Using external information to measure credit risk

The Riksbank regularly analyses the banks' resilience and tries to test it with regard to possible events. This article presents a model that enables us to test in a more coherent manner the development of the banks' credit risks – their largest risks – under different assumptions and different events. With the aid of a readily-available portfolio model and information from the annual reports, it is possible to better capture risks that are difficult to spot, such as diversification effects and concentrations and in this way better understand the dynamics of the banks' credit granting.

As a part of its stability analysis, the Riksbank assesses the banking system's resilience to various shocks that can arise in the economy. The banks' activities are dominated by lending, which means that credit risk is by far the largest individual risk factor in the banking system. A model for the banks' credit risks would enable a more coherent picture of how credit risks develop given different assumptions and sequences of events.

The Riksbank has therefore worked out a method of measuring credit risk in the four major Swedish banks, using a readily-available portfolio model and information from the banks' annual reports. The idea is that the resilience of the banks is reflected in the size of the capital buffer they hold in relation to the credit risk measured in their loan portfolios. Many banks use similar methods to calculate their credit risks. When the banks do this, they use information that is not publicly-available. We have chosen to use information to which all agents have access. However, this information is rough and does not take into account the banks' ability to judge risk and collect debts. The difference in the calculated credit risk among the banks relies solely on the exposures the banks have to various categories of borrowers.

Despite some deficiencies and simplifications, this method enables us to better capture risks that are difficult to spot, such as diversification effects and borrower concentrations. It also becomes possible to further link together the analyses of borrowers and banks. This increases the understanding of the dynamics in the banks' credit granting.

The article begins with a discussion of what a portfolio approach entails and which data are generally needed. After this, a portfolio model is applied to the four major Swedish banks. The third section presents the results for the banks' loan portfolios for the years 2002-2005. Finally, we demonstrate how the method can be used in the stability analysis, by stress testing the banks' loan portfolios in relation to various events, such as a deterioration in credit quality.

Portfolio analysis of credit risk

A credit granter who approves a loan must assess the probability that the borrower cannot repay the loan.[79] This expected probability for payment default can vary over time, which gives rise to credit risk.

Banks which have a large number of borrowers must take into account the fact that the expected default frequency may covary to some extent between different borrowers in order to assess the credit risk in their loan portfolios. A portfolio model makes it possible to calculate the probability that loan losses of various sizes may arise in existing portfolios. The focus of the analysis is thus on the risk of a negative outcome. The portfolio model takes into account how much risk an individual credit contributes to the total portfolio.

In order to calculate the risk in the loan portfolio, information is needed regarding:

- The composition of the portfolio

The composition of the portfolio is seen in the size of the credit exposures to different categories of borrower.

- The probability of default

This probability shows to what extent a borrower can be expected to default on payments on average.

- Recoveries

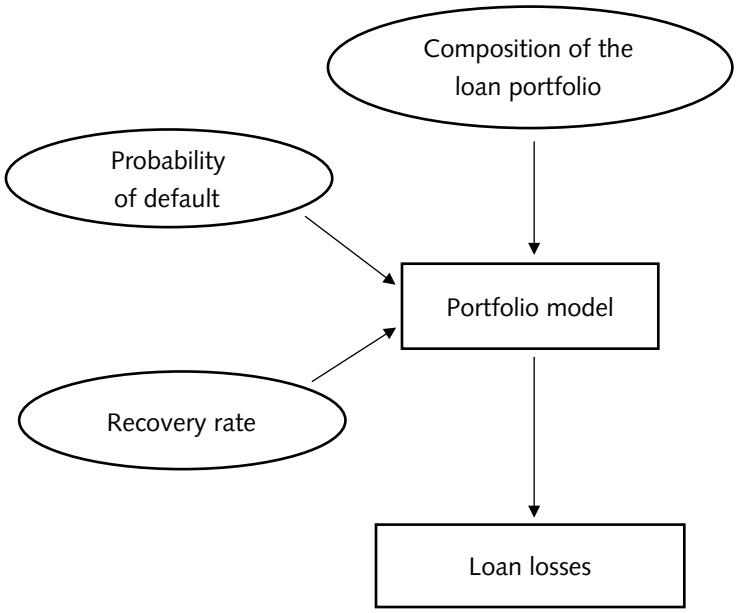
The size of the bank's loss given default (LGD) is affected by how much of the original debt can be recovered in bankruptcy proceedings. When the cost connected with the bankruptcy is low and the collateral that forms the basis for the credit can be realised at a value close to the original debt, the degree of recovery is high.[80] This means that the lender recovers a large part of the amount lent. Banks that usually only grant credit to borrowers with strong cash flows and acceptable collateral often have a high degree of recovery in their loans.

The analysis framework can be roughly summarised as shown in Figure 1.

79 This can be done either through making one's own assessment, using a credit rating, a reduced or structural model. One example of a structural model is Moodys' KMV Credit Monitor.

80 The recovery rate shows what part of the original amount lent the lender will receive in the event of a payment default.

Figure 1. Calculating loan losses with a portfolio model

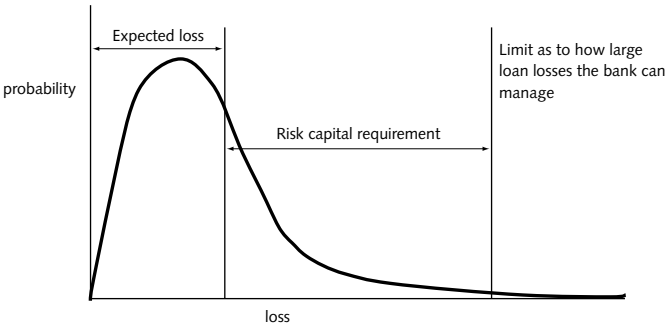


Calculation of losses – expected and unexpected

With this information it is possible to use a loan portfolio model to calculate potential loan losses in the form of a loan loss distribution. This shows with what probability loan losses of various sizes will occur – from the possibility of no loan losses occurring to the loss of the entire loan portfolio.

This approach makes it possible to study the banks' credit risks. We use two measures to quantify the loan losses the banks may face. These are the measure of the expected loss that states how much the bank expects to lose in its current portfolio, and the measure of how large additional losses on top of the expected losses might be. Figure 2 reproduces a loan loss distribution for a purely hypothetical loan portfolio.

Figure 2. Loss distribution for a hypothetical loan portfolio



The banks compensate themselves for the expected loss through a risk premium on the price of loans in their regular operations. If the expected loss in the portfolio increases, it may mean that the bank's costs increase as a result of increased reserve funds.

The banks hold a buffer to cover possible loan losses above those expected; let us call this the risk capital requirement. Loan loss distribution makes it possible for the banks to calculate the size of this need given a tolerance level.[81] The unexpected loan loss – and thereby the need for risk capital – also affects the prices the banks set for their loans. This is because holding capital entails a cost for the banks in the form of a return on investment requirement from the shareholders, and the banks must compensate themselves for this.

The amount of capital the bank requires to cover unexpected losses depends on the loan loss distribution. The greater the probability of extreme outcomes, that is to say, the more outcomes that lie far to the right of the distribution, the greater the need for risk capital.

If, in addition, the default frequency covaries between individual loans – there is a low degree of diversification – the need for risk capital will be even greater. The degree of diversification, and thereby the risk capital requirement, is affected by how much unique and how much systemic risk there is in the portfolio. Unique risk is the risk that is unique to the individual loan and can be eliminated by diversification with other loans in a portfolio. Systemic risk, on the other hand, affects all assets in the portfolio and cannot be eliminated by diversification.

The credit risk in a portfolio declines with increased diversification. An increase in diversification can be attained by increasing the number of exposures and the percentage of unique risk in the portfolio. A portfolio with exposures spread across many borrowers and with little covariation in the default frequency has a low credit risk. The portfolio is then said to be well-diversified. The reverse applies if the portfolio consists of exposures with a high covariation in the default frequency. If the portfolio is also dominated

81 The banks determine the tolerance level on the basis of how much of the possible total loan losses they can cover. Covering 100 per cent is unreasonable, as it would entail excessive costs. The commercial banks usually calculate their risk capital requirement at a tolerance level of 99.97 per cent. The choice of tolerance level reflects the credit rating the bank receives. A tolerance level of 99.97 corresponds to an AA rating.

by a few large exposures, it is said to have concentration. This further increases the total credit risk in the portfolio. With this kind of portfolio, a credit granter has to hold more capital as a buffer against unexpected loan losses in order to retain resilience than is necessary for a credit granter with a well-diversified portfolio.

The resilience a bank has to loan losses ultimately depends on the capital it holds in relation to the calculated risk capital requirement. It is not necessarily a bad thing for a bank to have a loan portfolio with a high credit risk, as long as the bank has sufficiently large capital. The banks' task is, among other things, to take on risk in order to provide borrowers with credit.

The total loan losses a bank suffers can therefore be much larger than expected. If the total loan losses were to exceed the bank's capital, the bank will experience problems. It is this type of extreme loan losses – far out on the right-hand tail of the distribution – that are of interest in the Riksbank's stability analysis. The portfolio model gives us the opportunity to test whether the banks are approaching this limit or perhaps even exceeding it.

Application of the portfolio model to Swedish banks

The Riksbank has used a readily available portfolio model, CR+, to calculate the credit risks in the four major Swedish banks for the years 2002–2005.[82] Information on the composition of the credit portfolios is collected from the banks' annual reports. However, all of the information necessary for a portfolio model is not available there. A description of our mode of procedure to apply this model to the major Swedish banks follows below.

THE COMPOSITION OF THE LOAN PORTFOLIO

The banks' annual reports describe how lending is broken down into regions (countries) and sectors (household, corporate sector, credit institutions and public sector). For the corporate sector there is also a description of different industries. We have also used the same degree of detail regarding the breakdown of the lending into different borrower categories in our credit risk analysis.[83]

Nordea is the bank that shows the largest geographical diversification, followed by SEB. Handelsbanken (SHB) and Föreningssparbanken (FSB) are both geographically concentrated on Sweden and have only minor operations abroad.

For some of the countries, particularly developing countries, there is no sector or industry breakdown in the annual reports. Here it is assumed that the borrower has the same credit rating as the country in question. A more detailed report of the banks' lending for the year 2005 is given in the box below.

82 The credit portfolio model drawn up by the Swiss investment bank Credit Suisse First Boston (CSFB) is available at their website http://www.csfb.com/institutional/research/assets/creditrisk.pdf. See also the article "A comparative anatomy of credit risk models" by Michael Gordy in the Journal of Banking and Finance 24 (2000) pp 119-149, for a description of CR+.

83 The credit risk analysis could be based on the borrowers' individual credit quality. However, this analysis contains a standard breakdown of the borrowers' credit quality in all four major banks. The borrowers are allocated a credit quality depending on which borrower category they belong to. The same allocation of credit quality according to borrower category is applied to all of the banks.

The major banks' lending

The major Swedish banks' lending activities differ with regard to where and to whom they lend money. Their various operations make them sensitive to different economic events. The banks' annual reports provide a rough estimate of how their lending is divided up into different countries and borrowers.

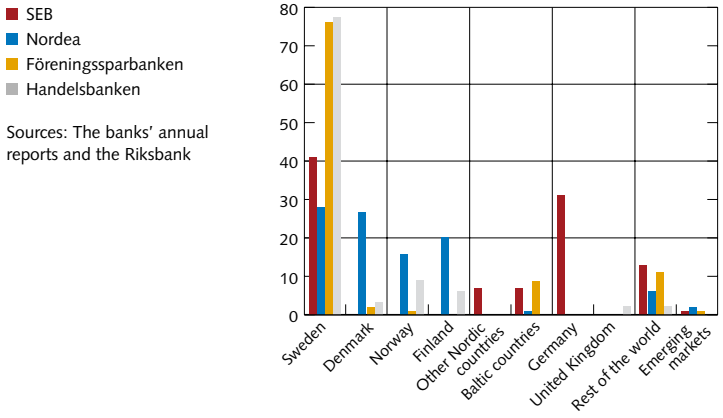
All of the four major banks have the largest percentage of their lending in Sweden, although the size of this percentage differs. SHB and FSB have more than three quarters of their total lending in Sweden, while the corresponding figure for SEB and Nordea is less than half.

SEB is geographically concentrated on Sweden and Germany, which together account for just over 70 per cent of the lending. However, lending in Nordea is relatively evenly distributed between Sweden, Denmark, Finland and Norway. Lending in these countries accounts for just over 90 per cent of Nordea's total lending. In the Baltic countries, it is primarily SEB and FSB that are active, with the share of their total lending amounting to 7 per cent and 9 per cent respectively.[84] All of the four major banks have only a marginal part of their lending to customers in emerging markets (See Figure B1).

When one looks at different customer categories, all of the four major Swedish banks have a relatively large part of their lending to the household sector, between 30 and 40 per cent. SHB has the largest percentage of lending to property companies, just over 30 per cent. Nordea has substantial lending to the remainder of the corporate sector, more than 30 per cent. Lending to public administration accounts for only a marginal part of the banks' lending activities, with the exception of SEB, where it amounts to just over 15 per cent of total lending by the bank (See Figure B2).

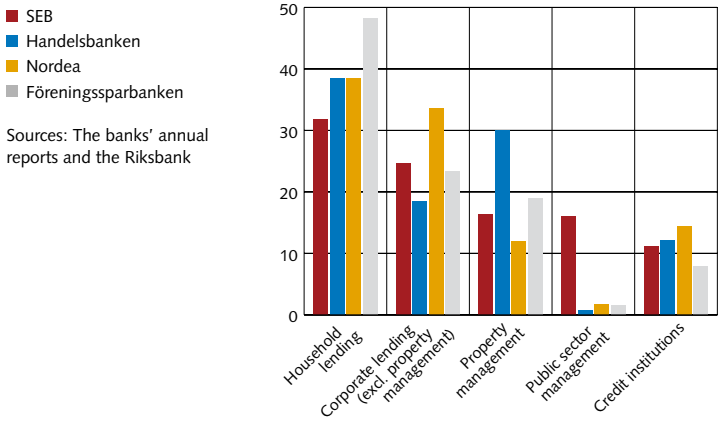
The corporate sector (excluding property management) is broken down into different industries in the banks' annual reports. For several of the major banks the manufacturing industry is the largest individual borrower category among companies (see Figure B3). SEB also lends a relatively large share to other service companies and SHB lends to the retail and service industries. Nordea has a relatively even spread across different company sectors,

Figure B1. Lending, geographical breakdown
Per cent



Sources: The banks' annual reports and the Riksbank

Figure B2. Lending, sector breakdown
Per cent



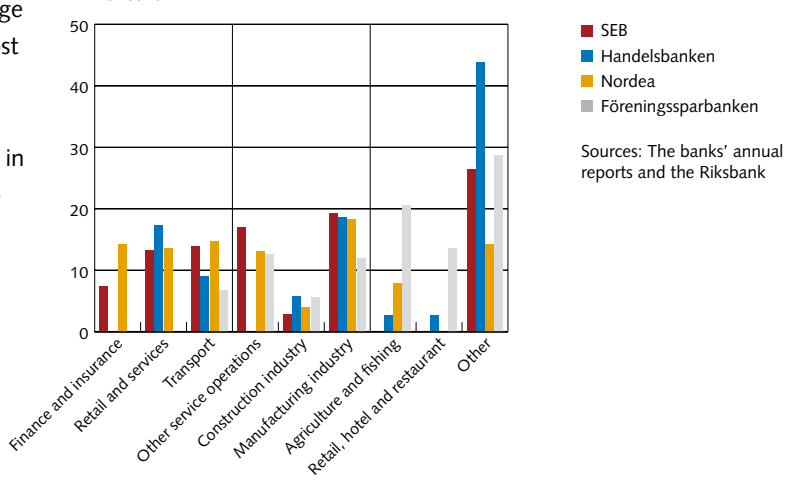
Sources: The banks' annual reports and the Riksbank

84 The major banks' lending in the Baltic countries is described in more detail in Financial Stability Report 2005:2 (box). The figure for SEB also includes operations in the Ukraine and Russia.

while FSB's individually largest corporate lending is to agricultural companies. SHB reports a large part of its corporate lending as "other" (almost 45 per cent).

To sum up, Nordea is the bank that demonstrates the largest geographical spread in its lending, followed by SEB. SHB and FSB are both geographically concentrated on Sweden and have only minor shares abroad.

Figure B3. Corporate lending, industry breakdown
Per cent



Sources: The banks' annual reports and the Riksbank

PROBABILITY OF DEFAULT

There is relatively good information on expected default frequency regarding companies. We have chosen to use available year-end and share data to calculate the default frequencies for this borrower group.[85] However, this model only includes data for listed companies, which have thus been used as the basis for a default measure for both listed and unlisted companies.[86]

There is no corresponding information on credit risk for households. Nor for the public sector. Default probabilities for these borrower groups must quite simply be based on assumptions regarding industry practice.

In order to capture the default probability linked to exposures to countries, we have used information from credit rating companies.

RECOVERY

There are no readily available, fully-comprehensive statistics on degrees of recovery in Swedish or other European banks' credit granting. We are therefore basing the assumptions on degrees of recovery for company exposures on US data regarding industry-specific degrees of recovery from the bond market. Studies show that the loss level for the observed companies is on average around 50 per cent.[87]

A recovery degree of 90 per cent has been assumed for the mortgage institutions' lending. This high degree is motivated by the underlying collateral for these loans. Here we have used discussions with industry representatives as a basis for making our own assumptions.[88]

Degrees of recovery linked to exposures to countries, primarily developing countries, have been assumed to be relatively low, 30 per cent. This is based partly on uncertainty regarding the underlying collateral and partly on economic developments in the country as a whole.

CREDIT QUALITY

In addition to these basic data in the model, we have divided the exposures into different credit qualities. This breakdown does not regard the entire exposure as one single credit. All borrowers who belong to an industry or sector are therefore not expected to fail simultaneously. This achieves a rough reflection of actual conditions. The Swedish banks that have internal systems for classifying their

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85 Expected default frequencies one year ahead can be obtained with the aid of Moody's-KMV (monthly data going back 5 years). A description of Moody's-KMV's Merton-based EDF measure can be found in "Modelling Default Risk", December 2003, Moody's-KMV. See also Persson & Blåvarg "The use of market indicators in financial stability analysis" in Sveriges Riksbank Economic Review 2003:2.

86 The reasoning behind this is that listed companies reflect the credit risk connected with the industry in which they operate and that problems in large, listed companies would have repercussions on sub-contractors and smaller companies. Therefore, we have used industry-wide EDFs based on information from listed companies as a proxy for both listed and unlisted companies in the same industry.

87 Altman, Edward I., and Vellore M. Kishore, "Almost Everything You Wanted to Know about Recoveries on Defaulted Bonds" Financial Analysts Journal, (Nov/Dec-1996).

88 A recovery rate of 90 per cent is also the highest permitted according to Basel II.

credits have many credit classes for exposures in their portfolios. [89] However, these could be roughly divided into three classes, and we have therefore chosen to divide the exposures included in the annual reports into this many categories:

- 10 per cent with quality below average
- 10 per cent with quality above average
- 80 per cent with average credit quality

Table 1 below shows how data entered into a credit portfolio model for a stylised bank with operations in Sweden, Norway and China could look:

Table 1. Data in the applied portfolio model

Country	Name	Exposure	LGD	Exposure *LGD	Average default probability	Standard deviation	Expected loss
Sweden	Household, *quality1*	100	20%	20.0	0.05%	0.05%	0.01
bank	Household, *quality2*	800	20%	160.0	0.10%	0.10%	0.16
	Household, *quality3*	100	20%	20.0	0.20%	0.20%	0.04
	Manufacturing, *quality1*	100	40%	40.0	0.13%	0.05%	0.05
	Manufacturing, *quality2*	800	40%	320.0	0.39%	0.20%	1.26
	Manufacturing, *quality3*	100	40%	40.0	1.18%	0.65%	0.47
Sweden	Household, *quality1*	100	10%	10.0	0.05%	0.05%	0.01
Mortgage	Household, *quality2*	800	10%	80.0	0.10%	0.10%	0.08
institution	Household, *quality3*	100	10%	10.0	0.20%	0.20%	0.02
	Manufacturing, *quality1*	100	10%	10.0	0.13%	0.05%	0.01
	Manufacturing, *quality2*	800	10%	80.0	0.39%	0.20%	0.32
	Manufacturing, *quality3*	100	10%	10.0	1.18%	0.65%	0.12
Norway	Household, *quality1*	60	30%	18.0	0.05%	0.05%	0.01
	Household, *quality2*	480	30%	144.0	0.10%	0.10%	0.14
	Household, *quality3*	60	30%	18.0	0.20%	0.20%	0.04
	Manufacturing, *quality1*	60	50%	30.0	0.28%	0.20%	0.08
	Manufacturing, *quality2*	480	50%	240.0	1.35%	1.09%	3.25
	Manufacturing, *quality3*	60	50%	30.0	4.78%	4.46%	1.44
China	Country	20	60%	12.0	0.05%	0.10%	0.01

The annual report gives exposures broken down by different sectors/industries for each country. According to the method above, these exposures are then divided into three credit qualities. Each credit quality has thus its own set of data; column 3 shows the exposure to the respective borrower category stated in the annual report. The forth column shows the percentage of the outstanding credit that is expected to be lost in a payment default, here referred to as LGD. The size of this LGD varies across different sectors/industries, but is the same for different credit qualities within the same sector/industry. For each credit class in the respective borrower category an average

89 This assumption is based on two Swedish banks' internal systems for classifying credits; Jacobsson, Lindé and Roszbach, the Riksbank's Working Paper series no 155 "Internal Rating Systems, Implied Credit Risk and the Consistency of Banks' Risk Classification Policies"

default proability and its standard deviation are reported in the two following columns.[90] To achieve the expected loss, EL, the exposure is multiplied by the LGD and the probability of default. The total of all exposures' expected losses comprises the portfolio's expected loss. This breakdown means there will be between 300 and 350 exposures in the banks' portfolios.

THE SIGNIFICANCE OF COVARIATION FOR THE RISK CAPITAL REQUIREMENT

In CR+ the credit risk is captured by the variation around the expected default probability for each individual exposure. This variation can consist of both the variation that is unique to the individual exposure and the variation that is common to all exposures.

The credit portfolio in the example above has two extreme cases regarding what governs the risk in the portfolio. In the one extreme case it is assumed that all variation around the probability of a payment default for each individual exposure is only affected by a systemic risk factor. This assumption enables us to capture all types of concentration risk that may exist in a portfolio, as the outcome for each individual exposure then covaries completely. In this extreme case, the risk capital requirement in the portfolio can be obtained by adding together the risk capital requirement for the individual exposures.

In the other extreme case, all variation in the EDFs is due to unique factors linked to each individual exposure. The risk capital in this extreme case will be lower than in the other extreme case described. The lower risk capital requirement is due to each independent credit entailing a diversification effect in the total portfolio.

As we want to be able to capture both concentration and diversification effects in the banks' portfolios, we have to distinguish which part of the variation in the EDF stems from a credit's unique characteristics and what can be ascribed to the variation common to all of the loans in the portfolio.

This breakdown has been made by estimating how large a part of the variation in an exposure's default probability covaries with the default probability for all exposures.[91] One of the features of the chosen method is that it is easy to change this breakdown in order to test the resilience of the banks.

90 Moody's KMV provides industry EDF measures per country. In order to take into account the different credit qualities, we have produced them for three different risk classes; the 25 per cent poorest, the median and the 25 per cent best credits for each industry. The standard deviation is estimated on the basis of monthly data regarding EDF for the past 5 years.

91 It would have been desirable to use information on each company in the portfolio. However, we must use information on listed companies, which have therefore had to serve as proxy for all companies. "All exposures" must therefore be represented by all listed companies included in KMV's database.

Some results from the model

Figure 1 shows the banks' expected losses as a percentage of their loan portfolios. SHB and FSB have the lowest outcomes. This is probably due to their large mortgage institutions. Lending via these institutions is linked to low risk, as the majority of the loans are mortgages with good collateral for the loans. The expected default probability is therefore low and the recovery rate is high, which leads to lower expected losses. All of the banks except SEB show a reduction in expected losses during the period 2002–2005, which indicates a reduction in loan losses in their portfolios. That is the actual development that can be seen in the banks during this period.

The reason why SEB's expected loss is high since 2004 is that their large exposures on the German market, particularly with regard to property companies, show an increased in expected default probability. [92]

The outcome for the major banks' risk capital requirement shows a relatively large spread between the banks, which can be seen in Figure 2. [93] However, the levels have moved closer to one another during the two latest years. At that point in time, the risk capital requirement declines for all of the banks except FSB. The fact that FSB's risk capital requirement increased in 2004 was largely because they acquired the whole of Hansabank. The expansion in the Baltic countries has two opposing effects on the risk capital requirement. On the one hand lending to borrowers in this region is associated with higher risk than credit granting in the remaining part of FSB's credit portfolios which results in a higher risk capital requirement. On the other hand, the expansion in the Baltic countries increases the geographic diversification which affects the risk capital requirement in the opposite direction.

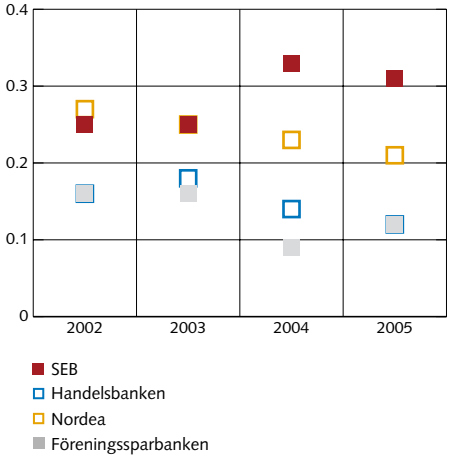
The result shows that the outcomes for expected loan losses and risk capital requirement for the different banks do not necessarily follow one another. It is therefore necessary to take into account both of these measures to obtain a comprehensive assessment of the banks' credit risks.

Figure 3 shows the banks' expected losses and risk capital requirement in relation to one another. [94] The further to the right of the Figure the bank is located, the greater the percentage of the portfolio that consists of expected loss, and the higher the bank's position in the Figure, the larger the percentage of risk capital.

According to the calculations, Nordea has a relatively high expected loan loss, but low risk capital requirement. The fact that the risk capital requirement is low is probably because Nordea has a broad geographical spread in its exposures – the portfolio is therefore more diversified and the risk of extreme cases is thus reduced.

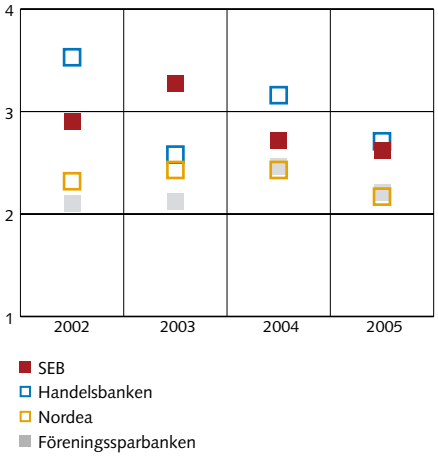
92 According to Moody's KMV's calculation of EDF.
93 In CR+ the financial capital has been calculated at a level of 99.9 per cent, while the banks themselves usually calculate financial capital at a level of 99.97 per cent.
94 The figures represent the banks' average expected losses and risk capital requirement for the period 2002–2005.

Figure 1. Expected loss as a percentage of the bank's credit portfolio
Per cent



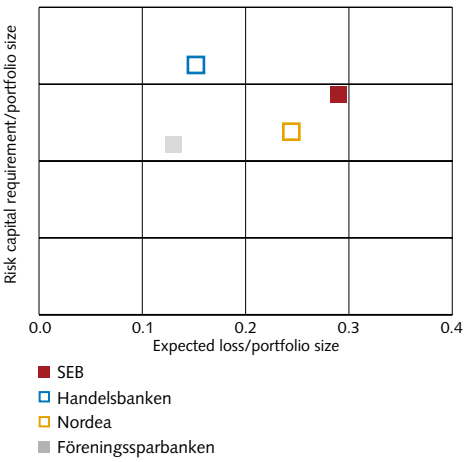
Source: The Riksbank

Figure 2. Risk capital requirement as a percentage of the bank's credit portfolio
Per cent



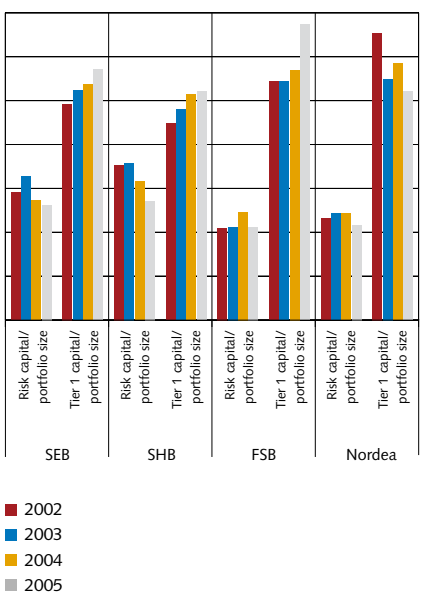
Source: The Riksbank

Figure 3. Expected loss and risk capital requirement as a percentage of the bank's credit portfolio



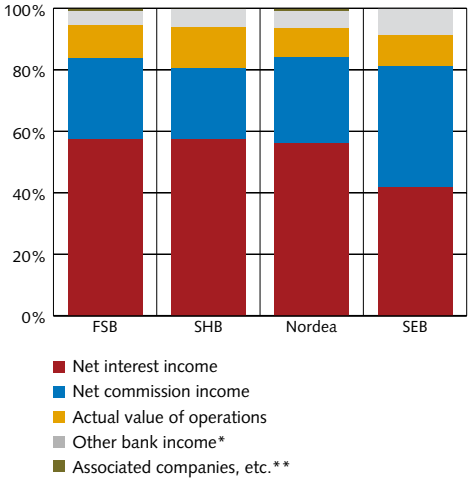
Source: The Riksbank

Figure 4. Risk capital and Tier 1 capital in the banks
Per cent



Source: The Riksbank

Figure 5. Income breakdown in the four major banks
Per cent



* Including dividends received

** Including insurance results

Source: The banks' annual reports and the Riksbank

The high expected loss is probably due to Nordea having a large part of its mortgage lending outside of Sweden. In the model all lending to non-Swedish public is assumed to be made via banks, regardless of whether it concerns mortgages or other loans. As recovery is assumed to be lower in banks, this means that the recovery for mortgages abroad is lower.

At the other extreme, SHB demonstrates a low percentage of expected loss and a high percentage of risk capital requirement. The main reason for this is the rough industry breakdown of SHB's corporate lending which leads to a high calculated risk capital requirement.

It is not self-evident that all banks should hold the same type of well-diversified loan portfolios. The banks' business strategies determine which risk profile they have in their loan portfolios. However, the important thing is that the banks compensate themselves for the risk they take on and that they maintain a sufficient buffer of capital against loan losses. To ensure that the credit market functions efficiently, it is most probably necessary to have several types of credit-granter to service different types of borrower.

Figure 4 compares the banks' risk capital requirement with the Tier 1 capital the banks actually hold. The comparison shows that the banks maintain a much higher Tier 1 capital than the capital they must hold to cover only credit risk, according to our calculations. The buffer against loan losses is thus much greater than is indicated by the risk capital requirement.

The risks in the loan portfolio are the largest risk factor the banks take into account when they determine the level of the Tier 1 capital. In addition to credit risk, Tier 1 capital should also cover other risks, such as market risks and operational risks. The size of the buffer against loan losses is thus also dependent on the importance of the bank's other operations. The larger part of the bank's earnings that come from net interest income, the closer the calculated capital for credit risk should come to the Tier 1 capital.[95] SEB's earnings from net interest income are lower than those of the other major banks (See Figure 5). The capital we have calculated for credit risk for SEB should thus comprise a minor part of their Tier 1 capital, compared with the other three.

Naturally, there are several factors involved when the banks choose the level of their Tier 1 capital. One important factor is that

95 More about the banks' earnings can be found in the box "Net interest income and costs".

the credit rating companies' assessments of which credit rating a bank should receive are largely based on the Tier 1 capital level. The credit rating in turn affects the banks' costs for financing.

Stress tests and sensitivity analyses

The method presented here makes it possible to use readily available data to measure the credit risks in the banks and thereby their resilience to various events in the economy. We can observe that, as expected, a large mortgage institution entails lower expected losses and that diversification (geographical, or by sector or industry) reduces the need for risk capital in the model. However, the real advantage of this method is the possibility to change the data we enter into the model and study how the banks are affected by different scenarios.

The variables included can be altered to see what this would entail in terms of increasing (or decreasing) expected loan losses or risk capital requirement. Another alternative could be to search for the set of variables in the input data that provide certain threshold levels for the banks, such as changing the portfolio and seeing when the bank's capital buffer is used up.

Below we present two scenarios, where we have experimented with the variables included.

In **scenario 1** it is assumed that *the credit quality deteriorates by 5 percentage points* so that the best credit class now only contains 5 per cent of the credits, while the worst contains 15 per cent. There are still 80 per cent of the credits that hold an average class.

The result shows that this deterioration in quality would mean that the expected loss in the banks' average portfolio increased by 27 per cent. This could be interpreted as the banks needing to increase their reserves by the same amount. At the same time, the banks' risk capital requirement would increase by an average of 9 per cent. The extra capital requirement may already exist within the bank. However, this would reduce the buffer against further negative outcomes and thereby reduce resilience in the bank towards external shocks.

In **scenario 2** it is assumed that *loss given default increases by 10 percentage points across the entire portfolio*.[96] The result shows that such a deterioration in the degree of recovery would increase both expected loss and risk capital requirement by roughly the same percentage as in scenario 1.

Table 2 Result of sensitivity analysis

	Δ Risk capital requirement	Δ Expected loss
Scenario 1	9%	27%
Scenario 2	15%	26%

Note. Change on average for the four major banks 2002–2005.

96 For example, changes in the preferential rights, which entail lower expected recovery.

Concluding comments

We have presented in this article a method for attempting to measure and assess the resilience of the banking system. This is based on the four major banks' annual reports to obtain a rough estimation of their loan portfolios. To gain a picture of the credit risk, we need a portfolio model. This type of analysis requires information regarding how much of a loss the bank recovers and the probability of the various borrowers defaulting on payments. The information on recovery is based primarily on US data. Default probabilities are based on accounting data and share data and, where this is not available, on industry practice. By then using this information in combination with a readily-available credit risk model, we can obtain an idea of the credit risk in a specific lending portfolio. As we do not make any assumptions about individual banks' ability to assess credit, etc. the differences between the banks are solely due to the composition of borrowers.

The method enables us to make different kinds of stress tests and scenario analyses. All of the variables included can be altered to see how this would affect the banks' loan losses and capital requirement. One possibility is to test an isolated event – a deterioration in a specific industry or a specific country – to see what impact it has on the different banks. More general macro scenarios, such as an economic downswing with a general deterioration for all borrowers can also be adapted to the input data and tested.

In our work on this method we have become aware that there are differences between the banks regarding the external information they report. Minor measures by the banks could significantly improve the possibilities for assessing credit risk in the banking system.

These measures largely concern two areas. The first is the banks' breakdown of corporate loans by industry. It would appear reasonable for this breakdown to follow the same standard in all of the banks, but that is not the case at present. The other area concerns the breakdown of the outstanding loans into different credit qualities. A breakdown into credit qualities/credit classes could provide a simple means for external analysts to assess information on how the risk of defaulting is distributed in the loan portfolio. The new capital adequacy rules that are to be implemented in Swedish legislation with effect from January 2007 will require that the banks provide external parties with this type of information.