone proved inadequate in signaling the recent financial crisis.

Another line of research is the development of composite financial conditions indices. As financial stability is measured along many dimensions, these indices try to combine information on different markets based on a set of indicators. Illing and Liu (2003) construct an index of financial stress for Canada covering the equity markets, bond markets, foreign exchange markets and the banking sector. Van den End (2006) builds a financial stability conditions index for the Netherlands and six OECD countries. Hanschel and Monnin (2004) construct a stress index for the banking sector in Switzerland.

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<sup>2</sup> Rebekka Reisvaag was employed in Norges Bank when the staff memo was written but is currently employed in Orkla

<sup>3</sup> The authors would like to thank Birger Vikøren, Sigbjørn Atle Berg, Ingvild Svendsen, Henrik Andersen, Per Atle Aronsen and Haseeb Syed for valuable suggestions and comments. Thanks to Birgitte H. Molden for commenting on the household dimension and to Helle Snellingen for the language dimension

<sup>4</sup> Galati and Moessner (2011) and Dattels, McCaughrin, Miyajima and Puig (2010) provide a detailed overview of methods for analysing financial stability

Andersen (2008) presents a risk index for Norwegian banks based on data from the banks' balance sheets and profit and loss accounts.

Early warning indicators have also been used to analyse financial stability. Drawing on econometric approaches, this method aims at detecting the build-up of financial imbalances. Early warning indicators for credit and asset prices have especially performed well in terms of signaling the build-up of financial imbalances, see Borio and Lowe (2002, 2004), Borio and Drehmann (2009) and Galati and Moessner (2011). The extensive use of early warning indicators is motivated by the existence of endogenous financial cycles, see Minsky (1977) and Kindleberger (1978, 2000). When times are good, asset prices and credit tend to rise, stretching private balance sheets and contributing to the build-up of financial imbalances. Such imbalances usually unwind in a disruptive manner when a shock occurs and threatens financial stability. Riiser (2005, 2008 and 2010) finds that asset prices, credit and investment are useful in predicting banking crises in Norway over a period of 150 years. VO Thi (2011) studies some other macroeconomic indicators for Norway such as credit, house prices and GDP, and concludes that credit is the best indicator.

Vector Autoregression Models (VARs) are another group of methods that are applied in financial stability analyses. The VAR modelling approach studies the transmission of a shock to some financial variables through the whole economy. A study employing VAR models has been performed by Norges Bank, see Jacobsen, Kloster, Kvinlog and Larsen (2011).

Another group of methods employs macro stress tests. Central banks perform macro stress tests to assess how robust the financial system is to exogenous shocks. Norges Bank semi-annually publishes stress tests in its report *Financial Stability*. A virtue of Norges Bank's stress testing framework is that it takes into account not only the propagation of shocks from the real economy to the financial sector but the feedback from the financial sector to the economy as well.

Achieving financial stability is a multidimensional task that is difficult to fulfil by complying with a simple target. Acknowledging that, central banks have started to exploit new methods that reflect the various facets of financial stability. The Bank of England has defined a list of key vulnerabilities to the UK financial system. In the *Financial Stability Review* (FSR) the Bank of England highlights the change in probability for the vulnerabilities and in their impact on the financial system compared with the previous FSR. The International Monetary Fund (IMF) has developed a global financial stability map (GFSM) presenting the main conditions and risks to financial stability, see Dattels et al. (2010). These are measured by a number of indicators on a scale from 0 to 10 depending on the history of the data. The scores are then graphically depicted as six dimensions in a cobweb-style diagram. The Reserve Bank of New Zealand has elaborated a similar national cobweb model of financial stability, see Bedford and Bloor (2009). In its effort to enlarge the toolkit for analysing the financial system, Norges Bank has developed a cobweb model of financial stability for Norway.

The rest of the memo is structured as follows: Section 2 outlines the design of the cobweb model for Norway and gives a brief description of the applied method. Section 3 describes the construction of each

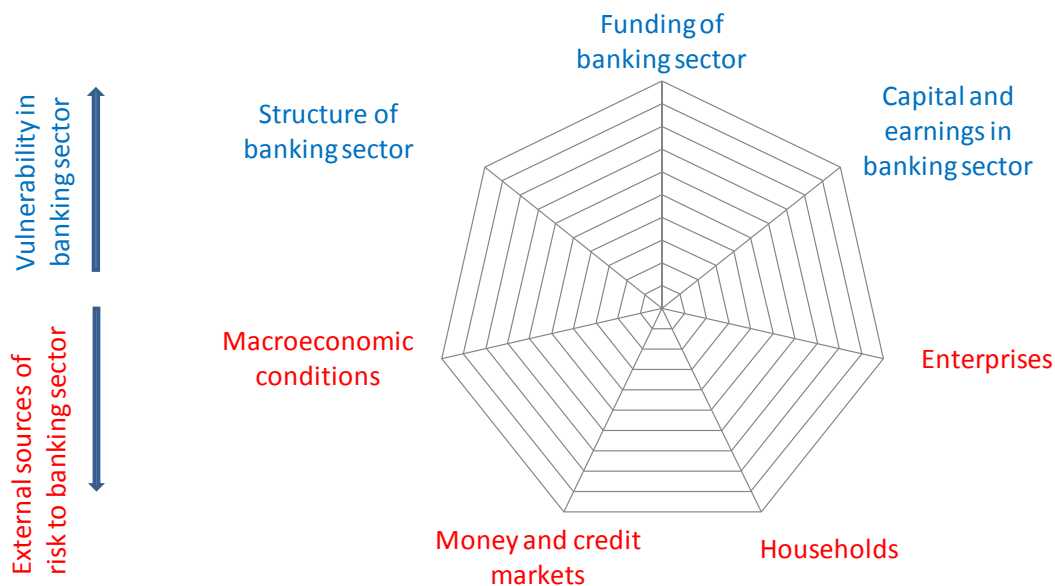
dimension of the diagram. Section 4 summarises the performance of the cobweb model during the periods of financial strain in Norway. Finally, Section 5 concludes.

## 2. Design and methodology for the cobweb model of financial stability

### 2.1 Design of the model

Financial stability implies a financial system that is robust to disturbances in the economy and that can channel capital, execute payments and redistribute risk in a satisfactory manner.<sup>5</sup> The cobweb model of financial stability summarises the main areas of surveillance as presented in the Norges Bank's *Financial Stability* report. Banks play a key role in credit provision and payment services – and they differ from other financial institutions in that they rely on customer deposits for funding. A well functioning banking sector is thus a necessary prerequisite for financial stability. Consequently, the cobweb model has been developed with the goal of mapping changes in the vulnerability in the banking sector and external sources of risks to the banking sector, thereby facilitating the communication of Norges Bank's assessment of financial stability and recommended measures.

Chart 1 The cobweb model of financial stability in Norway



Source: Norges Bank

<sup>5</sup> This definition of financial stability is used by Norges Bank, see the *Financial Stability* report

The upper part of the cobweb model consists of sources of vulnerability in the banking sector (see Chart 1). High vulnerability of banks reduces their robustness to withstand shocks and hampers financial stability. Sources of vulnerabilities are represented by three dimensions, i.e. capital and earnings, funding and structure of the banking sector. The lower part of the model comprises external risks to the banking sector, which include risks stemming from macroeconomic conditions, money and credit markets, enterprises and households.

The indicators of vulnerabilities in the banking sector and external risks are assigned scores from 0 to 10. Lower scores indicate lower level of vulnerability or risks. Moving further from the centre of the cobweb diagram indicates higher vulnerability or risks to the banking sector.

Changes in vulnerabilities and risks to the banking sector can be abrupt or more gradual. For example, household indebtedness tends to increase steadily over time, contributing to a permanent elevation in risks. Money and credit markets on the other hand can experience abrupt changes.

A positive assessment of financial stability requires both a robust banking sector, i.e. that vulnerability is low, and that there are no imminent risks to the banking sector. However, an unfavourable assessment of the vulnerability in the banking sector might render a lower total assessment of financial stability even in the absence of imminent risks, leading to a recommendation of measures.

## 2.2. Methodology

Each dimension in the cobweb model is based on a number of sub-indicators. Ideally, the data series for the sub-indicators should cover several economic and financial cycles. Preferably, the indicators should also be based on frequently published statistics to allow regular assessments of financial stability. Furthermore, we try to control for variations in the data which do not have implications for financial stability, such as seasonal variations or breaks in data series. The indicators are chosen to convey the most important and at the same time sufficient information. This has resulted in 4 to 8 sub-indicators in each dimension.

The sub-indicators are assessed against their historical values. We start by obtaining data series for the sub-indicators. These are subject to various transformations (see Annex A). As a first step we order the observations into a numerical sequence. The data is then divided into 11 equally sized data subsets (percentiles). The 11 percentiles for each sub-indicator correspond to a score between 0 and 10. The mean and the median of each sub-indicator equal 5. This value expresses only the average value of the sample we use and is not based on any assessment of a “normal” risk or vulnerability level. The main indicator is constructed as an unweighted average of the underlying sub-indicators. The value of the main indicator is rounded to the nearest whole number.

So far, each time the cobweb model has been updated, the percentile ranking has been performed on all data observations, including the new ones. This implies that a sub-indicator’s value that is associated with a certain score, for example 5, might change. A change in the main indicator score in the cobweb model might thus be due to either a change in the vulnerability and risk in the banking sector or to a

mere change in the average value of the underlying data. Separating the effects would have required that the percentile ranking was performed on a fixed data sample that was not extended with new observations. However, applying this approach, new observations exceeding the outer values of the fixed sample would not result in a change of scores, which might be a drawback especially when a crisis unfolds.

The advantage of using percentiles is that it is a relatively simple method that does not depend on specific distributional assumptions about the data. On the other hand, obtaining meaningful indicator values requires sufficient long-time series for each sub-indicator covering several cycles. Applying this method when series are characterised by tail events might be challenging. In such a case, the standard method results in a too high proportion of extreme events. Small variations in the time series can give too large variations in the indicator values as the data are not evenly distributed. For series where tail events are important, such as market data etc., we use an alternative method. Instead of equally distributing the number of observations into 11 data subsets (percentiles), we divide the series range (the distance between the maximum and the minimum values) into a number of equal length intervals. We also use discretion in deciding the outer boundaries for some indicators when neither of the two methods discussed above is suitable. The latter refers mainly to some sub-indicators in banks' capital and earnings and the structure of the banking sector.

Problems can also arise when new observations by far surpass historical values. In such a situation, we may not experience an increase in the score assigned to the sub-indicator as the risk or vulnerability escalates.

Assigning weights to the sub-indicators would imply a ranking of the importance of various factors for financial stability. As such ranking has not been undertaken, the sub-indicators are generally given equal weights in the main indicator. How important a factor is for financial stability might change over time, which is another argument for keeping equal weights. However, if there is an overlap of information conveyed by the sub-indicators in the different dimensions, some factors can practically be represented to a further extent than others.

The cobweb model is a technical tool that makes our assessment of financial stability more consistent over time as we have to evaluate the same set of indicators. The model is also meant to reflect our best assessment of financial stability. However, in some cases we might have information from the market (market intelligence) that might place greater weight on certain factors or that might be inadequately reflected in the cobweb model. In such cases, effort should be made to develop the cobweb model to make it better reflect this kind of information. However, we might in some situations have important information that is not easily quantifiable. In addition, sources of vulnerabilities and risks to the banking sector may be numerous and vary over time. Moreover, we try to limit the number of sub-indicators in the model. Therefore, our approach is to supplement the results of the model with subjective judgment in determining the final ranking of the indicators. In such cases, the arguments for overruling the immediate results of the model should be presented in the *Financial Stability* report.



### 3. Construction of the indicators

This section presents the main indicators in the cobweb model and the underlying sub-indicators. The indicators are tested against periods of financial distress in Norway. The periods are determined by postulating that a financial crisis occurs when liquidity or solvency problems in the banking sector result in government measures, bankruptcies or forced mergers with other financial institutions. According to this definition, two periods are outlined, i.e. the 1988 Q2 - 1993 Q3 banking crisis in Norway and the international financial crisis that affected Norway in 2008 Q3 - 2009 Q3. We also define a period of financial vulnerability in 2002 Q3 – 2003 Q4. We do not define this period as a banking crisis but loan losses, especially on loans extended to the fish farming industry, escalated and banks' liquidity became strained. As the period is not consistent with the definition of a banking crisis, we do not necessarily expect that all indicators give a signal. In the charts the crises are marked in grey while the 2002 Q3 – 2003 Q4 period of financial vulnerability is marked in a slightly different colour (shade).

#### 3.1. Capital and earnings in the banking sector

##### 3.1.1 Sub-indicators<sup>6</sup>

Financial stability depends on how robust banks are when they are exposed to disturbances. Banks' capital is an indicator of banks' ability to absorb losses when times are bad. Banks' profitability shows whether banks have the potential to increase their capital. This part of the cobweb is designed to measure the vulnerability regarding banks' earnings (profitability) and capital. Profitability and capital are interconnected as solid earnings boost banks' capital. Five sub-indicators have been chosen for the capital and earnings indicator. Three of them are related to earnings and two are related to capital. All sub-indicators are given the same weight in the main indicator. This implies that sub-indicators related to earnings make up 60 per cent of the main indicator while capital makes up 40 per cent.

Branches of foreign banks in Norway had a market share of 16 per cent in 2011 Q3.<sup>7</sup> However, data on capital for branches of foreign banks in Norway are insufficient and the data for total assets may vary widely. Branches are therefore excluded from the calculation of the sub-indicators with the exception of the sub-indicator for loan losses as a percentage of lending.

##### *Net interest income as a percentage of average total assets*

Net interest income is the most important income component for Norwegian banks. During the past decade, net interest income has decreased sharply as a percentage of total assets. A part of the decrease is structural and due to lower operating costs in banks driven by more automated bank services. Moreover, over the period 1990 - 2007 the share of residential mortgage lending in banks' portfolios has increased relative to corporate lending, contributing further to the declining trend in net

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<sup>6</sup> The sub-indicators for capital and earnings only use data for banks, i.e. excluding data for covered bond mortgage companies

<sup>7</sup> The market share is based on total assets

interest income. However, the large transfers of mortgages to covered bonds mortgage companies in recent years imply a partial reversal of this trend.<sup>8</sup> Because of the declining trend, the standard method for assigning values to an indicator is not suitable. Thus, we have opted to determine the boundaries for the indicator values subjectively. The width of the intervals is larger for higher ratios and becomes lower for lower ratios (see Table 1). The indicator is also inversed, i.e. a lower value of net interest income as a percentage of average total assets results in a higher indicator score, which implies higher vulnerability.

**Table 1 Net interest income as a percentage of average total assets**

| Sub-indicator value | ≤0.9 | 0.91 - 1.0 | 1.01 - 1.1 | 1.11 - 1.2 | 1.21 - 1.4 | 1.41 - 1.6 | 1.61 - 1.8 | 1.81 - 2.0 | 2.01 - 2.5 | 2.51 - 3.0 | >3 |
|---------------------|------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----|
| Score               | 10   | 9          | 8          | 7          | 6          | 5          | 4          | 3          | 2          | 1          | 0  |

### *Loan losses as a percentage of gross lending to the private and municipal sector*

Loan losses may have a significant negative impact on banks' earnings and capital, as experienced under the banking crisis in 1988–1993. Increasing loan losses are therefore an indication of higher vulnerability. The sub-indicator is calculated based on data for all banks in Norway, i.e. including branches of foreign banks in Norway. The standard method is applied to calculate the sub-indicator.

### *Pre-tax profit as a percentage of average total assets*

Banks can strengthen their capital by being profitable and retaining earnings. Pre-tax profit has been chosen as the indicator of banks' overall earnings as after-tax profit is more volatile due to tax rules and tax planning by banks. Banks' profit depends on net interest income and loan losses, i.e. the first two sub-indicators in the dimension. In addition, banks' profit includes the effects of other operating income, personnel expenses and other operating expenses. The standard method is applied to the sub-indicator. The sub-indicator is inversed.

### *Difference between Tier 1 capital ratio and the "practiced minimum requirement"*

Banks are subject to minimum capital adequacy requirements. The 2008-2009 financial crisis highlighted the importance of banks' capital quality. As Tier 1 capital is of higher quality than capital satisfying the capital adequacy requirements, we employ the Tier 1 capital ratio to construct the sub-indicator. However, Norwegian banks have been subject to stricter capital requirements than the minimum capital adequacy requirement. We have therefore transformed the pure Tier 1 capital ratio by subtracting "the practiced minimum requirement for Tier 1 capital". The higher the difference between Tier 1 capital ratio and the practiced minimum requirement, the larger banks' buffers are and the less vulnerable the banking sector is. Until 2008 we have set "the practiced minimum requirement" to 6 per cent, which corresponds to the implicit minimum requirement communicated by the Financial Supervisory Authority of Norway during the last part of this period. From 2009 "the practiced minimum requirement" is set to 8.5 per cent corresponding to the future minimum requirement for Tier 1 capital ratio of 6 per cent plus the conservation buffer of 2.5 percentage points. An introduction of a countercyclical buffer, more stringent capital requirements for large systemically important banks or increased requirements from

<sup>8</sup> The interest rate on the remaining mortgage loans in the banks is on average higher than on those transferred to the mortgage companies

supervisors or the rating agencies might increase “the practiced minimum requirement” used in the sub-indicator. The standard method is applied to the sub-indicator. The sub-indicator is inverted.

### *Equity ratio*

Under Basel II and Basel III banks can use their own models to estimate credit risk and calculate the required level of capital. The large Norwegian banks increasingly apply their own models (IRB models), which has reduced these banks’ risk-weighted assets and facilitated compliance with capital requirements. As a result, banks can hold less equity. Since equity is banks’ primary buffer to absorb losses, we include the equity ratio in the set of sub-indicators. The equity ratio is defined as equity relative to total assets. As it is not affected by the Basel II and Basel III risk weights, it represents an alternative measure of financial strength compared to the Tier 1 capital ratio. Norwegian banks raised equity after the 1988-1993 banking crisis but the equity ratio has decreased over the last decade. In the present calculations of the equity ratio we do not make deductions for intangible assets etc. and we do not include off-balance sheet items, which is an apparent shortcoming. In the future we intend to use the Basel III leverage ratio in the sub-indicator which will correct for the aforementioned deficiencies. The standard method is applied to the sub-indicator. The sub-indicator is inverted.

#### **3.1.2 Performance of the indicators**

The main indicator of capital and earnings in the banking sector starts just prior to the 1988-1993 banking crisis. The indicator’s value is high prior to the crisis and during the crisis (see Chart 2). Moreover, the indicator increases somewhat prior to the period of financial vulnerability in 2002-2003 and the financial crisis in 2008 – 2009. However, the maximum values during the last two periods are lower than the values during the banking crisis in 1988-1993.

Chart 2 Capital and earnings. Main indicator.  
Indicator on scale 0-10. 1987Q4 - 2011Q3

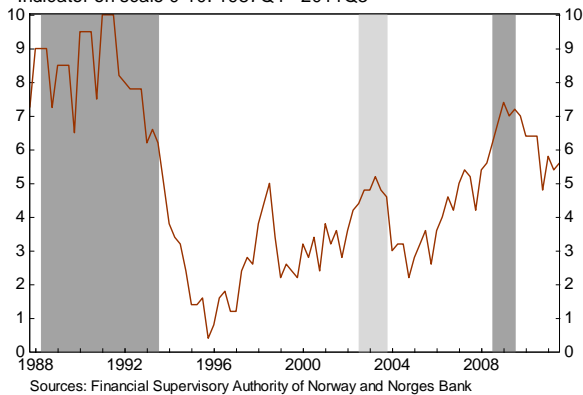
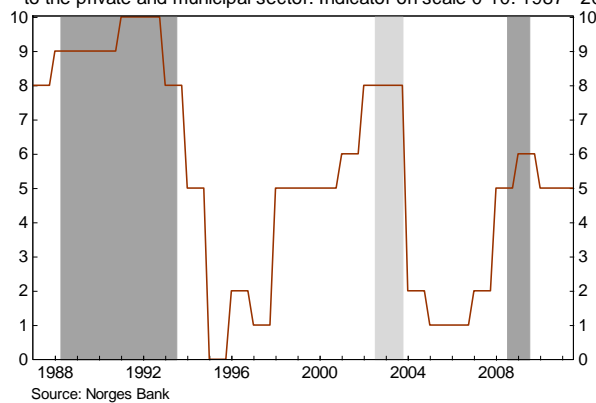


Chart 3 Capital and earnings. Loan losses as a percentage of gross lending to the private and municipal sector. Indicator on scale 0-10. 1987 - 2011



One of the sub-indicators that varies to a large extent and that has a considerable impact on the main indicator is loan losses as a percentage of lending. Moreover, this sub-indicator affects the development in the sub-indicator for pre-tax profit. Consequently, we assess the signaling power of this sub-indicator in more detail. Unfortunately, as the data series for loan losses starts in 1987, we are not able to evaluate the early warning properties of loan losses prior to the outbreak of the 1988-1993 banking

crisis. The value of the sub-indicator of loan losses is high during the banking crisis (see Chart 3). The indicator also increases somewhat prior to the period of financial vulnerability in 2002-2003. However, the indicator does not signal the financial crisis in 2008-2009 as loan losses in Norwegian banks were moderate over that period.

## 3.2 Funding

### 3.2.1 Sub-indicators<sup>9</sup>

The funding dimension gives an assessment of the risks to financial stability that stem from vulnerabilities in the funding of the banking sector. If the banks' funding structure is vulnerable, the banking sector will be less able to absorb shocks in the money and credit markets. This could undermine financial stability.

Funding maturity is essential for the build-up of vulnerabilities in the banking sector. Banks financing their activities with long-term market funding and customer deposits are less vulnerable to failures in the funding market. Banks' market claims and liquidity buffers are also important for assessing the vulnerabilities in the funding of the banking sector. Based on these considerations, we use five sub-indicators: the Liquidity Coverage Ratio (LCR), short-term market funding in foreign currency as a percentage of total assets, net short-term market funding as a percentage of total assets, the net stable funding ratio (NSFR) and the weighted average maturity of market funding. As data for the LCR and NSFR are only available from 2010, the main indicator is based on 3 out of 5 sub-indicators prior to 2010.

Short-term market funding is defined as market funding with a maturity of less than one year. The first three sub-indicators refer to banks' short-term market funding.

#### *Liquidity coverage ratio (LCR)*

To reflect banks' short-term funding risk we use the Liquidity Coverage Ratio (LCR) that is recommended by the Basel Committee. The LCR is proposed to be implemented no later than 2015. Under the LCR standard, each bank must have a sufficient stock of high-quality liquid assets to survive a 30-day period of considerable market stress featuring a net outflow of customer deposits. The standard requires that the ratio is no lower than 100 per cent. The Basel Committee has specified a number of characteristics that an asset must meet to be eligible for inclusion in the LCR. The standard is not yet in its final form and we use a simplified version of LCR.

$$\text{LCR} = \frac{\text{Stock of high quality liquid assets}}{\text{Net cash outflows over a 30-day time period}}$$

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<sup>9</sup> The sub-indicator for weighted average maturity of long-term market funding uses data for banks and covered bond mortgage companies. The other four sub-indicators use only data for banks

Since the LCR is not yet implemented in Norway there is no historical time series and no average estimates to set the value of the indicator.<sup>10</sup> Furthermore, banks need time to adjust to it. Until the

LCR is implemented we set the value between 0 and 10 based on discretion. If the LCR is very low, the value of the indicator is set close to 10. When deciding on the score, we assess how banks are funded, what kind of assets they hold and how close they are to complying with the LCR.

### *Short-term market funding in foreign currency as a percentage of total assets*

Norwegian banks have a considerable share of short-term market funding in foreign currency. Market funding in foreign currency gives banks access to more investors and enables banks to issue larger volumes. On the other hand, a large share of short-term market funding in foreign currency may pose a challenge in the event of financial market turmoil as a major bulk of the banks' funding matures during a period when the access to new funding is limited. Thus a large share of short-term market funding in foreign currency makes the Norwegian banking sector more vulnerable to developments in these markets. Therefore, we include the indicator in our assessment of vulnerabilities in banks' funding. The standard method is applied to the sub-indicator.

### *Net short-term market funding as a percentage of total assets*

Net short-term market funding is short-term market funding less short-term high-quality liquid assets. If a bank has a large share of short-term market funding, it can reduce the funding risk this represents by investing in safe and liquid assets. We define short-term high-quality liquid assets as deposits in central banks and government and government-guaranteed securities with a residual maturity of up to one year.<sup>11</sup> The indicator includes short-term market funding in both foreign currency and Norwegian kroner. Market funding in foreign currency is considerable for larger banks, while smaller banks in Norway primarily rely on NOK funding. The standard method is applied to the sub-indicator.

### *Net stable funding ratio (NSFR)*

To reflect banks' long-term funding risk we use the Net Stable Funding Ratio (NSFR) that is recommended by the Basel Committee. The NSFR is proposed to be implemented no later than 2018. NSFR is intended to eliminate funding mismatches by establishing a minimum acceptable amount of stable funding based on the liquidity characteristics of banks' assets and activities over a one-year horizon. The ratio is defined as "available amount of stable funding" divided by its "required amount of stable funding". The standard requires that the ratio be no lower than 100 per cent.

As the NSFR is not implemented yet, banks need time to adjust to it. As for the LCR indicator, we calculate a simplified version of the NSFR and we set the value of the NSFR indicator between 0 and 10

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<sup>10</sup> In 2011 Q1 Finanstilsynet (Financial Supervisory Authority of Norway) introduced a test LCR reporting for the largest banks. In Q3 the reporting was expanded to cover all banks. We do not use Finanstilsynet's LCR data but estimate the LCR based on available banking statistics

<sup>11</sup> Due to roll-over at maturity, holdings of treasury bills received in exchange for covered bonds in the government swap arrangement are assumed not to be short-term high quality liquid assets if the swap agreement matures more than one year ahead

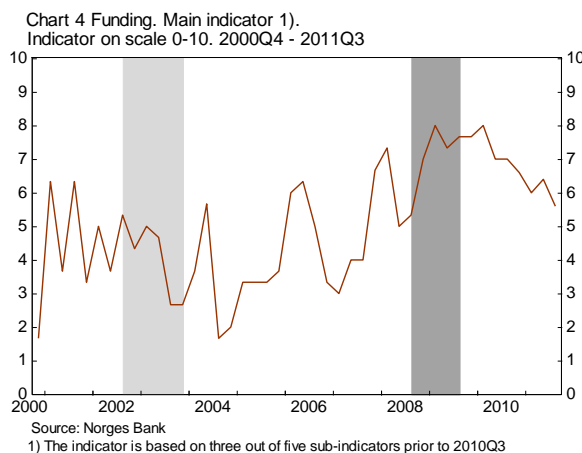
based on discretion. If the value is very low, then the value of the indicator is set close to 10. When deciding on the score, we assess how banks are funded, what kind of assets they hold and how close they are to complying with the NFSR.

### *Weighted average residual maturity of long-term market funding in years*

Weighted average maturity of market funding is calculated based on the share of market funding in each maturity interval. Only long-term market funding is included in this indicator. Long-term market funding is defined as market funding with a residual maturity of more than one year. If the weighted average maturity of a bank's market funding is sufficiently long, the bank will be less vulnerable to turmoil in financial markets. The alternative method is applied to the sub-indicator (see Section 2.2 and Section 3.5.2). A mid-interval (which corresponds to a score of 5) of width  $\pm 1.0$  standard deviations is constructed. The remaining data are distributed into 10 intervals of fixed and equal width. The indicator is inversed.

#### **3.2.2 Performance of the indicators**

Due to lack of data we consider the period from 2000 Q4. As Chart 4 demonstrates, the main indicator increases before the financial crisis of 2008-2009 but the score is generally lower than the average of 5. As there are no data for the LCR and NFSR during that period, the indicator truly does not provide a complete illustration of banks' vulnerability related to funding. Moreover, the indicator is rather volatile since it is primarily based on sub-indicators for short-term funding before 2009. However, the indicator captures the increase in banks' vulnerability during the financial crisis as it becomes difficult for banks to issue debt with long maturities.



#### **3.2.3 Further work**

The net short-term market funding indicator depends heavily on changes in the largest banks' funding structure. Some of these balance sheet changes do not reflect actual changes in the vulnerability of the funding structure of Norwegian banks. We are currently looking at ways to adjust for some of these balance sheet changes, especially movements in the very short-term market funding in the largest banks.

We will also make adjustments in the value setting of the LCR and NSFR indicators when they are implemented in Norwegian law.

### 3.3 Structure of the banking sector

#### 3.3.1 Sub-indicators<sup>12</sup>

Large and systemically important financial institutions may increase the vulnerability of the banking sector. Furthermore, it is important to assess how vulnerable the financial system is if the provision of a given bank product is impeded, for example if problems in an individual bank can hinder credit provision. Moreover, the vulnerability of the banking sector will also depend on how diversified banks' funding sources are. It is useful to look at the diversification of the asset side of banks' balance sheets. The indicator of the structure of the banking sector is based on six sub-indicators, of which five are currently in use.

In order to restrict the number of sub-indicators we have decided on two sub-indicators related to market shares and four sub-indicators related to dispersion within the banking sector in Norway.

#### *Market share of the largest bank in terms of total assets*

The market share of the largest bank in terms of total assets reflects the bank's total activity and indicates whether the bank has a dominant role in the banking sector. DNB Bank is by far the largest bank based on total assets. The larger the largest bank, and thereby the smaller the remaining banks are, the more vulnerable the Norwegian banking sector is if this bank should run into problems. The market share of the largest bank has increased substantially over time. Thus, the standard method is not ideal for this sub-indicator. We have therefore determined the outer boundaries for the sub-indicator values subjectively. A market share over 50 per cent results in an indicator value of 10, while a market share below 10 per cent gives an indicator value of 0. The interval between these outer boundaries is divided into 9 subintervals of equal width, e.g. a market share between 10 and 14.44 per cent produces an indicator value of 1.

#### *Ratio of lending to the corporate market*

Lending to the corporate market is a heterogeneous and a more specialised product compared with lending to the retail sector. In case of bank problems it is therefore more difficult to replace a bank's lending to the corporate market. The sub-indicator is based on the five largest banks' lending to the corporate market. The sub-indicator is defined as lending to the corporate market from the second, third, fourth and fifth largest bank divided by the largest bank's lending to this market. The higher the ratio, the less vulnerable lending to the corporate market is. We have used discretion to determine the

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<sup>12</sup> The sub-indicators for the structure of the banking sector only use data for banks, i.e. excluding data for covered bond mortgage companies

outer boundaries for the indicator values. A ratio below 100 per cent results in an indicator value of 10, while a ratio above 250 per cent gives an indicator value of 0. The outer boundaries represent the situation when the largest bank's lending to the corporate market is as large as the four other banks' total lending to the same market, and respectively the situation when lending from the largest bank is 40 per cent of total lending from the four other banks. The interval between these outer boundaries is divided into 9 subintervals of equal width, i.e. a ratio between 233⅓ and 250 per cent results in an indicator value of 1.

The last four sub-indicators look at the dispersion within the banking sector in Norway. The first two look at exposures to borrowers and debt funding sources, while the last two look at negative deviations compared to the average Tier 1 capital ratio and average Liquidity Coverage Ratio respectively.

### *Deviations from the macro bank's loan portfolio and deviations from the macro bank's debt funding structure*

Banks with similar characteristics may be affected in the same way by an economic shock. A banking sector consisting of a large number of banks with identical exposures to various categories of borrowers may thus be vulnerable. Likewise a banking sector with many banks with identical exposures to various debt funding sources may be vulnerable. We have constructed one sub-indicator of differences in lending exposures and one of differences in debt funding structure based on the calculated variance between individual banks' exposures and the average exposures of the Norwegian banking sector.<sup>13</sup> The higher the variance, the more diversified the banking sector is and the lower the indicator value is. Due to short time series for the two sub-indicators, the indicator values are currently restricted to the interval between 4 and 6 for the sub-indicator of loan portfolio and between 3 and 7 for the sub-indicator of funding structure. The standard method is used but restricted to the aforementioned intervals, i.e. 4-6 and 3-7, instead of the whole interval between 0 and 10.

### *Semi-variance for negative deviations from banks' average Tier 1 capital ratio*

Even if the average Tier 1 capital ratio for Norwegian banks is well above the minimum requirement, there may be individual banks which are close to the minimum requirement. To measure the negative dispersion we single out banks with Tier 1 capital ratio below the national average and calculate the semi-variance for these banks. A negative dispersion for a large bank will have a greater effect than the same dispersion for a smaller bank for this sub-indicator. The larger the semi-variance, the more vulnerable the banking sector is due to possible failures of individual banks. However, developments in the sub-indicator during 2007-2010 have to be interpreted with caution as the introduction of Basel II minimum capital adequacy requirements and banks' phasing-in of IRB-models have a considerable impact on the indicator. The standard method is applied to the sub-indicator.

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<sup>13</sup> The calculation of the variance in the sub-indicator for deviations from the macro bank's loan portfolio is based on lending weights for each individual bank. The calculation of the variance in the sub-indicator for deviations from the macro bank's debt funding structure is based on each bank's weights for total debt funding, i.e. liabilities less equity



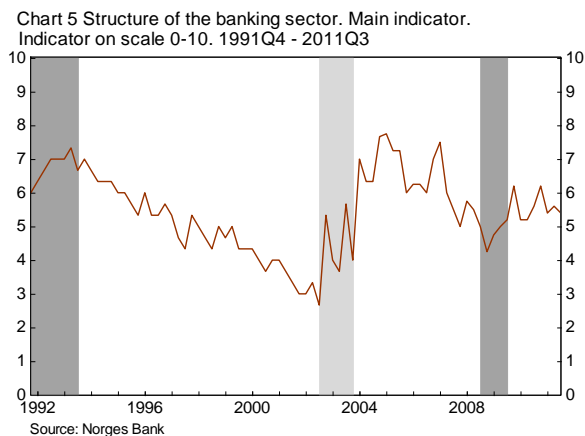
### *Semi-variance for negative deviations from the future LCR standard*

Likewise we intend to measure the negative dispersion of individual banks from the future Liquidity Coverage Ratio standard (LCR standard) by calculating the semi-variance. The Basel Committee is still working on elaborating the LCR standard. The sub-indicator will therefore be included in the dimension when the LCR standard is finalised and banks start reporting their LCRs.

#### **3.3.2 Performance of the indicators**

The structure indicator does not produce strong signals prior to the crises in our data set (see Chart 5). The two semi-variance indicators might be expected to show increased vulnerability prior to crises. However, the semi-variance for negative deviations from the future LCR is not in use yet. The two indicators for deviations from the macro bank's loan portfolio and debt funding structure will generally increase during a crisis, entailing a sharp increase in the main indicator.

As the data series for many of the sub-indicators are quite short, the structure indicator covers fewer aspects of the banking structure prior to 2005. The longest data series are for the sub-indicators for market share of the largest bank, for the ratio of lending to the corporate market and for negative deviations from the average Tier 1 capital ratio. The data series for the sub-indicators for diversification of loan portfolios and funding structure are too short to give strong signals. Furthermore, the sub-indicators in the structure dimension change quite slowly. However, the two sub-indicators for market concentration may exhibit large shifts when mergers of large banks occur.



## **3.4 Macroeconomic conditions**

### **3.4.1 Sub-indicators**

Macroeconomic conditions affect borrowers' capacity to service their debt and therefore have an impact on financial stability. Real economic growth determines future income prospects, and hence

borrowers' debt servicing capacity. Growth and growth prospects can also affect how the market perceives risk.

An ideal set of indicators should cover both cyclical as well as more structural or long-term developments, for example a situation with growing imbalances. One or several of the indicators should signal when a shock, given any economic imbalances, can result in a high share of loan losses in banks.

As the Norwegian economy is a small, open economy that is affected by developments abroad, we have included sub-indicators both of domestic factors and of Norway's trading partners. Furthermore, we use a measure of competitiveness, the real exchange rate. The latest Norges Bank forecast for mainland GDP is also incorporated in the dimension. As a large share of macroeconomic data is published with a lag, this indicator provides a forward-looking element to the dimension.

The indicator describing macroeconomic conditions consists of 8 sub-indicators. With the exception of the OECD composite leading indicator (CLI), we use the standard method when assigning values to each of the sub-indicators.

#### *Output gap for mainland Norway*

The output gap for mainland Norway is included to take account of current economic conditions. The gap is defined as the percentage deviation between actual and potential mainland output. The series is calculated by Norges Bank and is published in each *Monetary Policy Report*. Unlike a growth rate, a gap measure ensures that the evaluation of current developments also takes account of developments in previous periods. The sub-indicator is inversed.

#### *Output gap for trading partners*

Global economic growth gives an impetus to growth at home. An international setback would also affect the Norwegian economy through reduced exports. The gap captures developments for Norway's main trading partners and is calculated as the percentage deviation between GDP and projected potential GDP. The sub-indicator is inversed.

#### *Change in registered unemployment rate*

The unemployment rate is an indicator of the level of activity in the economy. Furthermore, it is an important factor in explaining household demand and problem loans for the household and the corporate sector, see Berge and Boye (2007). The unemployment rate also affects developments in house prices and hence collateral values.

We use the seasonally adjusted unemployment rate. The variable is available at a monthly frequency, and we use the average of the monthly values when calculating the quarterly value. Where monthly observations are not available, the quarterly observation is calculated using the available observations.

### *Real exchange rate in terms of relative wages*

We use the real exchange rate in terms of relative wages calculated in common currency as a measure of competitiveness. This time series is published as a percentage deviation from the mean in Norges Bank's *Monetary Policy Report*. Reduced competitiveness, either through higher relative wage growth or an appreciation of the currency, can have adverse effects on enterprises. The exchange rate in terms of relative wages also enters significantly in the estimated relationships for banks' problem loans to enterprises and bankruptcies in the stress test models at Norges Bank. As this variable is non-stationary in the sample, we subtract a trend from the indicator using a Hodrick-Prescott filter. As the exchange rate can be very volatile in the short-run, and a change in the exchange rate should last for some time to affect enterprises, we use the four-quarter moving average of the deviation from trend. The indicator captures the variation of both the exchange rate and more long-run, structural factors, considering that we use relative wages in the calculation.

### *Real oil price gap*

Oil prices constitute an important cyclical variable for the Norwegian economy. Activity in the petroleum sector provides a strong impetus to the rest of the economy. Norway's terms of trade also depend on oil prices. A substantial portion of the petroleum revenues is invested abroad through the Government Pension Fund Global. A certain percentage of the real return on the Fund may be spent via the annual national budget. As the oil price has been steadily increasing, we subtract a trend from this variable using a regression on a trend line. The sub-indicator is inversed.

### *Sovereign net external assets as a percentage of GDP*

This indicator is included to take account of government finances in Norway. For any given shock to the economy, the room for expansionary fiscal policy and other government measures depends on government finances. The sub-indicator is inversed.

### *Forecast for GDP growth mainland Norway, average for next four quarters*

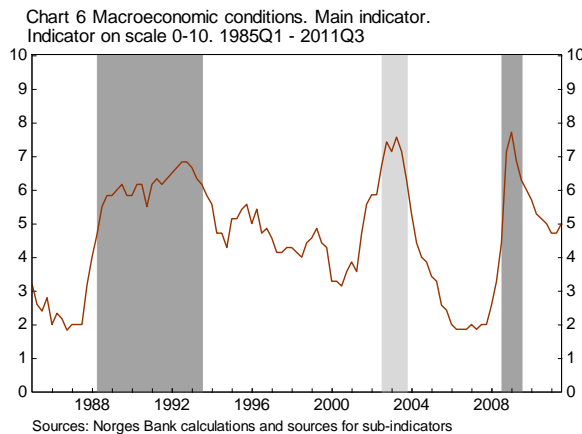
This indicator covers Norges Bank's view on future growth prospects for the mainland economy. It is calculated as the average of projected mainland GDP growth over the next four quarters. The sub-indicator is inversed.

### *OECD composite leading indicator (CLI), total OECD*

Like the IMF and the Reserve Bank of New Zealand, we include a leading sub-indicator that potentially can help us capture turning points. The OECD CLI includes a wide range of short-term indicators, such as commodity prices, labour market data, business and consumer tendency surveys, etc. As the time series has fat tails, we use the alternative method of equally wide intervals when assigning values to this sub-indicator (see Section 2.2). The sub-indicator is inversed.

### 3.4.2 Performance of the indicators

The macroeconomic conditions indicator increases ahead of all the three periods of stress in our sample (see Chart 6). The main indicator values also tend to increase even further during the periods of stress. Before the 1988-1993 banking crisis in Norway oil prices remained high and the conditions for our trading partners remained favourable. These developments limited the increase in the main indicator value prior to the Norwegian banking crisis. However, the indicator gave a clear signal in the period of financial distress in 2002-2003 and during the financial crisis of 2008-2009. During these periods, sub-indicators of both domestic and external factors increase.



## 3.5 Money and credit markets

### 3.5.1 Sub-indicators

The money and credit markets dimension seeks to quantify the conditions of the relevant funding markets for Norwegian banks. We define money and credit market conditions as market liquidity, price levels and access to funding for issuers in the market.

Norwegian banks are dependent on both short- and long-term wholesale funding. Lower equity and deposit-to-loan ratios have contributed to increased market funding, and over the last five years total market funding of Norwegian banks has doubled in absolute terms. The largest banks rely more on market funding than smaller banks. Furthermore, larger banks have a considerable share of their market funding issued in foreign currency. The dependence on foreign funding markets makes the Norwegian banking sector vulnerable to developments in these markets.

Three out of the four indicators in this dimension are based on foreign markets. This is both due to a lack of consistent data from the Norwegian funding markets and to the fact that foreign funding markets are important for the larger banks and hence for the Norwegian banking sector as a whole. In addition, the market conditions in domestic markets are strongly correlated with international funding markets.

### *The Merrill Lynch option volatility index - MOVE.*

This indicator reflects uncertainty among investors in the bond market. A high degree of uncertainty will contribute to higher costs and poorer conditions for issuers. The Move index is a yield curve weighted index of the normalised implied volatility on one-month US Treasury options, and is hence a measure of the expected volatility one month ahead. The options are written on futures contracts and the implied volatilities are the weighted average of the 2-, 5-, 10-, and 30-year contracts.

### *Bond spreads less the CDS premium*

This indicator is a measure of the market liquidity of bonds issued by European financial institutions. The indicator is derived from the difference between the spread on bonds issued by European financial institutions and the CDS premium on a selection of European financial institutions. The difference between the total spread and the CDS premium expresses the residual compensation investors demand for other types of risk than credit risk. A large part of this residual will consist of compensation for market liquidity. The bond spread is represented by the iBoxx all financials 3-5 years index, while the CDS premium is the iTraxx Financials index. Although the constituents of the two indices do not match completely, we believe the residual to a large extent will reflect the liquidity conditions in the market for bonds issued by financial institutions.

### *Spread on bonds issued by European banks*

To capture the bond issuance costs of banks we use the spread on 5-year European bank bonds represented by the option adjusted spread of the Merrill Lynch Euro Zone broad market AA Rated financial Corporate Index. The spread index is based on spreads in the secondary market and not on issuance in the primary market. Historically high spreads in the secondary market are associated with periods when banks perceive market conditions to be unfavourable and bond issuance costly.

### *3-month NIBOR minus expected policy rate*

The spread that banks demand for short-term funding in the Norwegian interbank market is expressed by the difference between the 3-month Norwegian Interbank Offer Rate (NIBOR) and an estimate of the expected policy rate over the same period. As seen during the financial crisis, high spread levels in the money market indicate that banks are uncertain about their own and other banks' future need for liquidity. Since there is no market for overnight-indexed swaps in Norway, we estimate the expected policy rate from the Forward-Rate-Agreement (FRA).

## **3.5.2 Methodology and calculation**

The money and credit markets dimension applies the alternative method for calculating the sub-indicators, (see Section 2.2). The method is based on a methodology with intervals of fixed width.

We start by calculating the standard deviation of the historical data. We then construct the mid-interval (which corresponds to a score of 5) of width  $\pm 0.5$  standard deviations. The remaining data are distributed into 10 intervals of fixed and equal width, corresponding to indicator scores from 0 to 4 and

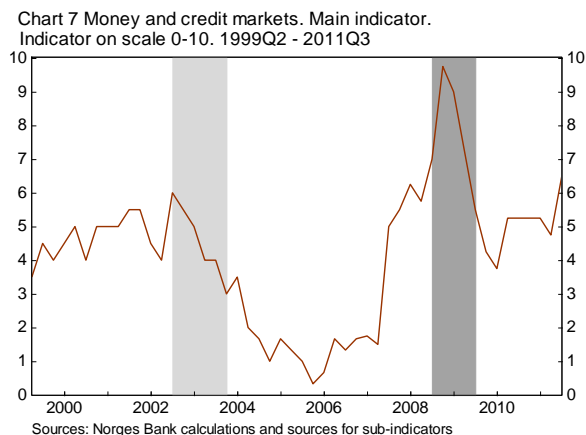
6 to 10. The size of the fixed intervals would then be the total width of the data set less one standard deviation.

Defining a mid-interval of  $\pm 0.5$  standard deviations implies imposing a wider interval for the indicator value of 5 than would be the case with a set of strict equally sized fixed intervals. This is motivated by the preference for a less volatile dimension and an interpretation of the score of 5 as representing “normal” money and credit market conditions. The method implies a non-uniform distribution of the indicator values, but follow the dynamics of the underlying market data, with the exception of more frequent observations of 5.

Each of the four indicators is calculated using the same method, and the value of the dimension is calculated as the average value of the four indicators.

### 3.5.3 Performance of the indicators

Due to a lack of data, we consider the period from 1999 to 2011. During this period the main indicator tracks the development in the money and credit market quite well (see Chart 7). After the bailout of the hedge fund Long-Term Capital Management (LTCM) in September 1998, money and credit market conditions eased somewhat, followed by shorter periods of market stress from 2000 to 2002, caused by the WTC 9/11 attacks, Enron collapse and accounting scandals in the US. The indicator has a value of 5 most of the time before 2002 and reaches values of 6 in the following quarters of observed market stress in 2002. Relative to the conditions of the recent financial crisis a level of 6 seems appropriate.



From 2003 to 2006, funding markets were characterised by low yields and investors’ “search for yield”, resulting in very favourable conditions for market-based funding. This is also reflected in the indicator, which has very low values.

From spring 2007, money and credit market conditions worsened gradually with severe stress around the rescue of Bear Sterns in March 2008 and the bankruptcy of Lehman Brothers in September 2008. The indicator increases to its maximum value in 2008 Q4. Along with the improvement of money and credit markets condition during 2009 it gradually decreases to a value of 5 in 2009 Q2.

### 3.5.4 Further work

#### *Indicators of domestic funding markets*

There is a lack of consistent indicators based on data from the Norwegian funding markets. We believe that the spread indicator based on European bank bonds is strongly correlated with domestic spreads, and hence serves as a proxy for price movements in the Norwegian market. However, the Norwegian bond market is small and more vulnerable to changes in market liquidity.

We are currently working on liquidity indicators for the domestic bond market at the Oslo Stock Exchange. Liquidity indicators, such as bid-ask spreads or price impact indicators, would be a valuable tool for assessing domestic money and credit market conditions.

The money and credit markets dimension is primarily based on price data. Data on the volumes of bond issuance is challenging to incorporate in the indicator due to systemic and seasonal trends. Moreover, structural changes make it difficult to interpret the data. However, information on access to the bond market can be obtained from the liquidity survey which Norges Bank has carried out since 2007. The survey, which covers the six largest Norwegian banks, contains both a qualitative and a quantitative part. In the qualitative part, banks are asked to assess changes in funding conditions for different maturities. Funding conditions comprise both market access and price movements.

We consider the implementation of a sub-indicator based on the qualitative part of the liquidity survey. The values of such an indicator will not be a mechanical result of the survey, but will to a large extent be set discretionally. Judgment of the survey results and of other available information will be essential in deciding on the sub-indicator's value.

## 3.6 Households

### 3.6.1 Sub-indicators

The household dimension gives an assessment of the risks to financial stability that stem from imbalances in the household sector. These imbalances may at some point lead to abrupt changes in household behavior that might impact banks negatively and undermine financial stability.

Household debt servicing affects banks' income directly. Changes in household consumption can have a negative effect on corporate profits and debt servicing capacity, thus affecting banks' income indirectly. Households are also investors and affect corporate investment opportunities and banks' funding. The risk to banks' funding from changes in household investor behavior is limited and is not discussed here. The indicators we include in the dimension reflect the build-up of imbalances in the household sector and households' ability to service their debt and to maintain their level of consumption in future.

The following four sub-indicators are included in the dimension: household debt burden, ratio of house prices to disposable income, household saving ratio and the share of households with a net debt burden above 500 per cent.

### *Household debt burden*

A high household debt burden means that households are vulnerable to sudden drops in income, increases in interest rates or changes in expectations of future income, house prices and interest rates. The higher the debt burden, the stronger households react to unexpected shocks by adjusting consumption and investment. It is difficult to assess when household indebtedness is too high. In spite of numerous theoretical and empirical studies no consensus has been reached so far on either methods or levels.

The household debt burden is defined as household loan debt as a percentage of disposable income. The debt burden is regressed on a trend component and the residuals are used in the sub-indicator. The measure is similar to what a Hodrick-Prescott filter with a sufficiently high lambda would produce. Comparing to a trend means that the debt burden can increase over time without necessarily implying the build-up of imbalances. This is consistent with falling prices on necessities (food, clothing etc) and a lower interest rate level over the last decade. However, such an assumption will not hold over an indefinite or a long period of time.

### *Ratio of house prices to disposable income*

Dwellings are the largest wealth component for Norwegian households and unexpected changes in the value of dwellings will affect household consumption and investment. Residential mortgages make up the bulk of household debt. A change in house prices will therefore spill over to both banks' credit risk and households' ability to borrow using dwellings as a collateral.

We have opted for an approach that compares house prices to household disposable income. As Norway has experienced a substantial terms-of-trade effect over the last decade, feeding into household disposable income, the latter has been chosen as a deflator rather than the CPI, building costs or house rents.

The sub-indicator is based on the deviation of the house-price-to-disposable-income ratio from its historical mean over the sample period. A positive deviation signals the build-up of imbalances in the housing market.

### *Household saving ratio*

A negative saving ratio is not sustainable over time. Abrupt increases in the saving ratio will lower consumption and weaken corporate profitability, thereby increasing credit risk on banks' lending to firms.

The sub-indicator is calculated using an average of quarterly data from the national accounts and Norges Bank's calculations<sup>14</sup> of the saving ratio based on financial accounts.<sup>15</sup> An 8-quarter moving average is

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<sup>14</sup> Norges Bank's calculations of the saving ratio based on the financial accounts are not public

<sup>15</sup> As deviation between the two series has increased over time, and as it is difficult to assess which measure is the more accurate one, we have decided on the average of the two series



used to construct the sub-indicator. We assume that a sub-indicator between 2 and 2.5 per cent represents a normal level and assign a score of 5 to observations in this range. A low saving ratio implies unsustainably low savings and a build-up of imbalances. Thus, a low saving ratio implies a high sub-indicator score. The standard method is applied to observations below 2 per cent and above 2.5 per cent. This means that observations below 2 per cent are ranked into 5 percentiles and get a score between 6 and 10. Observations above 2.5 per cent are ranked into 5 percentiles and get a score between 0 and 4.

### *Share of households with a net debt burden above 500 per cent*

Households with a high debt burden are more vulnerable to unexpected changes in economic conditions than households with a lower debt burden. A high share of households with a high debt burden might also signal lax lending standards in the banking sector, which might threaten financial stability.

A gross debt burden of about 500 per cent is equivalent to the requirement from Finanstilsynet (Financial Supervisory Authority of Norway) to a maximum debt-to-income ratio on mortgage loans of 300 per cent.<sup>16</sup> Net debt is defined as gross debt less bank deposits. The indicator is based on microdata from the household income and tax statements in Norway.

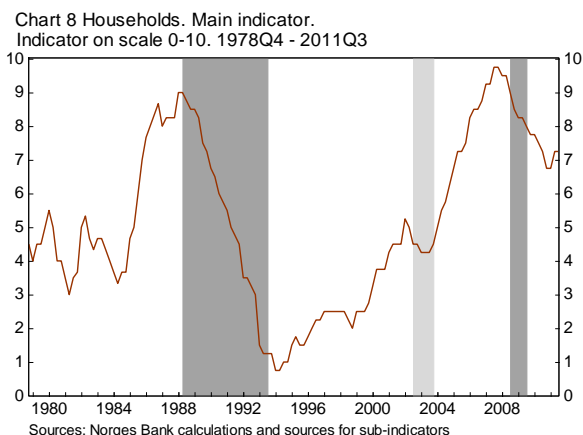
The ratio of households with net debt burden above 500 per cent is the only annual data series in the dimension, with observations over the period of 1987 - 2009. We construct a quarterly series by assigning the observed annual value to all the quarters in the respective year. We use the end observation for any consecutive quarters that we do not have data for. Unfortunately, data from the household income and tax statements are provided with a considerable time lag of up to two years, reducing the timeliness of the sub-indicator. However, as changes in the sub-indicator tend to be slow and gradual, the information still has a bearing on the assessment of household risks to the banking sector.

#### **3.6.2 Performance of the indicators**

The main indicator performs well in signaling the 1988-1993 banking crisis and the 2008-2009 financial crisis (see Chart 8). The main indicator value increases to very high levels prior to these two crises. However, the indicator does not seem to give signals prior to the period of financial vulnerability in 2002 – 2003 as it rises to considerably lower levels. Generally, the signals from the main indicator are broadly produced by all sub-indicators increasing sharply prior to the distress periods.

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<sup>16</sup> Finanstilsynet issued new guidelines for prudent residential mortgage lending in March 2010. According to the guidelines, if a bank applies the debt-to-income ratio as a loan approval criterion, the mortgage loan should normally not exceed three times the household's total gross income



## 3.7 Enterprises

### 3.7.1 Sub-indicators

Norwegian banks' and mortgage companies' lending to the corporate sector accounts for over 40 percent of their total lending. The largest corporate loan exposures are to the commercial property and shipping industries. Developments in these industries are therefore of great importance to banks. Based on the distribution of Norwegian banks' lending to the corporate sector we have chosen four indicators for the corporate sector in general, one for shipping and one for commercial property.

Norwegian companies provide annual financial statements. However, aggregated data based on annual financial statements are not available until nine months after year-end. In order to provide more frequently updated indicators, we use quarterly reports published by companies listed on the Oslo Børs to calculate some of the indicators. Historically the developments of listed companies and limited liability companies have been highly correlated. The Norwegian oil company Statoil is excluded from the sample. Statoil accounts for about one third of all listed companies' total assets, and it would therefore have an excessive bearing when calculating the indicators. Moreover, Statoil's profit is heavily correlated with developments in oil price.

#### *Debt servicing capacity of listed enterprises*

A higher debt servicing capacity lowers the risk of bank losses. We have defined debt-servicing capacity as operating profit before tax, depreciation and impairment losses over the previous four quarters as a percentage of interest-bearing debt. The ratio is based on quarterly reports published by non-financial enterprises that are constituents of the OBX index. This index consists of the 25 most traded securities on Oslo Børs. A higher debt servicing capacity lowers the indicator value.

### *Equity ratio of listed enterprises*

The level of the equity ratio determines how robust companies are to a period of increased costs and/or and reduced income. An increase in the equity ratio also reduces banks' loan losses in the case of default. Finally, the equity capital acts as a buffer in periods when access to funding is difficult, as enterprises can draw on their equity capital instead of raising loans. The equity ratio is calculated as total equity as a percentage of total assets. An increased equity ratio lowers the indicator value.

### *Output index*

In order to obtain early signals about developments in the Norwegian economy, Norges Bank has established a regional network of around 1500 enterprises and other organisations across the country. The information from the survey is obtained before other official statistics are available. The contacts are interviewed about their view of production volumes over the past three months relative to the previous three-month period. An increase in production volumes indicates a higher potential for earnings and thus lowers the indicator value.

### *Investment gap*

A high degree of optimism during an upturn can drive up asset prices and investments and, in turn, increase credit growth. This can contribute to the build-up of financial imbalances. Optimism will diminish when the economy is exposed to disturbances. As asset prices and investments fall, debt-servicing problems arise and bank losses increase. A negative investment gap could also constitute risk, as lower investments may indicate weaker prospects for enterprises.

Riiser (2005, 2008 and 2010) shows that an investment gap can be useful in predicting financial instability in Norway. The investment gap is calculated as the absolute value of the percentage deviation from trend for mainland gross fixed investment measured as a percentage of mainland GDP. The trend is calculated using a Hodrick-Prescott filter with Lambda equal to 400 000 and a recursive method. An increase in the absolute value of the investment gap leads to an increased indicator value.

### *Real market prices for office premises in Oslo*

The commercial property industry is the single largest recipient of bank loans in the business sector. Banks' loans to property companies are often secured against property belonging to the company. As the property company's earnings and the value of its property are closely related, changes in banks' expected losses can be substantial and increase rapidly. Developments in the property industry therefore have a considerable impact on the risk in banks' loan portfolios.

Rent income is the main income of property companies. In theory, market prices could be viewed as the present value of all future rent income. Market prices may therefore capture expectations on movements in rents ahead. Market prices will also affect profitability directly through sales proceeds, revaluations and impairment losses.

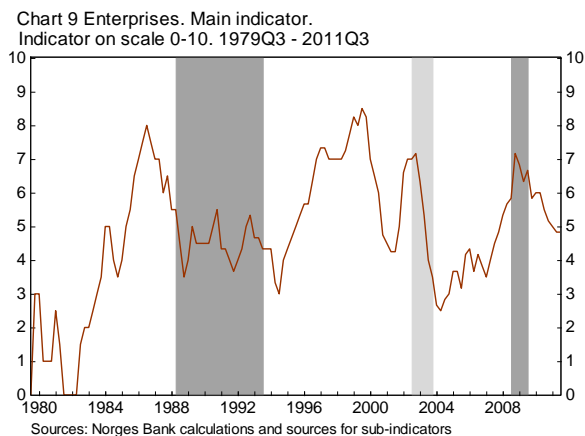
The indicator is based on an index for market prices for office premises in Oslo, as this segment constitutes Norwegian banks' largest commercial property exposure. The index is deflated by CPI. An increase in the level of real market prices leads to an increased indicator value.

### *Real shipping freight rates*

Shipping accounts for a large share of Norwegian banks' corporate lending. Developments in freight rates are important for shipping companies' earnings, and hence their debt servicing capacity. Shipping comprises a number of different segments. The indicator is based on the Clarksea index, which is a weighted average for earnings in the tanker, bulk, container and gas segments. These are some of the main segments Norwegian banks are exposed to. The index is deflated using the US CPI, and each observation is calculated as a 12-month moving average. An increase in real freight rates leads to a lower indicator value.

### **3.7.2 Performance of the indicators**

The main indicator increases before all the three periods of financial stress in our sample period (see Chart 9). From 1981 to 1990, the main indicator consists of only two sub-indicators, including market prices for office premises. A downturn in the commercial property market was one of the reasons behind Norwegian banks' losses during the 1988–1993 banking crisis. The sub-indicator for the market price of office premises reaches the maximum level of 10 in 1985. It remains at high levels almost until the start of the banking crisis in 1988, and then gradually starts decreasing.



All of the sub-indicators are included from 2002 onwards. The main indicator signals the 2002-2003 period of financial vulnerability. Several sub-indicators are at high levels at this point but decrease gradually in the following quarters. The exception is the equity ratio, which is at a level of 8–10 throughout the distress period.

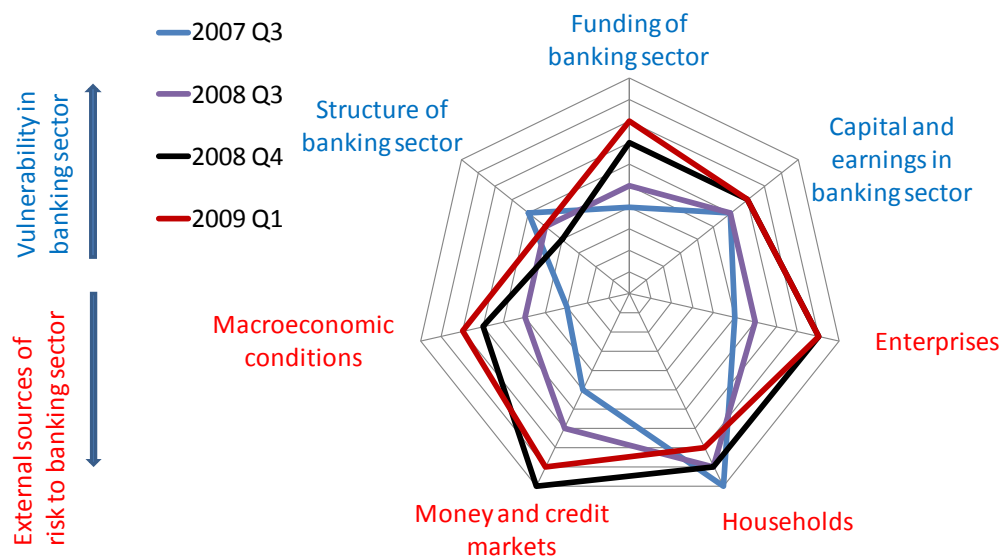
The signals from the main indicator prior to the financial crisis in 2008–2009 differ somewhat from earlier distress periods. Driven by the investment gap, the output index and the market price for office premises, the indicator starts increasing a year and a half before the crisis but the values are not that elevated. However, the largest increase takes place during the crisis period when the indicator climbs

steeply in the course of two quarters. Several sub-indicators such as enterprises' debt servicing capacity and equity ratio lead to the rise but shipping freight rates are by far the largest contributor. Hence, some of the sub-indicators seem to reflect current risk, while others appear to reflect vulnerabilities ahead of the crisis.

#### 4. Performance of the cobweb model

Most of the indicators signal the periods of financial distress. The indicators increase prior to the periods of distress and fall as financial distress subsides. The indicators usually reach a top during these periods. However, the household and the enterprise indicators tend to peak prior to the periods of financial distress.<sup>17</sup> Such early warning signals are much appreciated in deciding on the vulnerability of the financial system. At the same time, the fact that different indicators might show movement in different directions in the cobweb diagram between two periods, i.e. away from or towards the centre, might pose a challenge in giving an overall assessment of financial stability.

Chart 10 The cobweb model of financial stability in Norway during the financial crisis. 2007 Q3 – 2009 Q1



Source: Norges Bank

Chart 10 shows the results of the cobweb model during the 2008-2009 financial crisis.<sup>18</sup> The crisis affected Norway from 2008 Q3 until 2009 Q3. In the chart, the pre-crisis period of 2007 Q3 is also

<sup>17</sup> An exception to that observation is the enterprise indicator during the financial crisis in 2008-2009 as it reaches a peak during the distress period

<sup>18</sup> The indicators for the different periods are calculated using the total sample until 2011 Q3. A calculation based on the sample up to the relevant period was also performed, for example a calculation for 2007 Q3 uses data only

included to enable comparisons. A score about 5 reflects the average value based on the history of the indicator. Prior to the crisis, i.e. 2007 Q3, the vulnerability in the banking sector was over the average due to the dimensions for banks' capital and earnings and for the structure<sup>19</sup> of the banking sector. It can also be discussed whether the calibration of the indicator for banks' funding is satisfactory. Risks in the household sector were very high and the indicator was at its top level. As the crisis escalated, conditions in money and credit markets worsened. The money and credit market indicator increased from the average value of 5 prior to the crisis to its maximum value of 10 in 2008 Q4. Liquidity in Norwegian banks became considerably strained.<sup>20</sup> Macroeconomic conditions worsened, entailing a rapid increase in risks from enterprises. Banks' profits deteriorated and the difference between banks' Tier 1 capital ratio and the "practiced minimum requirement" narrowed, implying lower capital buffers in banks. As a result, vulnerability due to banks' profit and capital also rose.

Generally, the model provides a good representation of the crisis-related effects on Norwegian banking sector. Vulnerabilities and risks to the banking sector rise from around moderate to high or extreme levels. *Financial Stability* report 2/07 communicated four main risks to financial stability, i.e. the risk of an international recession, the risk of higher funding costs for banks due to turmoil in financial markets, the risk of an abrupt rise in the saving ratio for Norwegian households as a result of high debt and the risk of substantial optimism in the commercial property market. The model depicts the escalation of these risks in the following periods in a satisfactory manner. However, it might be questioned whether the initial levels of the risks in the cobweb diagram represent the same perception of risk that was conveyed by the report. *Financial Stability* report 2/07 concluded that "After several years of high earnings, banks are solid and well equipped to deal with a period of weaker results". Compared with the report, the model indicates somewhat higher banking sector vulnerabilities as two of the dimensions, i.e. capital and earnings and structure of the banking sector, exceed the average value of 5.<sup>21</sup> Thus, the cobweb model might help us interpret the information from our analysis in a more systematic way.

An advantage of the model is that it combines both vulnerabilities in the banking sector and risks outside the banking sector. However, vulnerability related to bank funding and risks related to enterprises are either moderate or below the average prior to the crisis. The early warning properties of the model are therefore yet to be tested.

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until 2007 Q3. The model exhibited similar dynamics applying the two different methods, i.e. an increase in vulnerabilities and risks as the crisis unfolds. However, when using a sample up to the relevant period, some of the indicators reached very high scores early in the crisis period. The explanation is that, when using the total sample until 2011 Q3, new extreme observations are added to some of the sub-indicators in the following periods, thus changing the percentile ranking. The changes in the main indicators are therefore more gradual in this case

<sup>19</sup> In 2007 Q4 the large banks in Norway started applying internal credit risk models in accordance with the Basel II minimum capital adequacy requirements. This has a considerable impact on the indicator for the structure of the banking sector. The indicator score is therefore rather low in 2007 Q4 compared with earlier periods. The introduction of Basel II influences the indicator in the following periods as well

<sup>20</sup> As the series for the sub-indicators in the funding dimension are short, only 3 out of 5 sub-indicators are included in the main indicator during the financial crisis

<sup>21</sup> However, developments in the structure dimension during that period should be interpreted with caution as banks' adjustment to Basel II has a considerable impact on the indicator

## 5. Conclusions

The cobweb model is a technical tool that incorporates both vulnerabilities in the banking sector and external risks to the banking sector. Thus, the model helps us analyse financial stability in a more systematic manner. As the model assigns scores to vulnerabilities and risks based on historical evidence, it improves our perception of the state of the financial system. Coupled with a graphical presentation along several dimensions, the model is expected to enhance communication of our assessment of financial stability.

The cobweb model performs reasonably well during periods of financial distress. Some of the indicators seem to signal the build-up of financial imbalances, while others are of a more contemporaneous nature. Judgment was used to decide on the final positioning of some of the indicators. As each crisis is different, no model can encompass all the relevant factors. In such cases, the indicators should be evaluated with the goal of improving them. If further development of the cobweb model is neither feasible nor appropriate, a subjective adjustment is undertaken based on other available information. Overruling the raw outcome of the model is documented in the *Financial Stability* report.

The model is regularly updated and developed, so that it better captures vulnerabilities and risks to the banking sector. As we gain experience with the model's performance, changes in the indicators might be considered. Banks' funding and money and credit markets are two of the dimensions where data series are rather short and where we are considering introducing additional indicators. Furthermore, the indicators of banking sector vulnerabilities will have to be adapted to the introduction of Basel III capital and liquidity requirements.

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## **Appendices**

### **A List of indicators in the cobweb model of financial stability in Norway**

| Indicators   | Definition  | Source   | Start date                                   | Method  |
|--|---|--|--|---|
| Capital and earnings in the banking sector                                       |   |  |  |   |
| Net interest income as a percentage of average total assets                      | Net interest income as a percentage of average total assets. Based on net interest income and total assets up to the present quarter in the current year. The data series includes all banks excluding branches of foreign banks in Norway. Inversed  | Norges Bank (the ORBOF database)   | 1987 Q4                                      | All intervals have been set based on discretion. The width of the intervals is larger for higher ratios and becomes lower for lower ratios. The intervals resulting in the different indicator values are: <3.00, ∞>; 0, [2.51, 3.00]; 1, [2.01, 2.50]; 2, [1.81, 2.00]; 3, [1.61, 1.80]; 4, [1.41, 1.60]; 5, [1.21, 1.40]; 6, [1.11, 1.20]; 7, [1.01, 1.10]; 8, [0.91, 1.00]; 9 and <-∞, 0.90]; 10 |
| Loan losses as a percentage of gross lending to the private and municipal sector | Losses on loans to the private and municipal sector as a percentage of gross lending to this sector. Annual series. For the current year loan losses up to the present quarter are annualised. The data series includes all banks in Norway.  | Norges Bank (the ORBOF database)   | 1987   | Standard method   |
| Pre-tax profit as a percentage of average total assets                           | Pre-tax profit as a percentage of average total assets. Based on pre-tax profit and total assets up to the present quarter in the current year. The data series includes all banks excluding branches of foreign banks in Norway. Inversed  | Norges Bank (the ORBOF database)   | 1987 Q4                                      | Standard method   |
| Difference between Tier 1 capital ratio and the "practiced minimum requirement"  | The weighted average Tier 1 capital ratio for all banks excluding branches of foreign banks in Norway minus the "practiced minimum requirement". The "practiced minimum requirement" is set at 6.0 per cent until 2008 Q4, and 8.5 per cent thereafter. Inversed  | Finanstilsynet (Financial Supervisory Authority of Norway) and Norges Bank | 1991 Q2                                      | Standard method   |
| Equity ratio   | Equity as a percentage of banks' total assets. The data series includes all banks excluding branches of foreign banks in Norway. Inversed   | Norges Bank (the ORBOF database)   | 1987 (yearly data), 1991 Q2 (quarterly data) | Standard method   |
| Funding  |   |  |  |   |
| Liquidity coverage ratio (LCR)   | Basel III definition. Inversed  | Norges Bank (the ORBOF database)   | 2010 Q3                                      | Discretion until Basel III is implemented   |
| Short-term market funding in foreign currency as a percentage of total assets    | Market funding is defined as deposits and other debt from credit institutions (including Norges Bank), bank certificates, (senior) bank bonds, subordinated debt and debt related to the government swap arrangement. Short-term market funding is market funding with a residual maturity of less than one year. Only short-term market funding in foreign currency is used in the indicator.  | Norges Bank (the ORBOF database)   | 2000 Q4                                      | Standard method   |
| Net short-term market funding as a percentage of total assets                    | Short-term market funding less short-term high-quality liquid assets. See above for a definition of market funding. Only deposits in central banks, government and government-guaranteed securities are defined as high-quality liquid assets. Short-term market funding and assets are market funding and assets with a residual maturity of less than one year. Due to roll-over at maturity, holdings of treasury bills received in exchange for covered bonds in the government swap arrangement are assumed not to be short-term high quality liquid assets if the swap agreement matures in more than one year. | Norges Bank (the ORBOF database)   | 2000 Q4                                      | Standard method   |
| Net Stable Funding Ratio (NSFR)  | Basel III definition. Inversed  | Norges Bank (the ORBOF database)   | 2010 Q3                                      | Discretion until Basel III is implemented   |
| Weighted average maturity of long-term market funding in years                   | See above for a definition of market funding. Weighted average maturity of long-term market funding is calculated based on the share of market funding in each maturity interval. Long-term market funding is defined as market funding with a residual maturity of more than one year. The time series is inversed.  | Norges Bank (the ORBOF database)   | 2000 Q4                                      | Alternative method. Mid interval of +/- 1.0 stdev. The remaining intervals are equally sized.   |

| Indicators   |  | Definition  | Source   | Start date  | Method   |
|--|--|---|--|-------------|--|
| Structure of the banking sector  |  |   |  |             |  |
| Market share of the largest bank in terms of total assets                      |  | Total assets of the largest bank in Norway divided by the total assets of all banks in Norway. The series is presented as a percentage. Loans transferred to covered bond mortgage companies are not included in the data series.   | Norges Bank (the ORBOF database)   | 1987 Q1     | The outer boundaries for the indicator values are set based on discretion. A market share over 50 per cent results in an indicator value of 10, while a market share below 10 per cent gives an indicator value of 0. The interval between these outer boundaries is divided into 9 subintervals of equal width, e.g. a market share between 10.00 and 14.44 per cent produce an indicator value of 1. |
| Ratio of lending to the corporate market                                       |  | Lending to the corporate market from the second, third, fourth and fifth largest bank in this market divided by lending to the corporate market from the largest bank. All banks in Norway are eligible to be included in the series. The series is presented as a percentage. Inversed   | Norges Bank (the ORBOF database)   | 1987 Q1     | The outer boundaries for the indicator values are set based on discretion. A ratio below 100 per cent results in an indicator value of 10, while a ratio above 250 per cent gives an indicator value of 0. The interval between these outer boundaries is divided into 9 subintervals of equal width, e.g. a ratio between 233% and 250 per cent produce an indicator value of 1.                      |
| Deviations from the macro bank's loan portfolio                                |  | The loan portfolio of all banks in Norway is divided into seven buckets, e.g. mortgage loans, loans to commercial property and shipping loans. The loan portfolio is expressed as percentage shares. The variance between the exposures of this macro bank and the exposures of each individual bank is calculated. The total lending of each bank is used as its weight in the variance calculation. Inversed  | Norges Bank (the ORBOF database)   | 2009 Q2     | Standard method, but restricted to the interval [4, 6] due to short time series  |
| Deviations from the macro bank's debt funding structure                        |  | The debt funding structure of all banks in Norway excluding branches of foreign banks is divided into seven buckets, e.g. secured deposits, unsecured deposits and bonds in foreign currency. The funding structure is expressed as percentage shares. The variance between the debt funding structure of this macro bank and the debt funding structure of each individual bank is calculated. The total debt funding of each bank is used as its weight in the variance calculation. Inversed | Norges Bank (the ORBOF database)   | 2005 Q1     | Standard method, but restricted to the interval [3, 7] due to short time series  |
| Semi-variance for negative deviations from banks' average Tier 1 capital ratio |  | The variance for banks with a lower Tier 1 capital ratio than the national average is calculated. Hence the term semi-variance. All banks excluding branches of foreign banks in Norway are considered. Each bank's weight in terms of total assets among all eligible banks is used in the semi-variance calculation.  | Finanstilsynet (Financial Supervisory Authority of Norway) and Norges Bank | 1991 Q2     | Standard method  |
| Semi-variance for negative deviations from the future LCR-standard             |  | The variance for banks with a lower LCR-ratio than the future LCR-standard is calculated. Hence the term semi-variance. All banks excluding branches of foreign banks in Norway are considered. Each bank's weight in terms of total assets among all eligible banks is used in the semi-variance calculation.  | Finanstilsynet (Financial Supervisory Authority of Norway) and Norges Bank | Not started | Probably standard method   |

| Indicators   | Definition   | Source   | Start date | Method  |
|--|--|--|------------|---|
| <b>Macroeconomic conditions</b>  |  |  |            |   |
| Output gap for mainland Norway   | Percentage deviation from potential output. Inversed   | Statistics Norway and Norges Bank. Published in Monetary Policy Reports  | 1985 Q1    | Standard method   |
| Output gap for trading partners  | Percentage deviation from potential output. Inversed   | IMF, Thomson Reuters and Norges Bank   | 1994 Q1    | Standard method   |
| Change in registered unemployment rate   | Four-quarter moving average of the quarterly change in the seasonally adjusted unemployment rate   | Statistics Norway  | 1978 Q1    | Standard method   |
| Real exchange rate in terms of relative wages  | Deviation from trend, Hodrick-Prescott filter with lambda=400,000. Four-quarter moving average   | Statistics Norway, Norwegian Technical Calculation Committee for Wage Settlements, Ministry of Finance and Norges Bank | 1977 Q4    | Standard method   |
| Real oil price gap   | Oil prices deflated by GDP deflator. Deviation from regression on trend line. Inversed   | Thomson Reuters, Statistics Norway and Norges Bank Ministry of Finance   | 1986 Q1    | Standard method   |
| Sovereign net external assets as a percentage of GDP                                 | Deviation from regression on trend line. Inversed  | Norges Bank  | 1985 Q1    | Standard method   |
| Forecast for four-quarter GDP growth mainland Norway, average for next four quarters | Rolling sample. Inversed   |  |            | Standard method   |
| OECD composite leading indicator (CLI), total OECD                                   | Inversed   | OECD   | 1977 Q1    | Alternative method of equally large intervals   |
| <b>Money and credit markets</b>  |  |  |            |   |
| The Merrill Lynch option volatility index - MOVE                                     | Yield curve weighted index of normalized implied volatilities derived from one month US Treasury options. Average of daily figures for the last month in the quarter                         | Thomson Reuters  | 04.apr.88  | Alternative method. Mid interval of +/- 0.5 stdev. The remaining intervals are equally sized. |
| Bonds spreads less the CDS-premium   | Benchmarkspread of the iBoxx all financials 3-5 years index minus the iTraxx Financials CDS index. Average of daily figures for the last month in the quarter                                | Thomson Reuters and Norges Bank  | 21.jun.04  | Alternative method. Mid interval of +/- 0.5 stdev. The remaining intervals are equally sized. |
| Spreads on bonds issued by European banks  | Option adjusted spread of the Merrill Lynch 5-year Euro Zone broad market AA Rated financial Corporate Index. Average of daily figures for the last month in the quarter                     | Thomson Reuters  | 01.jan.91  | Alternative method. Mid interval of +/- 0.5 stdev. The remaining intervals are equally sized. |
| 3-month NIBOR minus expected policy rate   | Spread between the 3-month Norwegian Interbank Offer Rate (NIBOR) and estimates of the expected policy rate over the same period. Average of daily figures for the last month in the quarter | Norges Bank  | 01.jan.07  | Alternative method. Mid interval of +/- 0.5 stdev. The remaining intervals are equally sized. |

| Indicators   | Definition   | Source   | Start date         | Method  |
|--|--|--|--------------------|---|
| <b>Households</b>                                      |  |  |                    |   |
| Household debt burden                                  | Debt as a percentage of disposable income adjusted for estimated reinvested share dividend for 2000 – 2005 and redemption/reduction of equity capital since 2006. The debt burden is regressed on a trend component and the residuals are used in the sub-indicator. | Statistics Norway and Norges Bank  | 1978 Q4            | Standard method   |
| Ratio of house prices to disposable income             | Deviation in the ratio of house prices to disposable income from its mean  | Association of Norwegian Real Estate Agents, Association of Real Estate Agency Firms, Finn.no, Econ Pöyry, Statistics Norway and Norges Bank | 1977 Q1            | Standard method   |
| Household saving ratio                                 | The average of the quarterly data for the saving ratio from the national accounts and Norges Bank's calculations of the saving ratio based on the financial accounts. 8-quarter moving average. Inversed   | Statistics Norway and Norges Bank  | 1980 Q1            | Values between 2 and 2.5 per cent are assigned a score of 5. The standard method is used for observations below 2 and above 2.5 per cent. Values below 2 per cent are ranked into 5 percentiles corresponding to the scores of 6-10. Values above 2.5 are ranked into 5 percentiles corresponding to the scores of 0-4. Standard method |
| Share of households with a net debt burden above 500 % | Net debt is defined as gross debt less bank deposits. Net debt burden is net debt as a percentage of income after tax less interest expenditure. Only households with income are included in the data. Self-employed households are excluded from the data.          | Statistics Norway and Norges Bank  | 1987               |   |
| <b>Enterprises</b>                                     |  |  |                    |   |
| Debt servicing capacity of listed enterprises          | Operating profit before write-offs and write-downs over the previous four quarters as a percentage of interest bearing debt. Inversed  | Norges Bank (internally developed data set for the period 1998 Q2–2001 Q2) and Bloomberg (data from 2001 Q3)                                 | 1998 Q2            | Standard method   |
| Equity ratio of listed enterprises                     | Equity as a percentage of total assets. Listed enterprises at the Oslo Stock Exchange excluding Statoil. Inversed  | Statistics Norway (key figures for all listed enterprises) and Bloomberg (key figures for Statoil)   | 2002 Q1            | Standard method   |
| Output index   | Output index from Norges Banks regional network. Inversed  | Norges Bank  | 2002 Q2            | Standard method   |
| Investment gap   | Absolute value of the percentage deviation from trend for mainland gross fixed investment measured as a percentage of mainland GDP (market value). The trend is calculated using a Hodrick-Prescott filter with lambda equal to 400 000 and a recursive method       | Statistics Norway  | 1979 Q3            | Standard method   |
| Real market prices for office premises in Oslo         | Semi-annual data for market prices for office premises in Oslo deflated by CPI   | OPAK and Statistics Norway   | 1st half year 1981 | Standard method   |
| Real shipping freight rates                            | The Clarksea index deflated by US CPI. 12-month moving average. Inversed   | Clarkson Research Service Ltd. and Jan. 1991 Thomson Reuters   | 1991               | Standard method   |

## B Charts of main indicators and sub-indicators<sup>22</sup>

### 1. Capital and earnings in the banking sector

Chart 1 Capital and earnings. Main indicator.  
Indicator on scale 0-10. 1987Q4 - 2011Q3

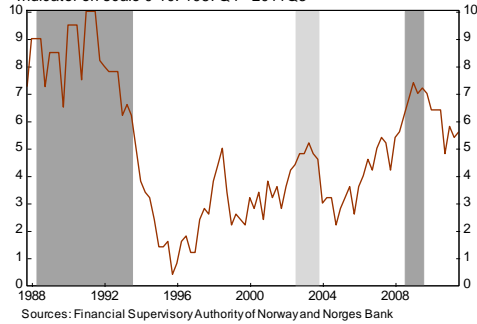


Chart 1.1 Capital and earnings. Net interest income.  
Indicator on scale 0-10. 1987Q4 - 2011Q3

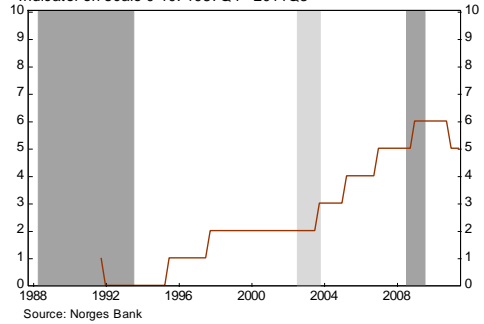


Chart 1.2 Capital and earnings. Loan losses.  
Indicator on scale 0-10. 1987 - 2011

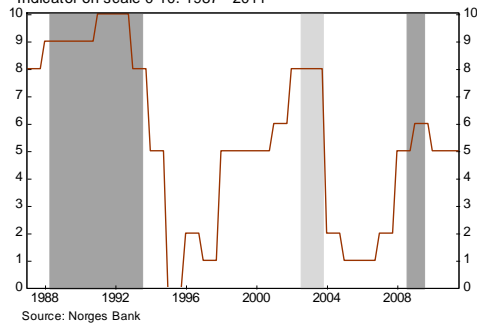


Chart 1.3 Capital and earnings. Pre-tax profit.  
Indicator on scale 0-10. 1987Q4 - 2011Q3

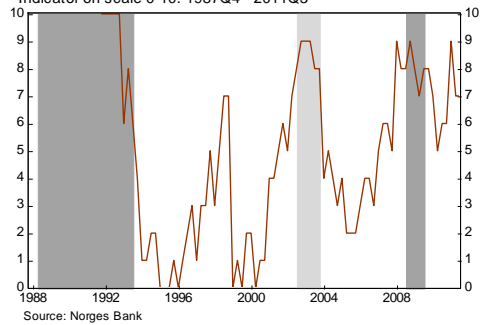


Chart 1.4 Capital and earnings. Tier 1 capital ratio less the practiced minimum requirement.  
Indicator on scale 0-10. 1991Q2 - 2011Q2

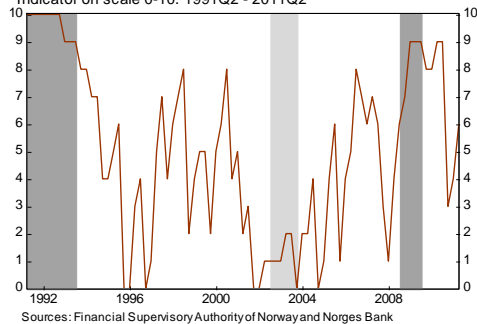
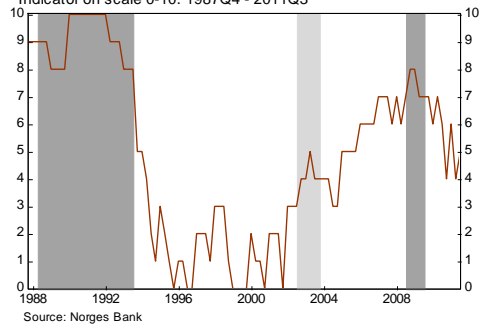


Chart 1.5 Capital and earnings. Equity ratio.  
Indicator on scale 0-10. 1987Q4 - 2011Q3



<sup>22</sup> In the charts the banking crisis in 1988 Q2 – 1993 Q3 and the financial crisis in 2008 Q3 – 2009 Q3 are marked in gray. The period of financial vulnerability in 2002 Q3 – 2003 Q4 is marked in a slightly different shade

## 2. Funding of the banking sector

Chart 2 Funding. Main indicator 1).  
Indicator on scale 0-10. 2000Q4 - 2011Q3

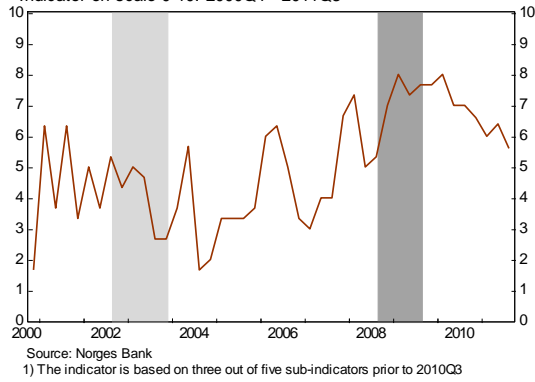


Chart 2.1 Funding. Banks' Liquidity Coverage Ratio (LCR).  
Indicator on scale 0-10. 2010Q3 - 2011Q3

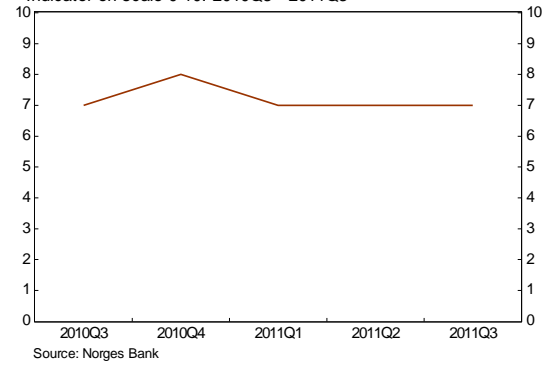


Chart 2.2 Funding. Banks' short-term market funding in foreign currency 1).  
Indicator on scale 0-10. 2000Q4 - 2011Q3

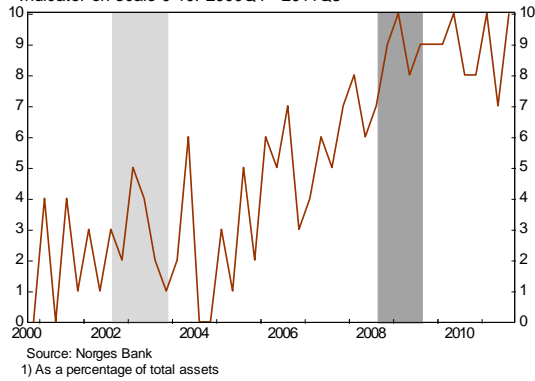


Chart 2.3 Funding. Banks' net short-term market funding 1).  
Indicator on scale 0-10. 2000Q4 - 2011Q3

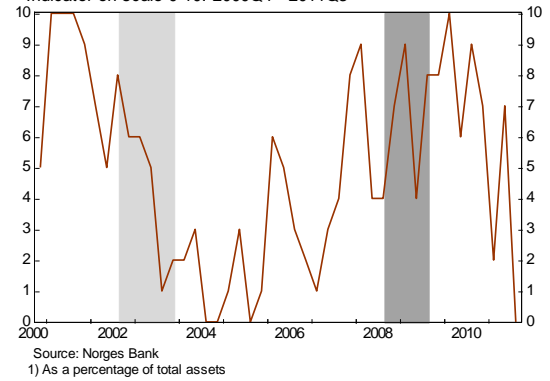


Chart 2.4 Funding. Banks' Net Stable Funding Ratio (NSFR).  
Indicator on scale 0-10. 2010Q3 - 2011Q3

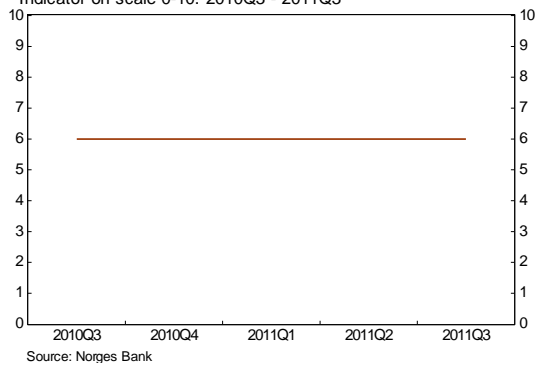
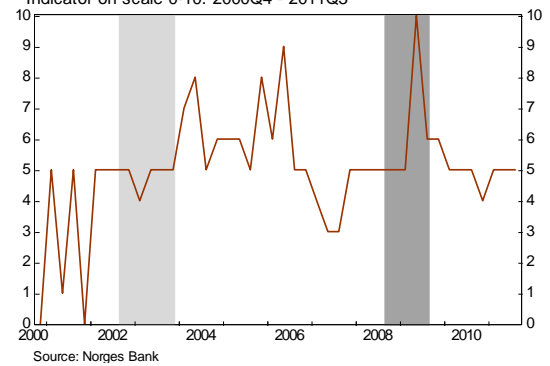


Chart 2.5 Funding. Weighted residual maturity of long-term market funding.  
Indicator on scale 0-10. 2000Q4 - 2011Q3



### 3. Structure of the banking sector

Chart 3 Structure. Main indicator.  
Indicator on scale 0-10. 1991Q2 - 2011Q3

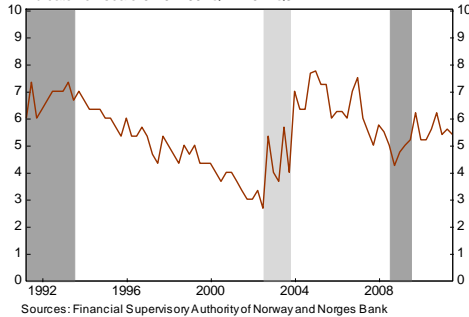


Chart 3.1 Structure. Market share of the largest bank in Norway.  
Indicator on scale 0-10. 1987Q1 - 2011Q3

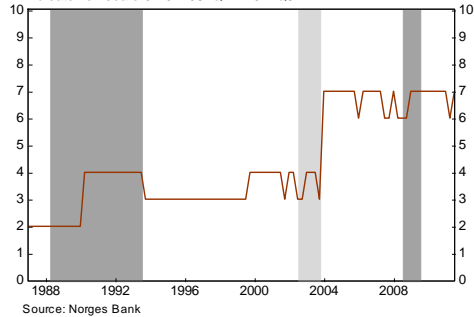


Chart 3.2 Structure. Ratio of lending to the corporate sector.  
Indicator on scale 0-10. 1987Q1 - 2011Q3

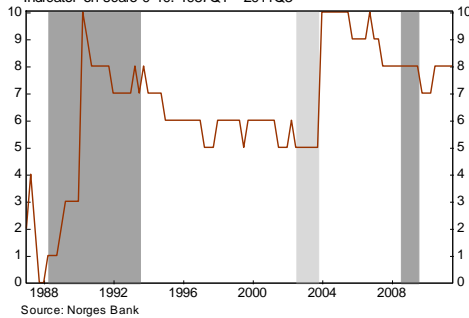


Chart 3.3 Structure. Deviations from the macro bank's loan portfolio.  
Indicator on scale 0-10. 2009Q2 - 2011Q3

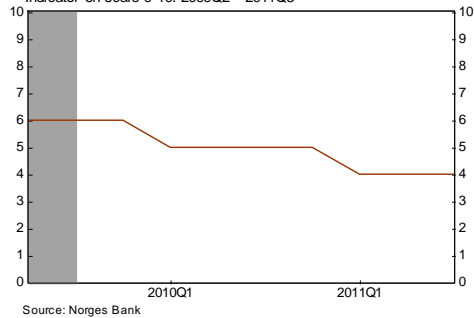


Chart 3.4 Structure. Deviations from the macro bank's debt funding structure.  
Indicator on scale 0-10. 2005Q1 - 2011Q3

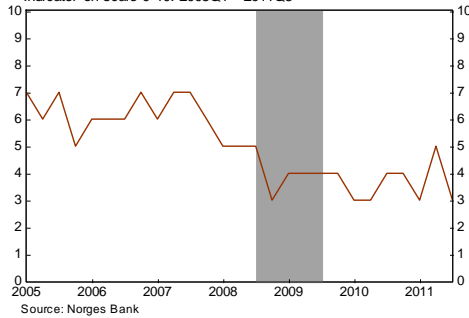
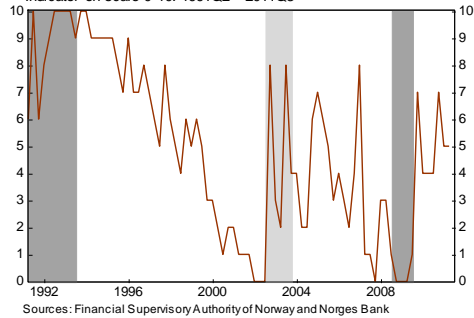


Chart 3.5 Structure. Semivariance for negative deviations from banks' average Tier 1 capital ratio.  
Indicator on scale 0-10. 1991Q2 - 2011Q3





## 4. Macroeconomic conditions

Chart 4 Macroeconomic conditions. Main indicator 1).  
Indicator on scale 0-10. 1985Q1 - 2011Q3

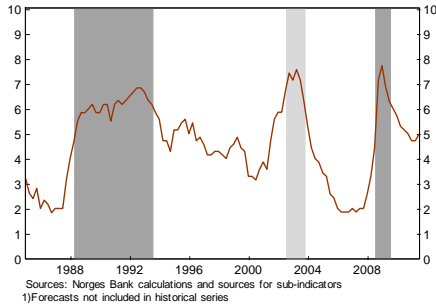


Chart 4.1 Macroeconomic conditions. Output gap mainland Norway.  
Indicator on scale 0-10. 1985Q1 - 2011Q2

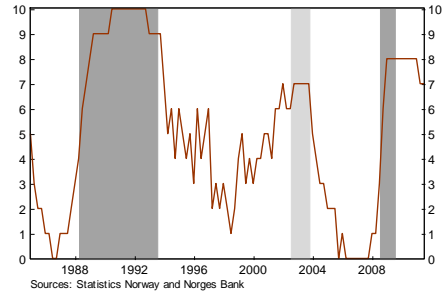


Chart 4.2 Macroeconomic conditions. Output gap trading partners.  
Indicator on scale 0-10. 1994Q1 - 2011Q2

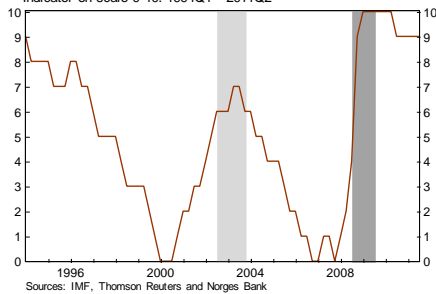


Chart 4.3 Macroeconomic conditions. Change in registered unemployment rate.  
Indicator on scale 0-10. 1978Q1 - 2011Q3

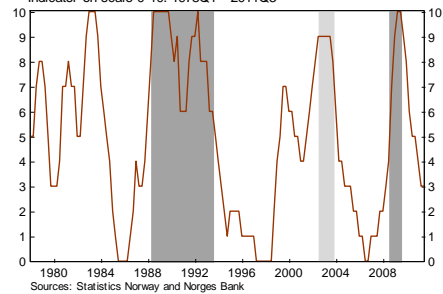


Chart 4.4 Macroeconomic conditions. Real exchange rate in terms of relative wages.  
Indicator on scale 0-10. 1978Q1 - 2011Q3

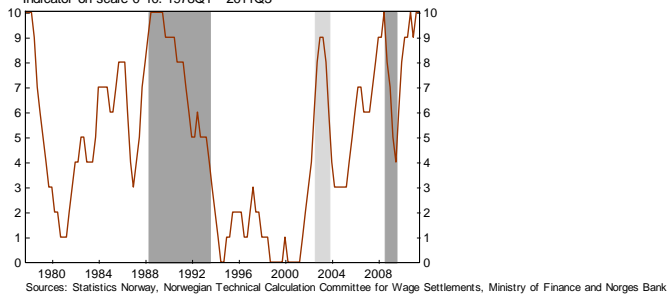


Chart 4.5 Macroeconomic conditions. Real oil price gap.  
Indicator on scale 0-10. 1986Q1 - 2011Q3

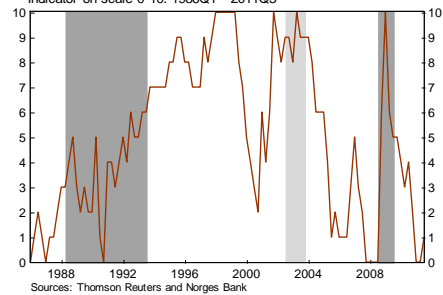
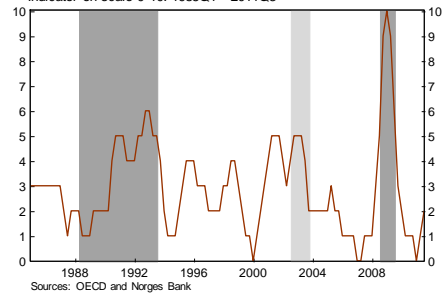


Chart 4.6 Macroeconomic conditions. Sovereign net external assets as a percentage of GDP.  
Indicator on scale 0-10. 1985Q1 - 2011Q3



Chart 4.7 Macroeconomic conditions. OECD composite leading indicator (CLI).  
Indicator on scale 0-10. 1985Q1 - 2011Q3



## 5. Money and credit markets

Chart 5 Money and credit markets. Main indicator.  
Indicator on scale 0-10. 1999Q2 - 2011Q3

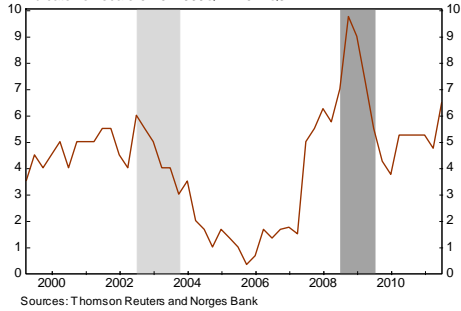


Chart 5.1 Money and credit markets. The Merrill-Lynch option volatility index - MOVE.  
Indicator on scale 0-10. 1998Q1 - 2011Q3

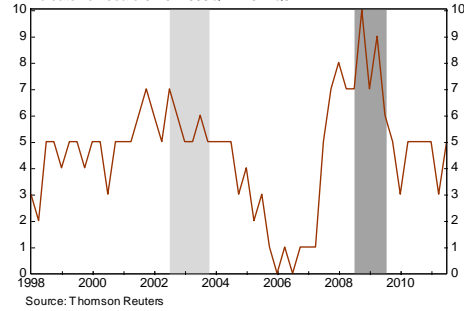


Chart 5.2 Money and credit markets. Liquidity premium. Bond spreads less the CDS premium.  
Indicator on scale 0-10. 2004Q2 - 2011Q3

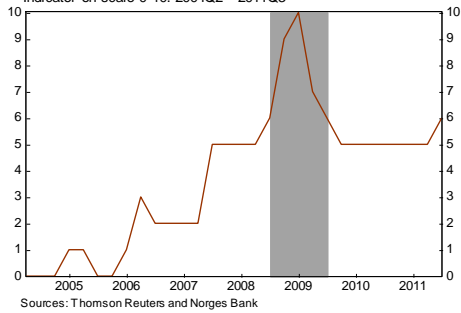


Chart 5.3 Money and credit markets. Spreads on bonds issued by European banks.  
Indicator on scale 0-10. 1999Q2 - 2011Q3

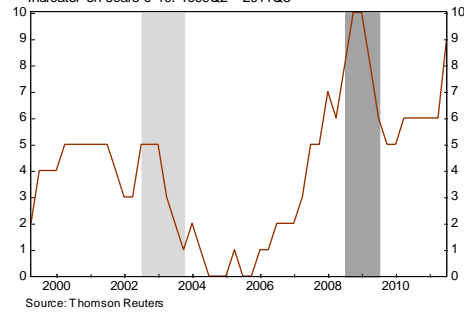
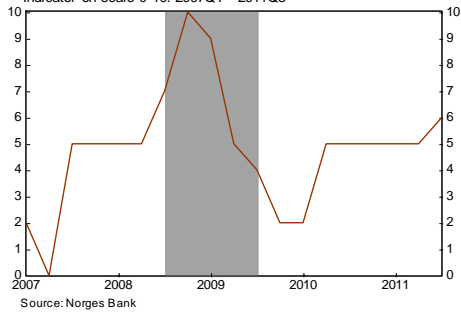


Chart 5.4 Money and credit markets. 3 month NIBOR minus expected policy rate.  
Indicator on scale 0-10. 2007Q1 - 2011Q3



## 6. Households

Chart 6 Households. Main indicator.  
Indicator on scale 0-10. 1978Q4 - 2011Q3

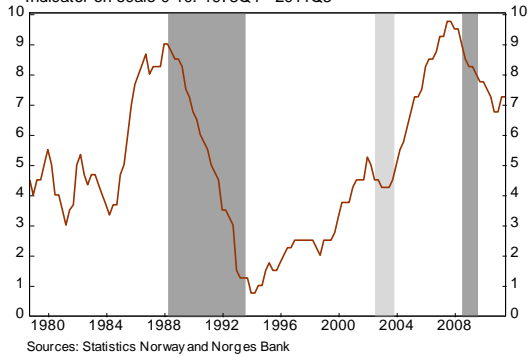


Chart 6.1 Households. Debt burden.  
Indicator on scale 0-10. 1978Q4 - 2011Q3

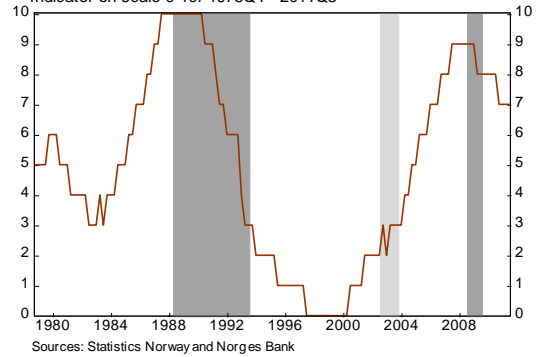


Chart 6.2 Households. Ratio of house prices to disposable income.  
Indicator on scale 0-10. 1978Q4 - 2011Q3

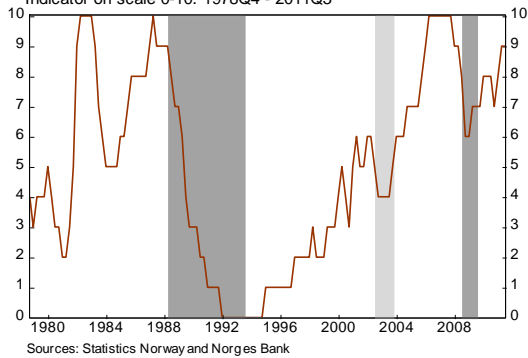


Chart 6.3 Households. Saving ratio.  
Indicator on scale 0-10. 1981Q1 - 2011Q3

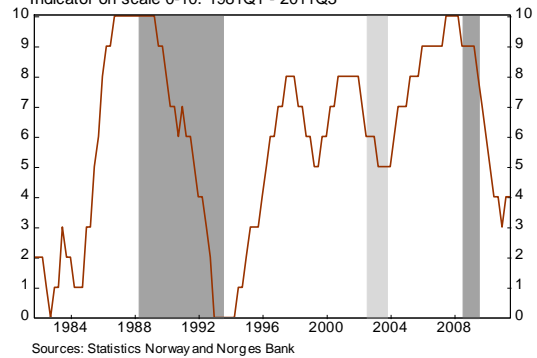
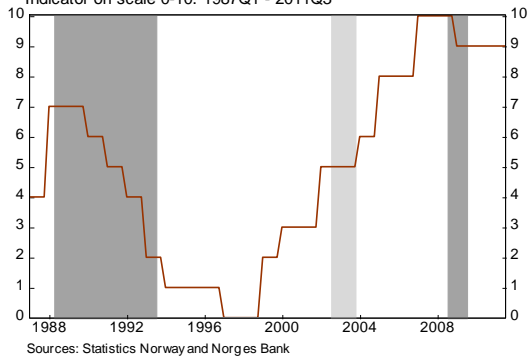


Chart 6.4 Households. Share of households with a net debt burden above 500 per cent.  
Indicator on scale 0-10. 1987Q1 - 2011Q3



## 7. Enterprises

Chart 7 Enterprises. Main indicator.  
Indicator on scale 0-10. 1979Q3 - 2011Q3

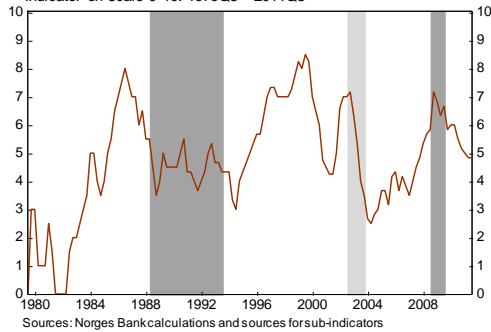


Chart 7.1 Enterprises. Debt-servicing capacity of listed enterprises.  
Indicator on scale 0-10. 1998Q2 - 2011Q2

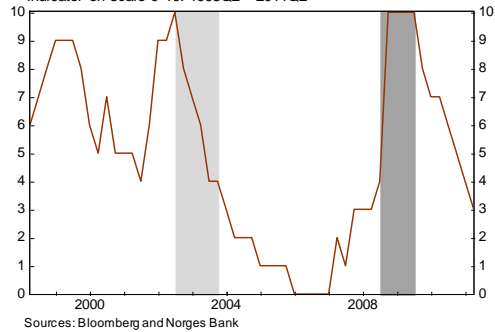


Chart 7.2 Enterprises. Equity ratio of listed enterprises.  
Indicator on scale 0-10. 2002Q1 - 2011Q2

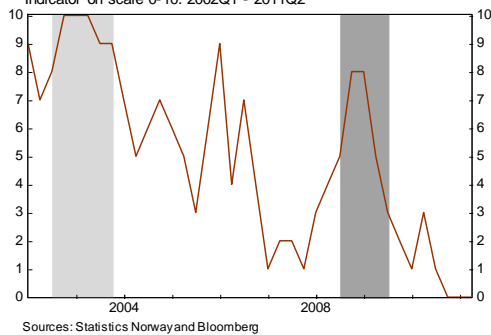


Chart 7.3 Enterprises. Output index.  
Indicator on scale 0-10. 2002Q2 - 2011Q3

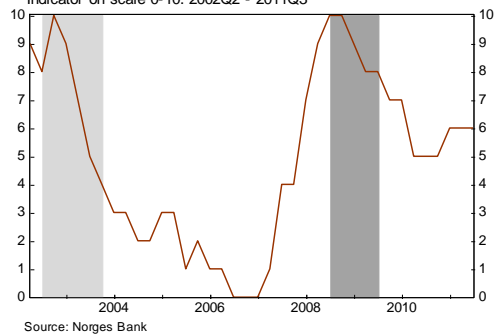


Chart 7.4 Enterprises. Investment gap.  
Indicator on scale 0-10. 1979Q3 - 2011Q3

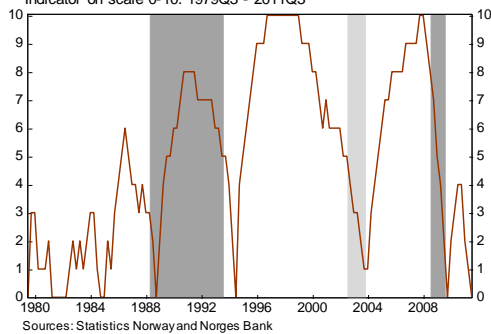


Chart 7.5 Enterprises. Real market prices for office premises in Oslo.  
Indicator on scale 0-10. 1981H1 - 2011H2

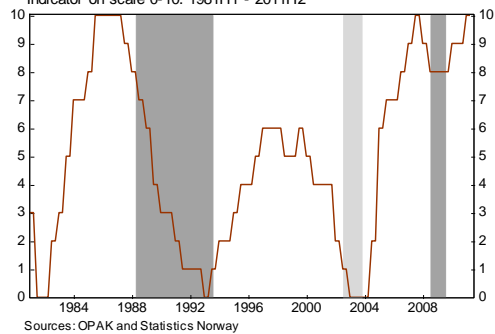


Chart 7.6 Enterprises. Real shipping freight rates.  
Indicator on scale 0-10. 1990Q1 - 2011Q3

