

# STAFF MEMO

## The bank model and the stress test in the 2015 Financial Stability Report

NO. 5 | 2015

BJØRNE DYRE  
SYVERSTEN,  
RØNNAUG MELLE  
JOHANSEN,  
ØYVIND ANDREAS LIND,  
HAAKON SOLHEIM AND  
NICOLAS STEFANO

FINANCIAL STABILITY

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# The bank model and the stress test in the 2015 Financial Stability Report<sup>1</sup>

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## 1. Introduction

Norges Bank uses stress tests to explore the possible consequences for banks of severe economic shocks. A new model framework for stress testing was introduced in the 2013 *Financial Stability Report*. The model framework now comprises the macro model NEMO, simple relationships for developments in banking groups' problem loans and a model for projecting banking groups' earnings, balance sheets and capital adequacy. The latter projection model is referred to as "the bank model". The projections in the bank model are based on developments in the macro scenario and projected developments in problem loans in the corporate and household sectors. This article describes Norges Bank's new model framework for stress testing with a particular focus on the assumptions, underlying data and projection rules in the bank model. The article is illustrated by the assumptions and results of the stress test in the 2015 *Financial Stability Report*.

### 1.1 Norges Bank's new model framework for stress testing

Norges Bank's previous model framework for stress testing is described in Andersen, Berge, Bernhardsen, Lindquist and Vatne (2008). The framework has been further developed since then, and the changes to date, with the reasons for these changes, are summarised below:

- We now use Norges Bank's macro model for monetary policy analysis and forecasts, NEMO (see Brubakk and Gelain (2014)) to generate the stress scenario.
  - Using the same macro model framework as for monetary policy analysis ensures consistency in the macro scenario and the same understanding of central mechanisms in the economy.
- We no longer use micro data-based models for enterprises and households to predict loan losses.
  - This represents a simplification of the methodology for loan loss prediction. Omitting micro data for enterprises, however, results in a more limited basis for our breakdown of loan losses to enterprises by industry. Finanstilsynet (Financial Supervisory Authority of Norway) still uses the SEBRA model (see Bernhardsen and Larsen (2007)) to predict losses on loans to enterprises. Finanstilsynet has the advantage of having information on individual banks' large borrowers, while Norges Bank only has information about the breakdown of individual banks' lending by industry.

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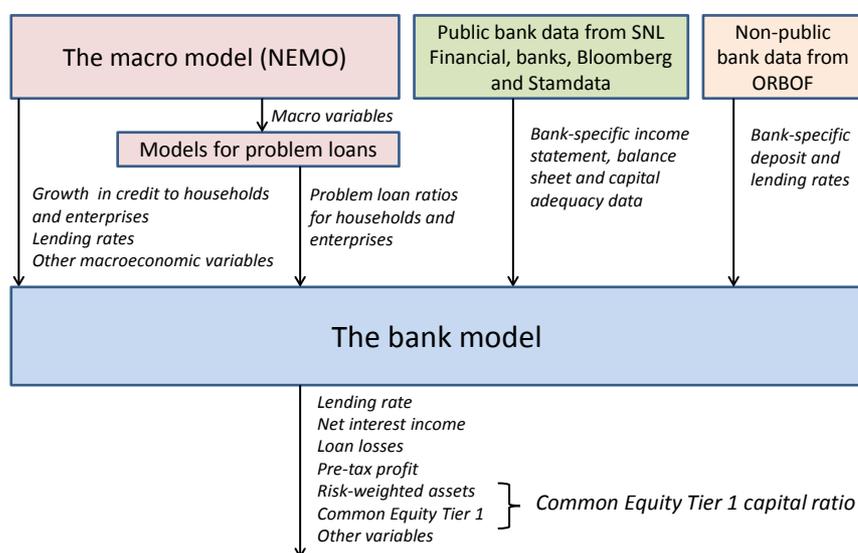
<sup>1</sup> Thanks to Karsten Gerdrup, Frank Hansen, Bjørn Helge Vatne and Sindre Weme for valuable comments and contributions.

- The bank model is now based on data from consolidated financial statements and simple projection rules.
  - Projections for banks were previously based on financial statement data for the parent bank. Since 2008, mortgage companies with the option to issue covered bonds have become an important part of the Norwegian banking sector. These mortgage companies are often subsidiaries in a banking group and have an integrated and important role in the banking group’s funding strategy. The bank model was therefore reorganised to enable projection of consolidated financial statements.

Norges Bank’s new model framework for stress testing is illustrated in Chart 1:

**Chart 1** Norges Bank’s model framework for stress testing

Models, data sources, important input and output variables



## 1.2 The bank model

The bank model has primarily been used for stress scenario projections. Developments in key variables, such as credit growth and shares of problem loans, are obtained from Norges Bank’s macro model framework. The bank model projects earnings and balance sheets for seven large Norwegian banking groups: DNB Bank, Nordea Bank Norge, SpareBank 1 SR-Bank, Sparebanken Vest, SpareBank 1 SMN, SpareBank 1 Nord-Norge and Sparebanken Sør. The figures are projected for each banking group and then aggregated. The aggregate banking group is called the “macro bank”. For the past two years, Norges Bank has only published macro bank data in its *Financial Stability Report*. This is partly because Norges Bank primarily has a macroprudential responsibility for the Norwegian banking sector, while Finanstilsynet is responsible for individual banks.

One consideration to be taken into account in the further development of the bank model is that the model should be based on simple projection rules that make it easy to understand which factors drive the results.

The bank model can also be used to produce projections in the baseline scenario and as a tool for analysing the effects of macroprudential policy measures, such as changes in the level of the countercyclical capital buffer.

## 1.3 Article structure

Section 2 describes the macro model framework and how macro scenarios are generated, while Section 3 provides a general overview of the bank model and the way it functions. Section 4 gives an account of the assumptions underlying the projections of some important income statement items, such as interest income, interest expenses and lending growth. Loan losses are a key variable in stress tests for banks. Section 5 discusses the assumptions on which loan loss projections are based. In stress testing, the consequences for banks are often measured in terms of bank solvency. Section 6 describes our methodology for projecting variables related to capital adequacy. Projection rules that are not directly related to the macro model are described in Section 7. Section 8 summarises the results of the stress test in the 2015 *Financial Stability Report* (FS 2015).

## 2. Macro scenarios

A range of analytical tools are employed in connection with the macro scenario. The baseline scenario is based on the projections in the latest *Monetary Policy Report*.

### 2.1 Norges Bank's macro model framework

In order to ensure consistency in the macro scenario and that the central mechanisms are understood, we use Norges Bank's macro model for monetary policy analysis and forecasting, NEMO (see Brubakk and Gelain (2014)). The model is based on international research and model development over the past 20 years and has many features in common with other central banks' structural macro models. The macro model projects real-economy variables such as investment, consumption and output, and financial variables such as house prices and growth in credit to households and enterprises.

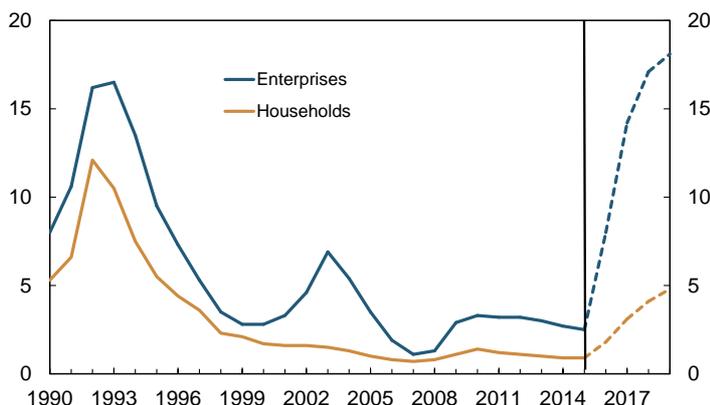
A characteristic of stress tests is that the developments in the real economy outlined in the test are of a low, albeit not negligible, probability. Norges Bank bases stress scenarios on the risk factors in the Norwegian and global economies identified in the *Financial Stability Report* and the *Monetary Policy Report*. A sharp downturn could lead to combinations of negative shocks and feedback mechanisms that are not observed in normal times. Experience of previous crises in Norway and other countries is therefore taken into account in the design of macro scenarios.

## 2.2 Models for problem loan ratios<sup>2</sup>

Based on developments in macro variables from Norges Bank's macro model framework, models for problem loan ratios in the corporate and household sectors are used to project developments in the stress scenario. The method used to estimate problem loan ratios in the two sectors is based on Berge and Boye (2007), and the underlying data consist of quarterly stocks of problem loans in the banking sector as recorded in the ORBOF database<sup>3</sup>. As the ORBOF database contains information about the breakdown of problem loans by sector, but not by industry, there are methodological challenges involved in projecting loan losses by industry (see Section 5.3.1).

In the household sector, the share of problem loans declines with higher house prices and disposable income, but increases with higher interest rates and unemployment. The model for problem loan ratios in the household sector is estimated on quarterly data in the period 1990 Q4–2012 Q4. In the corporate sector, a fall in real oil prices, a fall in domestic demand, an increase in real gross debt and higher real interest rates for firms will generate higher stocks of problem loans at constant prices. The model for problem loan ratios in the corporate sector is estimated on data in the period 1992 Q1–2013 Q4.

**Chart 2** Banks' problem loans<sup>1)</sup> in the stress scenario.  
Percentage of lending to sector. Annual average. 1990 – 2019<sup>2)</sup>



1) Problem loans to enterprises for banks. Problem loans to households for banks and mortgage companies.

2) Average for the second half of 1990. Projections for 2015 – 2019.

Sources: Statistics Norway and Norges Bank

The models for problem loan ratios are based on a period of very robust growth in the Norwegian economy. As problem loans and losses on loans to the household sector have shown little variation over the past 20 years, there is uncertainty related to developments in problem loans for households (Chart 2). Somewhat more variation has been evident in the corporate sector. The highest shares of problem loans for both series occur at the beginning of the estimation period during the banking crisis of 1988–1993. A number of factors have changed since then. The extensive 1992 tax reform and inflation targeting monetary policy since the beginning of the 2000s are

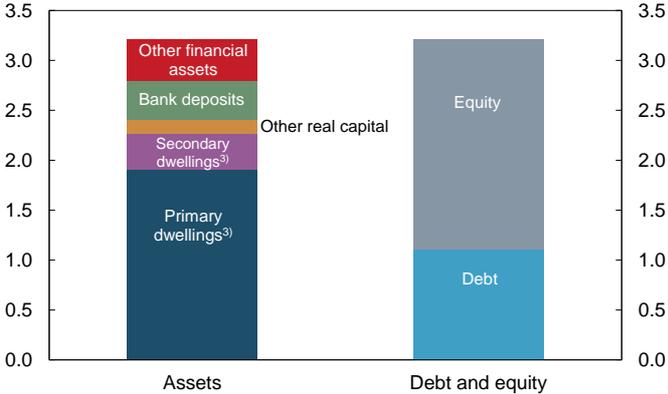
<sup>2</sup> The term 'problem loans' refers to the sum of non-performing loans and other loans with a high probability of default.

<sup>3</sup> ORBOF is a database of financial information from banks and mortgage companies for Statistics Norway, Finanstilsynet (Financial Supervisory Authority of Norway) and Norges Bank. Data for individual banks or companies are not publicly disclosed. Official statistics based on the data in the database are published by Statistics Norway.

two of the factors that may have contributed to changing the way the real economy works. Banks for their part have begun to use more advanced models for assessing customers' creditworthiness. The fact that the empirical basis for banks' advanced models is related to a period of very robust growth in the Norwegian economy and low loan losses may present a problem. It is not given that loans with seemingly low credit risk in a 'fair weather period' will not result in losses in the event of a sharp and prolonged downturn in the Norwegian economy.

Norwegian households have on average high debt burdens, but also a high level of net wealth. Residential mortgages account for a large share of household debt and, partly as a result of many years of high house price inflation, a large proportion of Norwegian households' gross wealth is related to property (primary and secondary dwellings) (Chart 3). A sharp fall in house prices could therefore result in a considerable decline in wealth and lead to an abrupt contraction in household demand for goods and services. As a result, banks' losses on loans to enterprises could increase. After many years of strong profits and higher capital ratios, many enterprises should be well positioned to weather a pronounced downturn in the Norwegian economy. If losses on loans to households and enterprises increase to the levels prevailing during the 1988–1993 banking crisis, the consequences for banks could be dramatic (see the analysis in the box "Losses on loans to households" in the 2014 *Financial Stability Report* (FS 2014).

**Chart 3** Household balance sheet.<sup>1)</sup> Average for private households.<sup>2)</sup>  
In millions of NOK. As at 31 December 2013



1) Based on tax values for 2013.  
2) Include wage earners, pensioners, benefit recipients and students.  
3) Estimated market value based on tax values in 2013.  
Sources: Statistics Norway and Norges Bank

### 2.3 Macro variables used in the bank model

Developments in problem loan ratios, credit growth and interest rates are the key variables used in the bank model (Chart 1). Problem loan ratios are central to the projections of loan losses, while credit growth developments and the interest rate path influence the projections of net interest income. Price and wage developments are also used, although these variables have less impact on the projections generated by the bank model.

## 2.4 Feedback effects

Although most of the projection alternatives that can be selected in the bank model are derived from the macro scenario, there are no automatic feedback effects from the bank model to the macro model. For some alternatives, the bank model's results for key macro variables may deviate from the macro model's stress scenario to such an extent as to require an adjustment to the macro scenario, followed by a re-projection of developments in the banking sector to achieve a closer alignment between the macro model and the bank model. One example of this is the alternative whereby each bank determines the lending rate that will achieve the required return on equity (see Section 4.1.1). Such an adjustment was required in stress scenario 2 in the stress test in FS 2014.

## 3. Introduction to the bank model

### 3.1 Banking sector data

The projections generated by the bank model are based on published financial statement and capital adequacy data for Norwegian banking groups. The data are primarily taken from the SNL Financial database, but are supplemented from other sources. In areas where the SNL Financial database is not sufficiently detailed for our purposes, data are taken directly from banking groups' financial statements. Projected interest rates are partly based on non-public interest rate data that Norwegian banks and mortgage companies are required to report to the ORBOF database. Data from Stamdata and Bloomberg are used for term structures and interest rates on bond debt outstanding in the Norwegian banking sector.

### 3.2 Projections of income statement and balance sheet data

The key income statement items projected are:

- Net interest income
- Net commission income
- Net income from financial instruments
- Operating expenses, including wage expenses
- Loan losses

The key balance sheet items projected are lending to the retail market (households) and lending to the corporate market (enterprises).<sup>4</sup> Most of the other balance sheet

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<sup>4</sup> The grouping of households and enterprises into "retail market" and "corporate market" in this article largely follows that used by banking groups in their financial reporting and will therefore not necessarily correspond to the groups "retail market" and "corporate market" used by Norges Bank in its *Financial Stability Report*. When referring to the bank model, the terms "enterprises" and "the corporate market" are used interchangeably even though they represent two different sectoral concepts. The same applies to the use of the terms "households" and "the retail market". The most important difference between these sectoral concepts is in the categorisation of self-employed persons. Self-

items are either projected using simple projection rules or implied based on income statement projections. Customer deposits are usually assumed to make up a fixed share of net lending to customers, i.e. the deposit-to-loan ratio is assumed to be constant. Given the projection rules for the other income statement and balance sheet items, bond debt issued will function as a residual item in balance sheet projections. Simple projection rules are used for items for which detailed underlying data is not available or where there is considerable uncertainty surrounding the projections, such as net income from financial instrument holdings and loan losses.

The projections of some income statement items are described in more detail in the next two sections: net interest income in Section 4.1, losses on securities under stressed conditions in Section 4.2 and loan losses in Section 5. Net commission income and operating expenses are projected using simple rules. Net commission income is projected as a constant share of total assets, the level of which is determined by the historical share in the four quarters immediately preceding the projection period. Wage expenses are projected based on the macro model projection for wage growth, while other operating expenses are projected using the macro model projection for inflation. Tax expenses for the banking groups are assumed at 27 percent of pre-tax income, corresponding to the tax rate for general income in 2015. In the event of negative taxable income, the banking group is assumed to generate a deferred tax asset.

## 4. Projections of some key income statement items

### 4.1 Projection of net interest income

Net interest income, i.e. gross interest income less gross interest expenses, is Norwegian banks' most important source of income. This income statement item is modelled in somewhat more detail in the bank model. The projection of gross interest income is described in Section 4.1.1, while the projection of gross interest expenses is described in Section 4.1.2.

#### 4.1.1 Gross interest income

Gross interest income will depend on lending growth and lending rates. Projections of these variables are based on the following assumptions:

##### ***Lending growth***

The main alternative in the bank model is to take the level of lending growth specified by Norges Bank's macro model framework as given. The macro model framework generates paths for growth in lending to households and to enterprises in the stress scenario. The other alternative is to allow each bank to choose its own level of lending growth given the bank's current capital ratio and the target for its future capital ratio.

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employed persons are included under households in the "households/enterprises" grouping, but under the corporate market in the "corporate market/retail market" grouping. In total, the "households/enterprises" grouping comprises the same sectors as the "corporate market/retail market" grouping. The reason why the terms are used interchangeably to some extent in this article is that many macro variables are published for the "households/enterprises" grouping, while many bank-specific variables are available for the "corporate market/retail market" grouping.

The latter alternative is particularly relevant for analysing banks' adjustments to changes in buffer requirements.

### **Lending rate**

A bank's current lending rate is calculated as gross interest income divided by the bank's total lending to all sectors, with adjustments for some atypical loans. Norges Bank has access to the individual banking group's lending and deposit rates for different Norwegian sectors from the ORBOF database. These rates vary across banks. Interest rate data from ORBOF at the individual bank level is non-public information. Projections of lending rates do not currently distinguish between loans to households and loans to enterprises. This distinction should be incorporated in the future. This will require using lending rates from the ORBOF database and calibrating against total interest income reported by banks in their income statements. As shown in the following section, a distinction has been made between interest expenses related to customer deposits and interest expenses related to wholesale funding.

There are three alternatives for projecting lending rates:

- a) Lending rates track developments in the macro model
  - The starting-point is each bank's current lending rate. The projections of these lending rates track the changes in the macro model paths for lending rates for households.
- b) Lending rates are set to enable each bank to achieve a constant interest margin
  - This means that all changes in the bank's debt financing costs, including any pronounced increases in market premiums, will automatically result in a corresponding change in the bank's lending rate.
- c) Lending rates are set to enable each bank to achieve its required return on equity
  - The bank sets a lending rate that enables the bank to achieve its required rate of return on equity given naïve forecasts regarding future income, expenses and loan losses. The required rate of return is set at 12 percent (see discussion in Aronsen, Erard, Nordal and Turtveit (2014)).

All the alternatives can be used in both the baseline scenario and the stress tests. Alternative b) was used in the stress test in FS 2015, while alternatives b) and c) were both used in the stress test in FS 2014. Alternative a) is also a good alternative in stress tests.

When difficult economic times are approaching, banks' natural reaction is to increase interest margins to compensate for higher credit risk. This reasoning is the basis for alternative c). This kind of behaviour, although it may seem optimal for the individual bank, could lead to a deeper economic downturn and higher loan losses for the banking sector as a whole than if banks had not increased lending rates to the same extent, as illustrated by adverse scenario 2 in the stress test in FS 2014.

The use of alternative b) is a way of preventing banks from "inflating" net interest income in a period of stress. At the same time, under alternative b), net interest income is maintained at about the same level as prior to the stress period. Net interest income will not be entirely unaffected; lending growth and loss of interest income on non-performing loans will have some impact. Under lending rate alternative b), net interest income has a fairly insignificant effect on the outcome of the stress test. Under alternatives a) or c), the assumptions regarding funding costs will determine whether

net interest income has a significant effect on the results of the stress test (see discussion in the following section).

In a stress period, the rule in alternative c) will often lead to a considerable increase in lending rates in an attempt to compensate for the increase in loan losses. Such high lending rates set outside the macro model will have real-economy effects, such as lower lending growth than assumed in the macro scenario, which was the basis for the projections in the bank model. This requires the macro scenario to be adjusted to the new, higher lending rates (see description of feedback effects in Section 2.4).

The different lending rate rules can also include restrictions on the speed and magnitude of a rise in lending rates. Two reasons for such restrictions are the required six weeks' notice for borrowers classified as consumers and the limitations on changes in the bank lending rate included in some corporate loan agreements.

#### **4.1.2 Gross interest expenses**

Interest expenses can be treated as a whole in the bank model, but it is often more useful to split them by type of lender. The main alternative is to split them into interest costs associated with customer deposits and interest costs associated with wholesale funding, with deposits by financial institutions treated as part of banks' wholesale funding.

##### ***Gross interest costs associated with customer deposits***

As an estimate of a bank's customer deposit rates, the bank model uses the relevant bank's most recently reported deposit rate applied to the general public<sup>5</sup> in the ORBOF database. The bank-specific general public deposit rate from the ORBOF database is projected after changes to the deposit rate in the macro model.

Alternatively, the deposit rate can be projected in the same way as for wholesale funding costs (see following section). If this alternative is used, the difference between the deposit rate for the general public and the interest rate on wholesale funding will be the same as the difference between these two rates at the last historical data point.

##### ***Gross interest costs associated with wholesale funding***

A bank's current wholesale funding costs are calculated as gross interest costs for this funding divided by the bank's total wholesale funding. A stress scenario will contain assumptions concerning developments in money market premiums (three-month NIBOR) and in risk premiums on banks' covered bond and senior bond funding. Using data from Stamdata and Bloomberg, Norges Bank keeps track of covered bonds and senior bonds issued by Norwegian banks and their terms to maturity. These data are used to calculate the effect the increased NIBOR and risk premiums on wholesale funding will have on average wholesale funding costs in the stress scenario (and in the baseline scenario). As the change in average funding costs is calculated for the banking sector as a whole, the effect is not bank-specific. Since the projections are based on implied historical wholesale funding costs for each bank, wholesale funding costs will nonetheless differ across banks.

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<sup>5</sup> The term 'general public' is used to refer to a sector that mainly consists of households, non-financial enterprises and municipalities.

## 4.2. Assumptions concerning securities losses under stressed conditions and net income from financial instruments

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As Norges Bank does not hold detailed information on banking groups' holdings of financial instruments, our assumptions in this area are general. Our methodological approach is based on a large loss on securities incurred by the banking group in the first quarter of the stress period, with a potential fall in net income from financial instruments relative to its "normal level" in the remaining quarters of the stress period. The initial impairment for financial instruments measured at fair value is estimated at 30 percent of banks' equity holdings and 5 percent of their fixed income portfolio (bonds and notes), with no change in value for derivatives. We do not have sufficient data to be able to set a reasonable loss rate for derivatives.

The assumption of a 30 percent fall in the value of equity holdings is a moderate assumption. Over the past 30 years, the Norwegian equity market, as measured by the Oslo Børs benchmark index, has fallen by more than 40 percent on several occasions. As most Norwegian banks' equity holdings measured at fair value are limited, the assumption of a fall in equity values has little effect on the macro bank's profit compared with many other parameters in the bank model.

Banks' public reports provide relatively limited information about the composition of a bank's fixed income portfolio and its average maturity. Credit risk for Norwegian banks' fixed income portfolios has probably declined in recent years as a result of adaptation to new international liquidity rules. The new liquidity framework requires fixed income instruments to have low credit risk and be liquid during a time of market stress to qualify as high-quality liquid assets (HQLA, the numerator of the LCR<sup>6</sup>). The impairment for the fixed income portfolio will depend on the increase in yield. Higher yields in stressed conditions will reflect factors such as wider credit spreads. Lower policy rates will push in the opposite direction. In the stress test in FS 2015, the net increase in yield is estimated at 1.6 percentage points. If the average maturity on the fixed income portfolio is about 3½ years, this results in an impairment of about 5 percent.

After the initial fall in value in the first quarter of the stress period, net income from financial instruments is assumed to revert to  $y$  percent of the "normal level" in the second quarter and remain at this level to the end of the stress period. It is natural to assume  $y \leq 100$ . In the stress test in FS 2015, the assumption is that  $y = 100$ , i.e. equal to the normal level. The normal level is set equal to the bank's average net income from financial instruments for the four quarters preceding the onset of the stress period. The normal level can be adjusted to another time period and to reflect subjective adjustments made if the last four quarters do not represent a "normal period". The following arguments support the relatively optimistic assumption of net income from financial instruments in the last part of the stress period in FS 2015:

- Experience gained during the financial crisis, which was a period of mild stress in Norway, indicated that banks' income from financial instruments quickly reverted to a normal level.

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<sup>6</sup> LCR = Liquidity Coverage Ratio

- The parameters of the fall in securities prices are set to result in a very large initial impairment, implying a more moderate assumption for the remainder of the stress period.

In the stress test in FS 2015, securities losses in the first quarter of 2016 totalled NOK 22.8 billion; comprising NOK 3.6 billion in equity losses and NOK 19.2 billion in losses on fixed income instruments. In isolation, this loss weakened the macro bank's Common Equity Tier 1 capital ratio by 1¼ percentage points in the first quarter of 2016.

The stress test in FS 2014 was based on other assumptions. The initial securities loss was milder, but net income from financial instruments was set at zero for the remainder of the three-year stress period.

## 5. How should loan losses be projected?

Loan loss projections are based on problem loan ratios (see Section 2.2). The bank model operates with two loss functions, called “loss function 1” and “loss function 2”. Loss function 1 is based on a flow approach where loan losses are related to the flow of new problem loans. With loss function 2, loan losses are related to the stock of problem loans. The share of the stock of the previous quarter's problem loans that is removed from the balance sheet (written-off) will have considerable impact on loss function 1. This is analysed in Section 5.1. The two loss functions are described in more detail in Sections 5.2 and 5.3 respectively. Section 5.4 contains a comparison with loan losses in previous crises.

There is considerable uncertainty about the estimation of loan losses during an ongoing crisis. A bank's reported loan losses will be a result of a decision-making process, where factors such as capital ratios and a changeover to a new CEO can have an impact beyond the purely loss-related assessments. After the financial crisis, US banks took large loan losses and quickly cleared up the issue of problem loans, while European banks tended to keep non-performing loans on their balance sheets. The relationship between problem loans and loan losses can thus vary from crisis to crisis. Modelling loan losses is not an exact science, and the choice of methodology and setting of parameters can lead to widely differing results.

### 5.1 How fast are problem loans removed from the balance sheet?

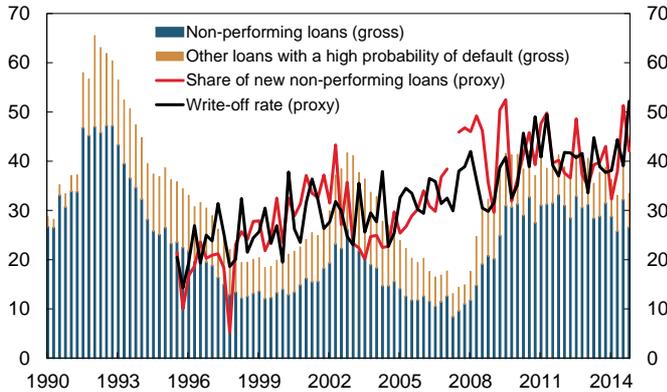
The term problem loan refers to the sum of non-performing loans (NPL) and loans with a high probability of default. Over the past 25 years, non-performing loans have on average accounted for about 70 percent of the stock of problem loans (Chart 4).<sup>7</sup> The ORBOF database contains some information on NPLs, while information on

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<sup>7</sup> As from January 2010, the definition of non-performing loans in the ORBOF database was changed from loans more than 90 days past due to loans more than 30 days past due. This entails an upward shift in the series for NPLs at the end of 2009/beginning of 2010.

loans with a high probability of default is more limited. Information on quarterly inflows of new NPLs has been available since the fourth quarter of 2010. Quarterly information is also available on the age composition of the stock of NPLs. Based on information from the ORBOF database, a proxy variable has been constructed for the inflow of new NPLs since the first quarter of 1996 and the ratio of new NPLs to total NPLs has been calculated (Chart 4). A problem loan will in time be removed from the balance sheet (written off) or be reported performing. ORBOF data is used to calculate the write-off ratio<sup>8</sup> for NPLs. The write-off ratio has averaged about 30 percent since 1996 (Chart 4). Through much of this period, Norway has experienced solid economic growth and low loan losses. The write-off ratio for problem loans is assumed to be the same as for NPLs. In a crisis, problem loans are likely to remain on the balance sheet for longer and in a prolonged crisis the write-off rate is likely to be lower than 30 percent. The assumption concerning the level of the write-off ratio influences the magnitude of the inflow of new problem loans assigned to banks in the projections and is therefore a very important technical assumption underlying loss function 1 (see following section).

**Chart 4** Composition of problem loans.<sup>1)</sup> In billions of NOK. Share of new non-performing loans<sup>2)</sup> og write-off rate<sup>3)</sup>. Percent. 1990 Q3 – 2015 Q2



1) Problem loans for all banks and covered bond mortgage companies in Norway.  
2) New non-performing loans in the quarter (proxy) as share of total non-performing loans.  
3) Share of non-performing loans removed from the balance sheet in a given quarter.  
Source: Norges Bank

## 5.2 Loss function 1

Loss function 1 is based on a flow approach and shares some similarities with the loss methodology applied by IRB banks to estimate probability of default (PD) and loss given default (LGD). Our framework operates with problem loan shares and loss given problem loan (LGPL).  $LGPL_{it}$  is the loss ratio on lending to sector  $i$  in quarter  $t$ . Under loss function 1, only new problem loans generate loan losses, and a loan loss on a given problem loan is taken only once. Losses on loans to sector  $i$  in quarter  $t$  with a write-off rate of  $z_{it}$  are given by the formula:

$$1) \text{ Loan losses}_{it} = [\text{Net loans}_{i(t-1)} * (\text{Problem loan share}_{it} - \text{Problem loan share}_{i(t-1)}) * LGPL_{it}] + [\text{Net loans}_{i(t-1)} * \text{Problem loan share}_{i(t-1)} * z_{it} * LGPL_{it}]$$

<sup>8</sup> Share of total NPLs removed from the balance sheet in a given quarter.

The square brackets in formula 1) indicate that the loan losses can be split into two parts. The first part shows losses attributable to net change in problem loans, while the second part shows losses on new problem loans that replace problem loans written off. We call the two parts the “change effect” and the “write-off effect”, respectively, interpreted as follows: The change effect shows loan losses under the assumption that only the change in the problem loan share represents new problem loans. In isolation, the change effect entails an assumption that all existing problem loans will remain on the balance sheet without generating new loan losses. In other words, no problem loans are removed from the balance sheet (written off). The write-off effect entails an assumption that  $z$  percent of the problem loans from the previous quarter are written off and replaced by new problem loans, and that this process repeats itself each quarter. The new problem loans that replace the existing problem loans written off are assigned the same loss ratio as other new problem loans. All else being equal, a higher write-off rate will result in higher loan losses.

The following is an example of the use of formula 1): Given net lending of 100, a problem loan share that rises from 10 percent the previous quarter to 11 percent this quarter, an LGPL of 40 percent and a write-off rate of 15 percent, the loan loss this quarter will be:

$$\begin{aligned} \text{Loan loss} &= \text{Change effect} + \text{Write-off effect} = \\ &[100 * (0.11 - 0.10) * 0.4] + [100 * 0.10 * 0.15 * 0.4] = \\ &[1.0 * 0.4] + [1.5 * 0.4] = 0.4 + 0.6 = \underline{1.0} \end{aligned}$$

In Norway, the loss ratio has historically been higher for loans to enterprises than for loans to households (see Kragh-Sørensen and Solheim (2014)). In the stress test in FS 2015, we operate with non-time-varying LGPLs and write-off rate. LGPLs for enterprises are set at  $\text{LGPL}_{\text{Enterprises}} = 40$  percent and for households at  $\text{LGPL}_{\text{Households}} = 25$  percent. We use a write-off rate of  $z = 15$  percent for problem loans to both enterprises and households.<sup>9</sup> In setting LGPLs, we have used the LGD levels used by Norwegian IRB banks as a reference. LGPL and LGD are similar, but not directly comparable. While LGD only includes losses on NPLs, LGPL also includes losses on loans with a high probability of default. Since these loans are not yet non-performing, there is reason to assume that losses on these loans will be lower than losses on loans that are already non-performing. This entails an assumption that the average LGPL for total problem loans is lower than the average LGD for banks’ total NPLs. For residential mortgages, the Norwegian authorities have introduced a minimum LGD requirement of 20 percent. For IRB banks using the foundation approach for corporate exposures, the standard LGD value is 45 percent. DNB Bank has used the advanced IRB approach for corporate exposures for several years.<sup>10</sup> At end-2014, DNB Bank’s IRB models for corporate exposures predicted an average LGD of 25 percent, with LGDs of up to 30 percent for some industries. Observed LGDs have, with one exception, been lower than predicted since 2010. However, the period 2010–2014 was a period of solid growth in the Norwegian economy and low loan losses among Norwegian banks. Predicted LGD rates produced by IRB models are rates during a downturn. Norges Bank’s assumption regarding the LGPL level for enterprises is lower than the standard LGD value under the foundation IRB approach, but relatively high compared with the LGD values from DNB Bank’s IRB models.

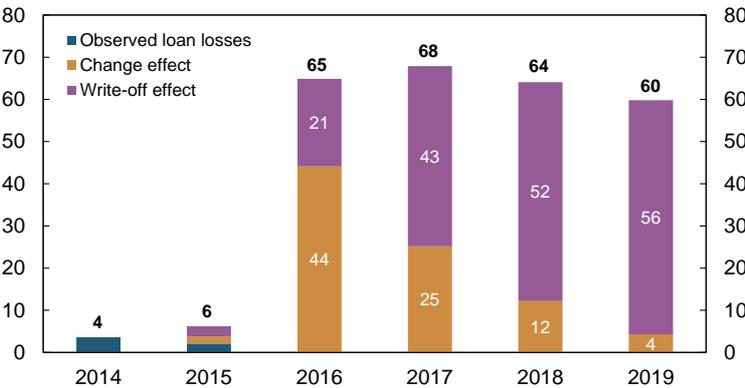
<sup>9</sup> These are the same LGPL and write-off rate assumptions that were used in the stress test in FS 2014.

<sup>10</sup> In February 2015, the largest banks in the SpareBank 1 Alliance were granted permission by Finanstilsynet to use advanced IRB models for corporate exposures. To date, public information regarding these models’ LGD predictions is limited. Sparebanken Vest continues to use a foundation IRB model for corporate exposures, while Sparebanken Sør is a standardised approach bank.

Very high growth in problem loan shares, especially for enterprises (Chart 2), combined with fairly high LGPLs, results in high loan losses for the macro bank throughout the stress period in FS 2015 (Chart 5). Just over 84 percent of total loan losses in the stress period are losses on loans to enterprises. Chart 5 also illustrates the change and write-off effects. The write-off effect has a substantial impact on estimated loan losses, particularly in the latter years of the stress period.

In an economic downturn as represented by the stress scenario, problem loans could remain on the balance sheet for longer before being written off. This suggests that the write-off rate should be lowered during the latter years of the stress period, which would then lower the estimated loan losses in these years.

**Chart 5** Decomposition of projected loan losses<sup>1)</sup> in the stress test in FS 2015 into change and write-off effects. In billions of NOK. 2014 – 2019



1) Projected loan losses for the period 2015 Q3 – 2019 Q4. Sources: SNL Financial and Norges Bank

When using the bank model to analyse bank behaviour in normal times, we operate with a higher write-off rate ( $z = 30$  percent; see the analysis in Section 5.1) and lower LGPLs than in stress scenarios.

### 5.3 Loss function 2

Under loss function 2, loan losses are directly related to the stock of problem loans. This implies that losses are taken on a given problem loan more than once, but that the loss ratio when the first loss is taken is lower than under loss function 1. We let LR stand for the loss ratio in loss function 2, where  $LR_{jt}$  is the loss ratio on lending to industry (segment)  $j$  in quarter  $t$ .<sup>11</sup> The loss ratio is set on the basis of judgement and can be calibrated to historical loss levels. LR must be set considerably lower than LGPL in order for loss function 2 to generate approximately the same loan losses as loss function 1. To take account of the fact that losses are taken on the same problem loan more than once, we let the loss ratio decline over time during crises. Loan losses on loans to industry  $j$  in quarter  $t$  are given by the formula:

$$2) \text{ Loan losses}_{jt} = \text{Problem loans}_{jt} * LR_{jt} \quad \text{where } LR_{jt} \text{ is a decreasing function of time}$$

<sup>11</sup> Loss function 2 is primarily used for industries, but with the household sector as a separate segment.

To ensure that  $LR_{jt}$  is a decreasing function of time, we multiply the initial loss ratio by a constant haircut factor. For the scenario analyses of loan losses by industry in FS 2015, an annual haircut factor of 0.75 was used. For example, a loss ratio of 10 percent the first year will result in a loss ratio of 7.5 percent the second year and 5.625 percent the third year.<sup>12</sup>

### 5.3.1 Use of loan loss function 2 for distribution of loan losses by industry

The SNL Financial database for Norwegian banks does not include a breakdown of lending by industry. Banks' public financial reporting provides a breakdown of the individual banking groups' lending and loan losses by industry, while the ORBOF database only includes a breakdown of lending in Norway by industry. Norges Bank does not have information showing individual banks' specific borrowers. The Bank has some information about levels of losses on loans to specific industries via the annual reporting of loan losses by industry submitted by selected Norwegian banks since 1997. These loss levels are not necessarily representative of loss levels in a crisis as Norwegian banks have not faced any major crises in the period between 1997 and today.

Loss function 2 was used in the scenario analysis of losses on loans across industries in FS 2015, with a main focus on the effect of losses on loans to the commercial real estate and construction industries. When determining the initial loss ratios for each industry (segment), we looked at the observed loss levels for Norwegian banks during the banking crisis of 1988–1993 (see Kragh-Sørensen and Solheim (2014)). In addition, loss ratios were adjusted to bring total loan losses into line with the loan losses under loss function 1. We divided the industries into four groups: “construction”, “shipping”, “commercial real estate” and a residual category, “other industries”. The loss ratio is typically higher for construction, shipping and commercial real estate than for “other industries”. The same industry-specific loss ratios were used for all banks. The ORBOF database does not contain a historical breakdown of problem loans by industry. In the absence of other information, the distribution of problem loans was assumed to be the same as the distribution of lending to the different industries. This is a naïve assumption as higher problem loan ratios would be expected in the industries in the highest risk categories. In the scenario analysis in FS 2015, a loan loss ratio<sup>13</sup> of 5 percent on loans to commercial real estate and construction resulted in about the same path for loan losses through the stress period as under loss function 1.

## 5.4 Comparison with loan losses during previous banking crises

The loan losses estimated in the bank model should be compared with observed historical loss levels in Norway and other relevant countries. During the Norwegian banking crisis 1988–1993, loan losses reached a maximum of over 4 percent of gross lending (Chart 6). The Norwegian banking crisis occurred over 20 years ago. Risk models used by both Norwegian and international banks have become more advanced since then. This did not, however, prevent many European banks from incurring large losses during the financial crisis. The level of cumulative losses for Irish banks was

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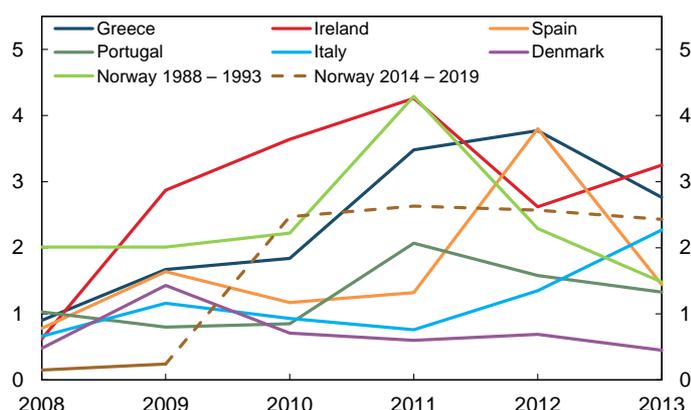
<sup>12</sup> The same loss ratio is used for all four quarters in a given year.

<sup>13</sup> Loan loss ratio = Annual loan losses / Gross lending

higher than for banks in Norway during the banking crisis (Chart 6). Loan losses were also high in Greece and Spain.

In the stress test in FS 2015, loan losses rise to 2½ percent and remain at this level for the following three years. Losses reach a lower peak than during the banking crisis 1988–1993, but remain at a high level for longer.

**Chart 6** Annual loan losses in selected European countries.<sup>1)</sup> Percentage of lending, 2008 – 2013<sup>2)</sup>



1) Sum of banks in SNL Financial's database for the selected countries.  
2) The two data series for Norway show loan losses in the banking crisis 1988 – 1993 and projected loan losses in the stress test in FS 2015.  
Sources: SNL Financial and Norges Bank

## 6. Projections of capital ratios

After projecting the balance sheet items referred to in the section above, we arrive at post-tax profits. The bank can pay a dividend based on these profits and distributable equity. The dividend assumptions in the bank model are described in Section 6.1. The size of banks' dividend payments or equity issues will affect capital ratios. Norges Bank's stress tests have primarily focused on the Common Equity Tier 1 (CET1) capital ratio with the application of the transitional rule, defined as CET1 capital divided by total risk-weighted assets. The projections of risk-weighted assets are described in Section 6.2 and the projections of CET1 capital in Section 6.3. Banks have also been instructed to report leverage ratios as from 2015. The plan is to set a minimum leverage ratio requirement, to be effective from 2018. As a proxy for the leverage ratio, the bank model is used to project the bank's Tier 1 capital as a share of total assets. The projection of this ratio is described in Section 6.4.

### 6.1 Dividend payments and other capital distributions

The projections in the bank model assume that a dividend is not paid in periods of stress or when a bank records a loss. In stress periods, it is more likely that banks that fall below given capital levels will be instructed to obtain fresh capital to strengthen capital ratios. In non-stress periods, the bank model presents two main alternatives for dividend payments:

- A fixed share of the profits for the period is paid as a dividend.
  - This share may vary across banks. A usual dividend in normal times is 50 percent of the bank's profits.
- As long as the bank is above its own CET1 capital ratio target, as much as possible of the profits for the period are paid out as a dividend.
  - This dividend alternative also takes account of the CET1 capital needed to fund lending in the following period.

As the bank model uses quarterly projections, it is assumed that banks set aside funds for dividend payments each quarter.

## 6.2 Projections of risk-weighted assets

Total risk-weighted assets (RWAs) with the transitional rule are the sum of RWAs for credit risk, operational risk, market risk and the transitional rule. RWAs for credit risk are by far the largest component of total RWAs for Norwegian banks. Our procedure for projecting RWAs for credit risk is described in Section 6.2.1. RWAs for operational risk are projected using the formula for the basic method. RWAs for market risk account for a small share of total RWAs for Norwegian banks and are assumed to constitute the same share of financial instrument holdings in the projections as prior to the projection period. The projection of RWAs for the transitional rule is described in Section 6.2.2.

### 6.2.1 RWAs for credit risk

The two key variables in our projection procedure for RWAs for credit risk are the average risk weight on lending to customers and the weighted share of problem loans in lending to customers. The average risk weight (ARW) for bank  $b$ 's lending to customers in quarter  $t$  is calculated as follows:

$$3) \text{ARW}_{b(\text{Customers})_t} = \text{RWAs for credit risk}_{b(\text{Customers})_t} / \text{Net lending}_{b(\text{Customers})_t}$$

The weighted share of problem loans (PLS) in bank  $b$ 's lending to customers, where Customers = Households + Enterprises and  $\text{PLS}_{bit}^{14}$  is the problem loan share of lending to sector  $i$  in quarter  $t$ , is given by:

$$4) \text{PLS}_{b(\text{Customers})_t} = [(\text{PLS}_{(\text{Enterprises})_t} * \text{Net lending}_{b(\text{Enterprises})_t}) + (\text{PLS}_{(\text{Households})_t} * \text{Net lending}_{b(\text{Households})_t})] / \text{Net lending}_{b(\text{Customers})_t}$$

Using actual figures for the previous quarter, each bank's average risk weight is calculated using formula 3). This average risk weight is projected by the change in the weighted problem loan share:

$$5) \text{ARW}_{b(\text{Customers})_{(t+1)}} = \text{ARW}_{b(\text{Customers})_t} + (\text{PLS}_{b(\text{Customers})_{(t+1)}} - \text{PLS}_{b(\text{Customers})_t})$$

The change in the weighted problem loan share will depend on the mix of the bank's lending to enterprises and households. Given the developments in problem loan shares shown in Chart 2, average risk weights for banks with a high proportion of lending to

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<sup>14</sup> Only problem loan shares for customers  $\text{PLS}_{b(\text{Customers})_t}$  are bank-specific. Problem loan shares for enterprises  $\text{PLS}_{(\text{Enterprises})_t}$  and households  $\text{PLS}_{(\text{Households})_t}$  are not bank-specific.

households will rise less than for banks with a high proportion of lending to enterprises. The new RWAs for credit risk are given by:

$$6) \text{ RWAs for credit risk}_{b(\text{Customers})(t+1)} = \text{ARW}_{b(\text{Customers})(t+1)} * \text{Net lending}_{b(\text{Customers})(t+1)}$$

The following is an example of the use of the above formulas: Given net lending to customers of 100, divided into 70 to households and 30 to enterprises, for both the previous and the current quarter, a problem loan share for enterprises that increases from 10 percent in the previous quarter to 11 percent in the current quarter, a problem loan share for households that increases from 2.5 percent in the previous quarter to 3.0 percent in the current quarter and RWAs for credit risk of 40 in the previous quarter, the average risk weight for lending to customers in the previous quarter was:  $40 / 100 = 40 \text{ percent}$ . The weighted problem loan share for customers in the previous quarter was:  $[(0.0 * 30) + (0.025 * 70)] / 100 = 4.75 \text{ percent}$ , and in the current quarter is:  $[(0.11 * 30) + (0.03 * 70)] / 100 = 5.4 \text{ percent}$ . This increases the average risk weight for lending to customers to:  $0.40 + (0.054 - 0.0475) = 40.65 \text{ percent}$  in the current quarter and RWAs for credit risk to:  $0.4065 * 100 = 40.65$ .

### 6.2.2 RWAs for the transitional rule

Norwegian IRB banks are required to use the transitional rule to calculate their total RWAs.<sup>15</sup> Under the transitional rule, total RWAs must make up at least 80 percent of the bank's total RWAs under the Basel I requirement. Several IRB banks are bound by the transitional rule, and for these banks the difference between total RWAs with the transitional rule and total RWAs without the transitional rule can be referred to as "RWAs for the transitional rule".

RWAs without the transitional rule are projected in the bank model, as described above. RWAs for the transitional rule,  $\text{RWAT}_{bt}$ , are projected by revising down by the change in RWAs for credit risk as a result of the change in average credit risk weight:

$$7) \text{ RWAT}_{b(t+1)} = \text{Max} \{ [\text{RWAT}_{bt} - ((\text{ARW}_{b(\text{Customers})(t+1)} - \text{ARW}_{b(\text{Customers})t}) * \text{Net lending}_{b(\text{Customers})t})], 0 \}$$

In a period of stress with increasing credit risk weights, RWAs for the transitional rule will be reduced and will eventually be zero for many banks.

## 6.3 Projection of CET1 capital

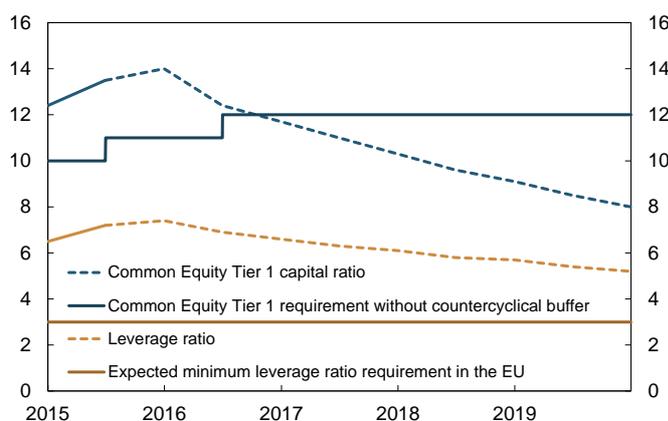
CET1 capital is a regulatory variable. Normally, retained earnings (net profit minus dividend) are only included in CET1 capital at year-end. In the bank model projections, profit adjusted for any dividend payments is added each quarter. Severe stress scenarios often result in bank losses. As the resulting deferred tax asset is not included in CET1 capital, CET1 capital will be reduced by total net loss in such situations.

The CET1 capital ratio is defined as CET1 capital divided by total RWAs. The CET1 ratio Norges Bank reports as the "result" of stress tests is the CET1 capital ratio with the transitional rule. Chart 7 shows the result of the stress test in FS 2015.

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<sup>15</sup> Of the seven banks that make up the macro bank, only Sparebanken Sør is not an IRB bank.

**Chart 7** Common Equity Tier 1 capital ratio and leverage ratio<sup>1)</sup> for the macro bank in the stress scenario. Percent. 2015 – 2019<sup>2)</sup>



1) Leverage ratio is calculated as: Tier 1 capital / Total assets.

2) Projections for 2015 Q3 – 2019 Q4.

Sources: SNL Financial and Norges Bank

## 6.4 Tier 1 capital and the leverage ratio

A leverage ratio requirement is scheduled to be introduced in the EU in 2018. In the proposed international regulatory framework, the leverage ratio is defined as Tier 1 capital divided by an exposure measure. The exposure measure consists of banks' total assets and off-balance sheet items, which are included according to specific rules.

In the Tier 1 capital projection, the bank model assumes that the hybrid capital issued by the banking group is constant. Tier 1 capital will thus be equal to projected CET1 capital plus the constant hybrid capital. Total assets are automatically projected as a result of the projections of other balance sheet items, as described in Section 3.2. As banks do not yet publish sufficient information to project the other adjustment items in the denominator in the leverage ratio formula, Tier 1 capital as a percentage of total assets is used as a projection for the leverage ratio in the stress test in FS 2015 (Chart 7).

## 7 Projection rules for analysis of bank behaviour

The bank model can also be used to analyse bank behaviour in normal times. A relevant issue is banks' adjustment to a new level for the countercyclical capital buffer a specific number of quarters ahead. Any increase in the countercyclical capital buffer is normally preannounced by four quarters. If the authorities reduce the countercyclical buffer, they are required to give notice of the minimum length of time that will pass before the buffer can be increased again. The bank model can be used to analyse how different banks may choose to adjust their capital ratios in this phase.

## 7.1 Projection rules not directly related to the macro model

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Projection rules that are not directly related to the macro model are useful for the analysis of individual banks' adjustment to a change in prospects. This is a way of analysing banks' adjustments at the micro level. Norge Bank uses three projection rules in which banks make individual adjustments:

- The bank determines its lending rate
- The bank determines its level of lending growth
- The bank determines its dividend level

The projection rule for the lending rate is lending rate alternative c), discussed in Section 4.1.1.

The projection rule for lending growth is referred to in Section 4.1.1. This rule deals with how a bank will adjust in order to maintain/achieve the required capital level. According to the rule, banks will initially employ available capital reserves to extend loans to households. Available capital reserves after the bank has satisfied the macro model's growth in lending to households will be employed to extend loans to enterprises. Any remaining available capital reserves after the bank has satisfied the macro model's growth in lending to enterprises will be distributed according to one of the dividend payment rules described in Section 6.1.

The projection rule for dividend payments is the second alternative described in Section 6.1. The rule can be regarded as an extension of the lending growth rule referred to above.

## 8 Summary of the stress test in the 2015 Financial Stability Report<sup>16</sup>

The stress test shows that the largest Norwegian banks will incur large loan losses in the event of a pronounced downturn in the Norwegian economy. CET1 capital ratios fall, although not below the minimum requirement. The stress scenario in this report extends over a period of four years, while the period in FS 2014 was one year shorter.

### 8.1 Economic developments

The stress scenario in FS 2015 outlines developments of low, albeit not negligible, probability. Developments in the key macro variables in the stress scenario are summarised in Table 1 below.

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<sup>16</sup> The text in this section is largely based on the text in the 2015 *Financial Stability Report*.

**Table 1:** Macroeconomic aggregates in the stress test in FS 2015.  
Percentage change from previous year<sup>1)</sup>

	2015 <sup>2)</sup>	2016	2017	2018	2019
GDP mainland Norway	1.3	-2.5	-2.3	0.1	1.5
CPI-ATE	2.7	3.2	3.2	1.9	1.2
Registered unemployment (rate, level)	3.0	4.8	6.3	6.8	6.7
House prices	7.4	-10.4	-12.9	-8.5	-7.5
Exchange rate (level, I-44)	102.8	111	111	111	111
Oil price, USD per barrel (level)	54	30	32	39	47
3-month NIBOR (level)	1.3	1.7	2.0	2.0	1.5
Weighted risk premium for covered and senior bank bonds <sup>3)</sup>	0.7	0.8	0.9	1.0	1.1
Credit (C2) households <sup>4)</sup>	6.9	3.4	0.9	-2.1	-1.7
Credit (C2) non-financial enterprises <sup>4)</sup>	2.8	-1.4	-4.5	-4.4	-1.2
Share of problem loans <sup>5)</sup> , households	0.9	1.8	3.1	4.1	4.8
Share of problem loans <sup>5)</sup> , non-financial enterprises	2.5	8.0	14.2	17.1	18.1

1) Unless otherwise stated. Levels are measured as annual averages.

2) The macroeconomic aggregates are from the baseline scenario in *Monetary Policy Report 3/2015*.

3) Percentage points at year-end. The higher premiums only have an effect on new bonds.

4) Change in stock measured at year-end.

5) Delinquent loans and other loans with a particularly high probability of default. All banks excluding branches of foreign banks in Norway. Problem loans to households include problem loans from mortgage companies. Percentage share of lending to the sector.

Sources: Statistics Norway, the Technical Reporting Committee on Income Settlements, Thomson Reuters, Eiendom Norge, Finn.no, Eiendomsverdi AS, Finanstilsynet and Norges Bank

Growth among Norway's trading partners is assumed to fall markedly at the beginning of 2016, primarily driven by weaker growth in China and the euro area. Owing to a fall in energy demand, oil prices fall to USD 30 per barrel. Oil prices remain low for a long period, and rise towards USD 50 per barrel in 2019. A substantial repricing of all risk premiums occurs in financial markets, with the effects amplified by low market liquidity. A lack of confidence among banks also leads to higher money market premiums.

The international developments in the stress scenario lead to a pronounced downturn in the Norwegian economy. Activity falls markedly and unemployment rises towards 7 percent. The key policy rate is set at zero, but banks raise their lending rates owing to increased money and credit market risk premiums.<sup>17</sup> Combined with heightened uncertainty, this contributes to a sharp fall in house prices totalling 35 percent. The persistent increase in house prices and household debt since the beginning of the 2000s amplifies the impact on the Norwegian economy. Since household wealth is largely in the form of housing, the fall in house prices in the stress scenario results in a substantial fall in household equity. This affects household consumption. High and rising debt burdens have increased household vulnerability to interest rate increases. Declining collateral values and higher lending rates limit households' ability to take on new debt, amplifying the negative effects on private consumption. Together with higher unemployment and a fall in household income, this results in a considerable reduction in consumption. Higher unemployment, increased lending rates and weaker income growth also lead to higher household default rates. Banks' share of problem loans to households increases to almost 5 percent in the stress test (Chart 2).

Lower demand from households, petroleum-related industries and trading partners contributes to lower profitability and lower business sector investment. A number of firms experience debt-servicing problems and the share of problem loans to enterprises rises to 18 percent at the end of the stress period (Chart 2).

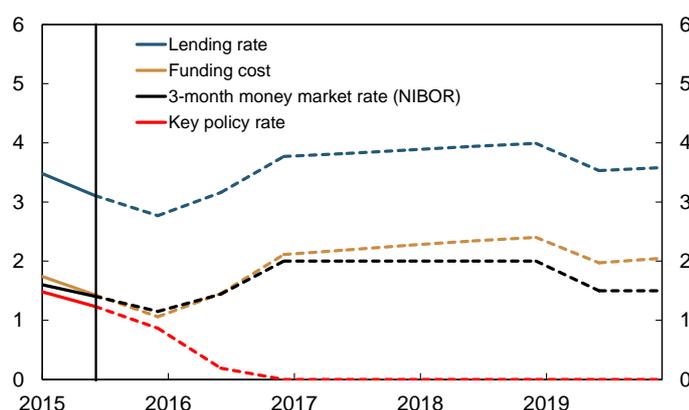
<sup>17</sup> No extraordinary liquidity measures are implemented. Fiscal policy follows the baseline scenario in the September 2015 *Monetary Policy Report*.

## 8.2 Macro bank developments

The stress test is conducted for a macro bank comprising seven large Norwegian banking groups: DNB Bank, Nordea Bank Norge, SpareBank 1 SR-Bank, Sparebanken Vest, SpareBank 1 SMN, Sparebanken Sør and SpareBank 1 Nord-Norge. The macro bank's CET1 capital requirement increases, in principle, to 13.5 percent from 1 July 2016, in accordance with the requirement for systemically important banks. In the stress scenario, it is assumed that the countercyclical capital buffer is switched off, resulting in a Pillar 1 CET1 capital requirement of 12.0 percent.

Bank lending, especially to non-financial enterprises, falls throughout the stress period and contributes to reducing total assets. Banks are assumed to pay out 30 percent of their profits for the financial year 2015 in dividends, but there are no dividend payments during the stress period. Each individual bank adjusts its lending rates to achieve the same margin against their funding costs as before the stress period. Funding costs remain high throughout the stress period despite cuts in the key policy rate. This results in an increase in the macro bank's lending rate (Chart 8).

**Chart 8** The macro bank's lending rate and funding cost, money market rate and key policy rate in the stress scenario.<sup>1)</sup> Percent. 2015 – 2019<sup>2)</sup>



1) Semiannual averages.

2) Projections for 2015 Q3 – 2019 Q4.

Sources: SNL Financial and Norges Bank

Loan losses in the stress period are calculated assuming loss given problem loan rates (LGPL) of 25 percent for new problem loans to households and 40 percent for new problem loans to enterprises. Moreover, it is assumed that banks will have to recognise impairment losses of 30 percent of their equity holdings and 5 percent of their fixed income portfolio at the beginning of the stress period. For the rest of the stress period, net income from securities or other financial instruments is assumed to revert to the pre-stress period level.

High loan losses lead to weak results and the macro bank incurs a loss throughout the stress period (Table 2). The CET1 capital ratio falls to 8 percent at the end of the stress period (Chart 7). The fall in total assets cushions the fall in the leverage ratio. In the CET1 capital ratio, this effect is countered by higher risk weights as a result of higher shares of problem loans. This illustrates the less cyclical character of the leverage ratio as a measure of solvency.

The macro bank breaches the total CET1 capital requirement of 12.0 percent at the end of 2016, but is well above the minimum CET1 capital requirement of 4.5 percent. The result indicates that the macro bank holds sufficient capital to survive the stress scenario. However, there are a number of elements of uncertainty. One factor that may influence the results is the extent to which banks maintain interest margins throughout the stress period. Another element of uncertainty is the magnitude of losses on loans to households. The empirical basis is weak (see the analyses in the box “Losses on loans to households” in FS 2014). A large portion of Norwegian banks’ lending to the enterprise sector is to commercial real estate and construction. In the event that losses on these loans are higher than assumed in the stress test, capital adequacy could be significantly impaired.

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The bank model generates projections of a large number of variables, which can be used as checkpoints for the macro scenario and to assess how well the different projection rules work. Table 2 shows developments in some key variables for the macro bank:

**Table 2:** Key figures for the macro bank in the stress test in FS 2015 (in billions of NOK<sup>1)</sup>)<sup>2)3)</sup>

	2015	2016	2017	2018	2019
Net interest income	55	57	54	53	49
Securities losses in 2016 Q1		23			
Loan losses	6	65	68	64	60
of which:					
Losses on loans to non-financial enterprises	5	57	58	53	48
Losses on loans to households	1	8	10	11	12
<i>Loan losses as share of gross loans</i>	0.2%	2.5%	2.6%	2.6%	2.4%
Profit after tax	32	-29	-16	-15	-15
Net lending to customers	2 580	2 558	2 499	2 410	2 365
Total assets	3 715	3 544	3 462	3 340	3 272
<i>Annual growth in total assets</i>	2.1%	-4.6%	-2.3%	-3.5%	-2.0%
Risk-weighted assets (with the transitional rule)	1 817	1 830	1 869	1 890	1 893
<i>Annual growth in risk-weighted assets</i>	1.6%	0.7%	2.1%	1.1%	0.2%
Common Equity Tier 1 (CET1) capital	254	214	192	171	151
CET1 capital ratio (with the transitional rule)	14.0%	11.7%	10.3%	9.1%	8.0%
CET1 capital ratio (without the transitional rule)	15.9%	12.5%	10.8%	9.5%	8.4%
Tier 1 capital / Total assets <sup>4)</sup>	7.4%	6.6%	6.1%	5.7%	5.2%

1) Unless otherwise stated.

2) Balance sheet figures and CET1 figures at year-end. Income statement figures for the whole year.

3) Projections for 2015 Q3 – 2019 Q4

4) This ratio is an estimate of the leverage ratio.

Sources: SNL Financial and Norges Bank

Table 2 also shows projected CET1 capital ratios without the transitional rule. Because of the increase in average risk weights through the stress period, the difference between CET1 capital ratios with and without the transitional rule is reduced. This shows that the transitional rule is a backstop mechanism that reduces the procyclicality of reported capital ratios in a crisis period.

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