FINANSINSPEKTIONEN

Market risks management

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CONTENTS

Summary

During 2011, Finansinspektionen (FI) investigated how 11 financial companies market risks management. 'Market risk' refers to the risk of loss-incurring value changes in assets and liabilities due to fluctuations in interest rates, foreign exchange rates, stock prices and commodity prices. Market risks often arise during normal business transactions, e.g. within client-driven trade or during lending/borrowing transactions. In some cases, companies actively expose themselves to market risks in order to earn money, which is referred to as 'proprietary trading'. To a certain extent, companies can choose the level of market risk exposure via hedging, an investment strategy used to mitigate or eliminate risk.

As a whole, FI has observed that the majority of companies included in the investigation in general do not satisfactorily prioritise their management of market risks. The quality of the risk management varies considerably; some companies have very good risk management while others have needed or will need to take measures to improve their risk management.

Finansinspektionen has the capacity to intervene with sanctions against companies who break the rules. However, this does not mean that Finansinspektionen should always choose to exercise this right. Often, Finansinspektionen chooses to hold discussions with the company management rather than resort to formal sanctions. In this case, the deficiencies that have been found are definitely cause for concern but are on the whole not serious enough to warrant sanctions. This is partly because the deficiencies have not been so tangible that they have typically offered a threat to the companies. Moreover, all of the companies concerned have quickly and resolutely begun work on improvement measures to reduce the risks.

FI determined during the investigation that, in some cases, the companies exclude risks which are not considered 'of non-negligible significance' and therefore should have been taken into account in the companies' systems for market risk management. These risks are identified in the report as significant risks.

FI also noted that risk reporting often does not take into account the manner in which the financial instruments are valued from an accounting perspective. It is often not possible to determine from the risk reporting which instruments in the accounts are valued at fair value on an ongoing basis and which are valued at amortised cost. This means that the bank cannot compare the risk measure to its profit/loss. Risk reporting that has been designed to provide an overview of the total risk per accounting classification is therefore often necessary.

The majority of the companies in the investigation need to make improvements in a number of areas, and these improvements should also be of interest for other actors.

Absence of general market risk measures in operating activities

A general risk measure is a measure that includes all significant risks in a company and, where applicable, a financial group. This measure is often calculated using a Value-at-Risk model (VaR) or a scenario analysis.

Few of the companies, and in particular the smaller companies, in the investigation use general risk measures in their operating activities. As a result, these companies have difficulty gaining a comprehensive overview of their total risk.

Simplified risk matrices

A risk matrix is a simple simulation of gains or losses that arise when applying different rates of change to prices and volatilities. This analysis is often applied to a portfolio of financial instruments. The companies in the investigation relatively often applied this method in a manner that enabled significant risks to fall outside of the risk measurement. Companies should therefore continuously evaluate the exposure of excluded risks and control them in another way if they are significant in size.

Weaknesses inherent to Value-at-Risk models and scenario analyses

A VaR model is an aggregate risk measure that can take into account a large number of risk factors. A VaR model estimates the loss a company could incur at a certain probability level using probability calculations which are based on historic data. In its investigation, FI observed a number of weaknesses in VaR models that were related to the analytical structure, choice of the historical time period and choice of risk factors. These factors are important and determine the reliability of the VaR model when measuring different types of market risks. In several cases FI found that there is a need for supplementary scenario analyses that have a special focus on the limitations of the chosen VaR model. FI also found that these supplementary analyses needed improvement in a number of companies. In general it can be said that:

- the need for supplementary historical scenario analyses increases the shorter and less representative the span of the VaR historical data is,
- the need for both hypothetical and historical scenario analyses and stress tests increases the less robust the analytical structure of the VaR is,
- all scenario analyses should specifically take into account risk factors that are excluded or estimated by the VaR model.

Insufficient risk control in treasury operations

FI observed that the methods and processes for market risk control within a company often differ depending on where the market risk exposure is located from an organisational perspective. This was particularly apparent for positions within the treasury operations. In all of the companies in the investigation, the treasury operations were significantly less transparent from a risk perspective than other areas of the company. Less sophisticated methods and fewer risk measures are used in the treasury operations and as a result several significant risks are generally not identified. More specifically, FI identified exposures to cross-currency basis swap spreads and credit spreads as two areas in which many companies need to improve their risk control. For most of the companies with foreign borrowing, cross-currency basis swap spreads represent a significant risk. FI noted that, in most cases, these risks are neither measured nor limited. Even credit spreads, which are often a significant risk in companies' liquidity portfolios, are often either reported and limited at a grossly aggregated level or not at all.

Objectives and methodology

Given the identified deficiencies in HQ Bank in 2010, which resulted in the withdrawal of the bank's authorisation, FI decided to conduct an investigation that focused on the management of market risks and the valuation of financial instruments. The investigation commenced in January 2011 and was concluded in December 2011.

The objectives of the investigation were to ensure that:

1. the market risks resulting from positions in financial instruments were identified, understood, measured, reported, limited and controlled.

2. positions in financial instruments, which from an accounting perspective were classified as being marked-to-market on an ongoing basis, were valued using recognised valuation methods and sound assumptions.

3. the financial instruments recognised at amortised cost fulfilled the definitions of the accounting categories "Loans and receivables" or "Held to maturity".

4. reclassifications of financial assets between the above-mentioned accounting categories were conducted in accordance with applicable accounting principles.

Eleven companies were selected for the investigation. FI's primary criterion for this selection was the companies' share of financial instruments in the balance sheet in relation to their balance sheet total. The following companies were included in the investigation:

ABG Sundahl Collier AB
Aktiebolaget Svensk Exportkredit
Carnegie Investment Bank AB
Erik Penser Bankaktiebolag
E. Öhman J.or Fondkommission AB
Kommuninvest AB
Nordea Bank AB
SBAB Bank AB
Skandinaviska Enskilda Banken AB
Svenska Handelsbanken AB
Swedbank AB

One conclusion that was drawn from the HQ Bank case was that it may be necessary to conduct a detailed portfolio analysis, in some cases down to the level of individual positions, to determine if a company has satisfactory risk control. The methods that are appropriate for measuring and controlling risk vary depending on the specific risk profile of the portfolio in question. For this reason, FI conducted an independent market risk analysis of each company's holdings of financial instruments and then compared this analysis to the company's own reports and methods.

This method consisted of four steps:

- FI requested detailed data on individual positions for the last day of the second, third and fourth quarters of 2010 for each company

included in the investigation. Smaller companies were requested to provide information about all positions assigned from an accounting perspective to fair value categories. For the four major banks, a random sample of position data for certain portfolios was requested. FI also requested that the companies submit their internal risk reports and internal instructions and guidelines.

- The position data was analysed during the spring and summer of 2011 to create an independent overview of the market risks in each company.
- FI's risk overview was then compared to each company's risk reports, internal instructions and guidelines.
- FI then made its assessment based on how well FI's risk overview reconciled with the risk overview of the company.

An ongoing dialogue was held with the companies during the course of the investigation and, during the autumn of 2011, onsite visits were made at eight of the eleven companies. The objective of the onsite visits was to further analyse and gain insight into the strengths and weaknesses of the methods used to identify, measure, report, limit and control market risks.

During its investigation, FI was able to identify "few significant weaknesses regarding the accounting of financial instruments" (Objectives 2-4 on the previous page). This report therefore focuses on the weaknesses in the companies' market risk controls (Objective 1). FI has chosen to highlight the weaknesses found in four areas:

- General risk measures
- Risk matrices
- VaR models
- Risk controls in treasury operations

The report is structured as follows. First, it presents the regulatory framework currently applicable to the management of market risk. It then describes the weaknesses identified during the investigation and FI's views on these weaknesses. It concludes with a chapter dedicated to the classification of financial instruments under IFRS and the effect this has on how the risk control should be designed.

Regulatory framework regarding management of market risks

General provisions regarding companies' risk management are set forth in the Banking and Financing Business Act (2004:297) and the Securities Market Act (2007:528). These acts state that a company shall identify, measure, steer, internally report and maintain control over the risks associated with its business. Furthermore, companies shall in particular ensure that their credit risks, market risks, operational risks and other risks as a whole do not jeopardise their ability fulfil their obligations.

In order to comply with the provisions of the law, companies should have methods in place to regularly measure and maintain sufficient capital to cover the nature and level of the risks to which the companies are or may be exposed. This provision is a framework provision, which means that the companies have both an obligation and an opportunity to design appropriate risk management systems that are tailored to their unique business requirements.

The Capital Adequacy and Large Exposures Act (2006:1371) (Capital Adequacy Act) contains provisions which state that financial groups shall fulfil the risk management requirements at the group level. This means, for example, that risk management systems should be in place to monitor the aggregate risks of the group, the group should have sufficient capital to cover all risks in the operations and the group should have a process in place to evaluate this capital (ICAAP).

The companies' systems for managing market risks should fulfil two general purposes. From a general risk management perspective, they should sufficiently provide the companies with a good understanding of the size of the market risk and they should allow the companies to take risk mitigation measures that will ensure that their balance sheets are not exhausted. These systems can also form the basis for the companies' capital needs calculations.

Finansinspektionen's general guidelines (FFFS 2000:10) governing management of market and liquidity risks in credit institutions and investment firms1 contain guidelines for identifying, measuring, limiting and reporting market risks and the organisation of the risk control function. These general guidelines define market risk as interest rate, currency, equity and commodity risks, which expressed differently means the risk of loss-incurring value changes in assets and liabilities due to market fluctuations in variables belonging to these four types of risk.

Specific rules regarding companies' calculation of capital requirements for market risks are set forth in the Capital Adequacy Act, which specifies that market risks in this respect also include settlement risks. This means that companies must also take into account the risk of losses resulting from transactions which, for various reasons, are not settled on the agreed settlement date. The legislation provides for the use of inter-

1 Finansinspektionen's regulations (FFFS 2010:7) repeal the sections of Finansinspektionen's general guidelines (FFFS 2000:10) regarding the management of market and liquidity risks in credit institutions and investment firms that pertain to liquidity risks.

nal models when calculating capital requirements for market risks. Internal models may only be used following approval from FI.

Finansinspektionen's regulations and general guidelines (FFFS 2007:1) regarding capital adequacy and large exposures supplement the Capital Adequacy Act with more detailed rules regarding the calculation of capital requirements for market risks. The companies which have received permission to use an internal method to calculate capital requirements for market risks use a VaR model in combination with stress tests and scenario analyses. Other companies calculate their capital requirement for market risks using a standardised approach, but VaR models are often also used as a supplemental tool to manage market risks. During the investigation, FI primarily reviewed and assessed the companies' VaR models as tools to manage market risks.

According to the main rule, the companies' systems for risk management should take into account all risks. This means that the companies' systems for managing market risks must take into account all significant risks and the companies themselves must have methods in place to identify what constitutes significant risk.

The statutory proportionality principle requires that companies design their risk management systems in proportion to the nature, scope and complexity of their operations. This means that, even if most market risks are general in nature, FI takes individual conditions into account when determining if risk management systems are tailored to a company's current risk profile and the risk profile it may potentially have in the future.

General risk measures in day-to-day activities

Several companies in the investigation do not have any general risk measures, which is not satisfactory given that the companies are required to regularly measure, limit and report their total overall exposure to market risk.

The capital adequacy regulations require that a company, as part of its ICAAP, quantify the total market risks in a general risk measure in order to determine the capital need. This also applies to companies using the standardised approach to calculate capital requirements since the capital requirement under Pillar 1 must still be validated against a general risk measure. The ICAAP is usually carried out once a year at a specified point in time. However, companies may not be undercapitalised at any point in time. Therefore, in order for companies to be able to gain an understanding of the total market risk in the financial group or the individual company on an ongoing basis, the general risk measure must be regularly measured, limited and reported.

FI found that few of the companies in the investigation use a general risk measure in their day-to-day governance or risk reporting. In general, the smaller companies do not calculate a general risk measure in their operating activities at all. These companies tend to rely on an arrangement of partial risk measures.

FI would like to emphasise that a general risk measure does not necessarily have to be in the form of a VaR model. Other methods which include all significant market risks in a sound manner can also be considered.

Risk matrices

FI's investigation has shown that risk matrices should be used with prudence since they can easily exclude significant risks. Companies should therefore continuously evaluate their exposure to excluded risks and, if they are significant in size, measure these risks in some other way. In this section, FI describes risk matrices in detail as well as the danger associated with excluding basis risks and other risks for which risk matrices are not suitable. FI also presents an example of how excluded risks can be managed.

The investigation showed that most of the companies in the investigation use risk matrices. The risk matrices are used to measure, control and report risks. A risk matrix is an outcome analysis of a scenario in which two risk factors are stressed at different intensities. The factors that are altered are almost always the price of the underlying asset (delta and gamma risk) and expected volatilities (vega risk). An example of a risk matrix is presented below.

Vol/Pris	-20%	-10%	-5%	0%	5%	10%	20%
-30%	- 33 480 000	- 29 430 000	- 26 955 000	- 24 180 000	- 21 105 000	- 17 730 000	- 10 080 000
-20%	- 25 420 000	- 21 370 000	- 18 895 000	- 16 120 000	- 13 045 000	- 9 670 000	- 2 020 000
-10%	- 17 360 000	- 13 310 000	- 10 835 000	- 8 060 000	- 4 985 000	- 1 610 000	6 040 000
0%	- 9 300 000	- 5 250 000	- 2 775 000	-	3 075 000	6 450 000	14 100 000
10%	- 1 240 000	2 810 000	5 285 000	8 060 000	11 135 000	14 510 000	22 160 000
20%	6 820 000	10 870 000	13 345 000	16 120 000	19 195 000	22 570 000	30 220 000
30%	14 880 000	18 930 000	21 405 000	24 180 000	27 255 000	30 630 000	38 280 000

This risk matrix is calculated for a portfolio consisting of long call options. As shown, the portfolio would incur the most losses if both underlying prices and volatilities fell sharply.

The matrix shows gains or losses given different scenarios in which volatilities and underlying prices fluctuate within an interval of +/-30 percent and +/- 20 percent, respectively. Many companies use risk matrices to set limits at the level of the largest acceptable loss. Another alternative is to define a subsection within the matrix and set the limit where the greatest loss occurs within this subsection.

According to FI, both the strengths and weaknesses of risk matrices lie in their simplicity. Their strengths include that they offer an extremely clear and comprehensible method in which to place potential outcomes in direct relation to changes in relevant market variables, which is attractive for traders as well as risk functions and senior management.

Their weaknesses are that they do not capture basis risks2 between different maturities, exercise prices and underlying assets and they completely ignore risk factors other than price and volatility. FI also found that, among the companies in the investigation, the degree of stress that is tested, in particular with regard to volatilities, is not high enough. FI describes each of these weaknesses separately.

2 The risk that opposite positions in a hedging strategy do not move as expected in relation to one another.

Basis risks

Risk matrices ignore basis risks between different underlying assets, maturities and exercise prices (the latter two refer exclusively to options) since the risk matrix calculates the sum of all positions in the trading portfolio in the calculation. In FI's opinion, this is the greatest weakness of the risk matrix. It is also FI's impression that companies in the investigation are not sufficiently aware of the consequences of this weakness.

By calculating the sum of positions, two strong assumptions are implicitly made:

- The market prices of all assets and liabilities in the portfolio are assumed to be perfectly correlated. In other words, for example, it is assumed that if the price of an asset increases 1 per cent, all other underlying assets in the portfolio will also increase by 1 per cent. This means that a negative position and a positive position in two assets would cancel one another out and as a result the risk (expressed as delta and gamma) can appear to be very small or non-existent.
- With regard to options, it is assumed that implicit volatilities for different maturities and different exercise prices are perfectly correlated. For example, this means that if the volatility of an option maturing in 3 months increases by 5 per cent, it is assumed that volatilities of all other options in the portfolio with different maturities and exercise prices will also rise by 5 per cent. This would also mean that negative and positive positions in different maturities could completely cancel one another out and the risk (expressed as vega) could appear to be small or non-existent in the risk matrix.

It is worth noting that it was this exclusion of basis risks between both different underlying assets and different maturities that to a large extent contributed to the failure of HQ Bank to identify the enormous risks in its tradingportfolio. The HQ Bank case therefore represents a good example of the danger of risk matrices.

Case study: HQ Bank

HQ Bank's main market risk measure for its trading portfolio was a risk matrix as described above. The bank simulated a worst-case outcome within the matrix and set its limits based on this measure.

The absolute largest exposures in HQ Bank's trading portfolio were to index-linked options in the German DAX index and the Swedish OMX index. The table shows the exposures expressed as delta and vega at 18 May 2010. The table also shows the exposures broken down by underlying asset and maturity (which the risk matrix does not illustrate).

Position date	2010-05-18

		Data	
Underlying	Exp.date	Sum of Vega	Sum of Delta
ODAX	2010-05-21	-259 069	-4 317 526
	2010-06-18	11 136 970	-37 881 767
	2010-09-17	51 855 354	82 996 030
	2010-12-17	-53 655 171	-67 476 377
ODAX Totalt		9 078 084	-26 679 640
OMXS30	2010-05-21	742 152	15 725 210
	2010-06-18	-581 817	-3 214 468
	2010-07-16	-3 272 317	-10 597 947
	2010-10-15	-4 174 850	-1 880 670
	2011-01-21	-6 019 420	133 047
OMXS30 Totalt		-13 306 252	165 172
Totalt		-4 228 168	-26 514 468

Vega in the table is expressed as the change given an increase in implicit volatilities of one percentage point.

Delta is expressed as the change given an increase in the underlying asset's price of one percent.

Several important events are evident from the above table.

The bank has a negative vega exposure in OMX and DAX for long maturities (primarily December 2010) and an opposite exposure for short maturities (primarily June and September 2010).

The total exposure in DAX is positive in terms of vega and negative in terms of delta, while the total exposure in OMX has the opposite signs.

The aggregate exposure (SEK -4.2 million in vega and SEK -26.5 million in delta) appears to be relatively small compared to the subexposures per maturity and underlying asset.

When the risk in these exposures is transferred to a risk matrix, the assumption is made, as mentioned above, that all maturities and underlying assets are perfectly correlated. Given this assumption, the exposures in HQ Bank, at least in terms of vega, undeniably appear to be relatively small. In vega, the December outcome in DAX eliminates the September outcome and the total exposures in both vega and delta in OMX compensate for the opposite exposures in DAX. As a result, only the total exposure of SEK -4.2 million in vega and SEK -26.5 million in delta are illustrated by the matrix. This is naturally a gross simplification of the risk profile.

The table shows that if all underlying prices would remain unchanged and if the volatility would increase by 1 percentage point in the DAX December outcome at the same time as the volatility would remain unchanged for all other maturities and underlying prices (which is not an improbable scenario), HQ Bank would have lost SEK 53.6 million at the same time as the risk matrix would have indicated a loss of SEK 4.2 million.

This example illustrates how the risk matrix's underlying simplified assumptions regarding basis risks can lead to a gross underestimation of risks.

One conclusion that can be drawn from the HQ example is that if a portfolio contains significant positions which cannot be assumed to have a particularly strong correlation and/or significant option positions with different maturities and exercise prices that are not proven to be strongly correlated, the basis risks are probably significant. These risks, therefore,

must be measured and controlled, which an aggregate risk matrix does not do.

FI's conclusions from the investigation

There are several ways to improve risk matrices so that they capture basis risks:

1. Lower aggregate levels: Some companies in the investigation grouped their instruments by correlation levels. For example, it is conceivable that the correlation between two Swedish shares is greater than the correlation between one Swedish and one Japanese share. It is therefore possible to form two groups, one with Swedish shares and one with Japanese shares, and construct a risk matrix for each of these groups. FI identified a need among the companies in the investigation which applied this approach to ensure that correlation within the groups is actually high in order to ensure that significant basis risks are not underestimated.

2. Other correlation assumptions: The basic assumption in the risk matrix is that there is perfect correlation between underlying assets, maturities and exercise prices, which may be viewed as an extreme assumption. In order to examine what would happen in the presence of imperfect correlation3, it is helpful to simulate the matrix under other assumptions. The most common alternative is to test the opposite extreme scenario - the absence of correlation - but other correlation assumptions may also need to be tested. Simulating two extreme cases can be a good exercise since the results provide an interval of outcomes for comparison. This type of simulation also illustrates what could happen if correlations drastically change, which is important information since correlation patterns are not constant over time.

3. Combinations with other risk measures: This is the absolute most common and, in FI's opinion, most robust way to manage basis risks. For maturities, it is common to measure vega in time buckets, which are often also subject to limits. For basis risks between underlying assets, scenario analyses in which the largest positions in individual assets are stressed under an assumption that the correlation is zero are often used. For companies which use VaR models, these models usually function as a good complement, provided that the same correlation assumptions are not made between the risk factors in the VaR model as in the risk matrix.

EXCLUSION OF RISKS

FI identified in its investigation a number of instances where risk matrices were used as the only method of risk measurement for portfolios in which a number of other significant risks were excluded. As described above, risk matrices measure the exposure to two types of risk:

- Change in price of underlying assets (delta and gamma risks).
- Change in expected volatility in underlying assets (vega).

These two definitely qualify as significant risks for, for example, an equity portfolio with optionality4. However, the portfolio may be exposed to other significant risks which might need to be analysed and measured outside of the matrices. FI would like to highlight in particular the following risks:

3 Perfect correlation is when the correlation is equal to 1.

4 Optionality arises in a portfolio via the use of options.

- Sensitivity to changes in maturity (theta5) is one factor that is often excluded from risk measurements. One possible explanation for why theta is often excluded is that it is questionable if it is a "risk" in the true meaning of the word since it is not directly affected by market risk factors. Because theta is the gain/loss arising due to the additional passage of time, it is relatively predictable. FI believes that theta may still need to be measured in order to be able to derive the origin of the results.
- If the portfolio contains optionality, the interest rate (rho) can be a significant risk factor.
- For some asset classes there are also other types of risks that are difficult to measure with risk matrices, for example credit spread risks6 and twist risks7 in bond portfolios or dividend risks for equity derivatives.

VOLATILITY STRESS IN THE RISK MATRICES

FI noted in its investigation that asset prices and volatility are stressed differently. For share portfolios, the price dimension is stressed by +/- 10-15 percent while the volatility dimension is stressed by +/- 20-30 percent. FI considers a 10-15 per cent fluctuation in a share portfolio to be an extreme stress scenario over a short period of time, particularly since the stress is often applied to a diversified portfolio and not an individual share. However, it is not particularly unusual for implicit volatilities to fluctuate in considerable excess of 20-30 per cent. In other words, the companies exposed the model to a stress scenario that was too weak. For example, the VIX index8 rose by more than 50 per cent in one day during the Lehman crash in 2008. In 2011 alone there were two trading days during which the volatility in VIX fluctuated by more than 30 per cent in just one day. The stress on volatility is therefore not proportionate to the stress on price for most of the companies included in the investigation. Similar differences were also observed for asset classes other than equities.

FI's conclusions from the investigation

The price and volatility dimensions in the matrix need to be stressed proportionally to eachother in order to achieve more consistent stress scenarios and set more appropriate limits. With regard to the risk matrices of several of the companies in the investigation, FI was able to observe market fluctuations in implicit volatility which exceeded the interval in the matrix on a relatively frequent basis. In these cases the interval should be changed.

5 Theta is defined as the change in value of an option due to the option's maturity becoming one day shorter.

6 Credit spread from a specific bond is defined as the difference between the bond's market rate and the rate of a risk-free bond with the same maturity. Credit spread risk is the risk of loss in the form of a change in value of the bond when the credit spread changes.

7 Defined here as interest rate risks in the event of non-parallel shifts in the yield curve, e.g. an increase of short interest rates in relation to long interest rates.

8 Chicago Board Options Exchange Market Volatility Index, a popular measure of implicit volatility based on the American S&P 500 stock index option prices.

VaR models

FI's investigation demonstrates that many of the companies excluded significant risks from their VaR model or estimated risk factors that were not representative of the actual underlying risk. Furthermore, FI found in some cases that weaknesses in the analytical structure of some VaR models can underestimate the risks. FI's general conclusion from the analysis of the companies' use of VaR is that the models often contain significant simplifications and that they in general are not as robust as they may appear. The investigation demonstrates that the more significant the simplifications made in the VaR model, the greater the need for supplementary risk measures that can compensate for these simplifications.

In summary, the following statements can be made:

- The need for supplementary historical scenario analyses increases the shorter and less representative the span of the VaR historical data is.
- The need for both hypothetical and historical scenario analyses and stress tests increases the less robust the analytical structure of the VaR model is.
- All scenario analyses should specifically take into account risk factors that are excluded or estimated by the VaR model.

VAR MODELS IN GENERAL

VaR is a probability-based risk measure that is statistically created by a model. The measure should be interpreted as a loss that with a certain probability is not expected to be exceeded during a certain period of time. Swedish companies normally use a VaR with a probability of 99 per cent or 95 per cent and a 10-day time horizon. For example, a VaR measure of SEK -200 million, 99 per cent and 10 days would mean that, at the date of measurement, a company could expect with 99 per cent probability not to exceed losses of more than SEK 200 million over a period of 10 days. However, VaR does not say anything about what the losses could be in extreme cases. VaR is also almost always based on historic market fluctuations, and forward-looking hypothetical market fluctuations and correlation patterns are not captured in the model.

VaR models are a globally accepted method for measuring and controlling risk. This method is primarily used by the larger companies, but also by some of the smaller companies. VaR models are good supplements to risk matrices and other sensitivity measures since they contain a probability aspect that is not found in the these methods. The VaR measure is also more comprehensive than, for example, risk matrices since it takes into account many more risk factors than only price and volatility. A VaR model is relatively intuitive and easy to understand as a concept and also enables comparisons of risk-taking between different parts of a company's business.

In FI's opinion, it is important to understand the function of the VaR model in order to be able to understand its limitations. A VaR model rapidly becomes more complex as more asset classes and types of instru-

ments are included. A number of assumptions and simplifications must be made in the model to simulate the risk of loss. The most important, from FI's viewpoint, was to ensure that these simplifications were not so significant in nature that the VaR measure did not give a realistic loss amount.

CHOICE OF ANALYTICAL STRUCTURE

FI identified in the investigation a number of common methods for simulating a distribution of losses. These methods can be divided into three groups, Parametric VaR, Monte-Carlo Simulated VaR and Historically Simulated VaR, which are described in more detail in Appendix 1. FI presents below its opinion about each type of analytical structure.

Parametric VaR – This type of model is the least robust of the three discussed in this report. The reason for this is that an assumption is made about the underlying probability distribution and since a full revaluation of the financial instruments is not carried out. FI believes that this type of model can be used for areas with low complexity, e.g. isolated parts of the organisation that handle simpler instruments. If this model is to be used for risk control with well-defined limits, it should be supplemented with additional limits on well-planned and robust risk measurement methodologies, such as stress tests and scenario analyses that reflect extreme fluctuations in risk factors.

Monte-Carlo Simulated VaR - Provided that a full revaluation of financial instruments is carried out, this model is better suited for complex, non-linear instruments than parametric VaR. It is therefore FI's assessment that this model can be used for risk control and risk measurement when such instruments are included. However, since a distribution assumption is made in the simulation of risk factors (often normal distribution), extreme fluctuations, just like for parametric VaR, should be taken into account separately via scenario analyses and stress tests.

Historically Simulated VaR – The advantage of this VaR model is that it does not require a distribution assumption while, at the same time, a full revaluation of the instruments is carried out. It is FI's impression that this method is in the process of establishing itself as "best practice" among Swedish actors. The disadvantage of this model is that the simulation is strongly dependent on the model is based on a representative historical period of time (more on this below).

FI's conclusions from the investigation

Depending on the type of analytical structure a company has chosen for its VaR model, scenario analyses and stress tests, both hypothetical and historical, should be designed with a special focus on the weaknesses of the model.

CHOICE OF PERIOD OF TIME FOR VAR CALCULATIONS

Irrespective of the analytical structure, a number of assumptions must be made to estimate the parameters used to construct the probability distribution. The parameters are usually estimated using actual data from a past period in time. The VaR models of the companies in the investigation proved to be extremely sensitive to the period that was chosen,

which in particular applies to historically simulated models. For example, in the investigation a company's VaR value more than doubled if the historical period included the financial crisis in 2008.

FI observed during the investigation that the most common period of time consisted of the most recent one-year period. The longest period of time FI observed during the investigation was two years, and the shortest period was 17 days. For companies using approved VaR models to calculate capital requirements for market risks, the requirement is a period of at least one year. FI observed that most of these companies have chosen the minimum level. One possible explanation for why companies have chosen such short periods of time could be the rules in the capital adequacy regulations regarding backtesting. These rules apply to companies using VaR models approved by FI for the calculation of capital requirements for market risks. The rules entail that a company whose results include too many overshootings compared to the VaR value (the backtesting overshootings9) is assigned an extra capital requirement. It is therefore to the company's advantage to minimise the number of backtesting overshootings. A short historical period of data makes the VaR value more sensitive to new data, while a long historical period of data makes the value less sensitive. Everything else equal, the probability of backtesting overshootings is greater for a long historical period than a short historical period.

FI's conclusions from the investigation

The basis for FI's assessments of the companies' use of VaR models to manage market risks is the understanding that an ideal historical period is a period that is representative of market fluctuations in general, particularly in the sense that both stable and volatile conditions are included. Otherwise, there is a risk that the period of time will only include a relatively beneficial period, which results in a model that significantly underestimates the risk. According to FI, a reasonable assumption is that the shorter the time period, the less probable that it is truly representative.

Given this background, FI identified a need for companies to more carefully monitor if the choice of historical period can underestimate the risk indicated by the VaR measure. According to FI, thorough historical scenario analyses can satisfactorily compensate for non-representative VaR periods. It can be worth mentioning at this point that as of 1 January 2012, the capital adequacy requirements require companies using VaR models for capital adequacy (Pillar 1) to also calculate a "Stressed VaR". This measure can be viewed as a supplementary scenario analysis (more on this below).

CHOICE OF RISK FACTORS FOR THE VAR MODEL

A VaR model selected as a risk measurement method for specific operations should include all significant risk factors associated with such operations. However, if a company's operations in a specific market are very small, or if the risks are negligible, some risk factors may be estimated or even completely excluded from the model.

FI found in its investigation that it is a relatively common occurrence for

9 Backtesting overshootings mean that the actual result attributable to fluctuations in market prices exceeds the VaR value. This should, in theory, only occur at a rate corresponding to the degree of confidence of the VaR measure.

risk factors to be excluded or estimated using risk factors that cannot be assumed to have a reasonable correlation with the actual risk. FI also found that most of the companies included in the investigation do not have any ongoing analysis of this process in order to regularly monitor how accurate the estimates are. FI requested such an analysis in these cases, not only per risk factor but also at an aggregate level since many smaller estimates can become significant when taken as a whole. One example of such an analysis could be a measure of the portion of the risk that is measured using estimated risk factors. FI would also like to point out that as of 1 January 2012, the capital adequacy regulations, with regard to estimated risk factors, require that companies are able to show that the variables previously worked well for the position that is actually held.

FI's conclusion from the investigation

FI takes the position that it is acceptable to exclude or estimate risk factors that are not considered significant. Companies should therefore evaluate on a regular basis the consequences of estimating or excluding risk factors. If it is not possible to include certain instruments even if they represent a significant risk, for example in the case of portfolios containing certain complex financial instruments, it is important that this is communicated and that the risks for the excluded instrument be comprehensively measured in an alternative manner.

It is also of particular importance that the excluded or estimated risk factors be taken into account when designing supplementary stress tests and scenario analyses.

SIGNIFICANCE OF THE VAR MODEL FOR THE DESIGN OF SCENARIO ANALYSES

The capital adequacy regulations and general guidelines state that companies using VaR models need to apply stress tests and scenario analyses to supplement the VaR model, particularly for the aspects that are not taken into account in the VaR measure.

FI's conclusions from the investigation

One general conclusion that FI draws from the investigation is that the more significant the risks not taken into account in the VaR model's analytical structure, choice of historical period or choice of risk factors, the greater the need for more comprehensive and rigorous supplemental stress tests and scenario analyses.

During the investigation, FI identified two components in addition to the VaR model that may be needed to achieve a complete risk analysis:

1. Historical scenario analyses and stress tests that reflect stressed historical conditions not included in the VaR model's historical period. A range of relevant negative scenarios should be prepared and regularly analysed here. The "Stressed VaR" also falls under this category.

2. Hypothetical scenario analyses and stress tests which are forward-looking and take into account conceivable negative scenarios that have not previously occurred. A range of negative scenarios should also be prepared here based

on macroeconomic analysis and the company's own weaknesses. "Reverse stress tests"10 fall under this category.

10 Reverse stress tests are when an institution assumes an extremely non-beneficial outcome and analyses which events could lead to such an outcome.

Risk controls in treasury operations

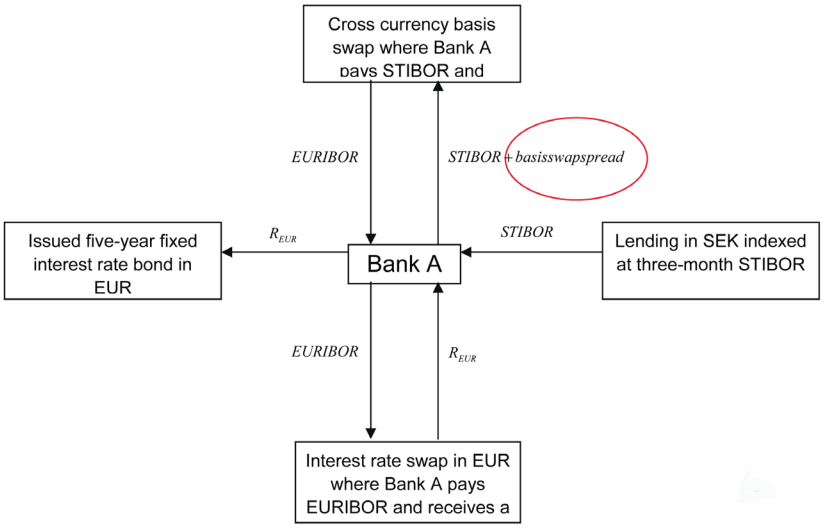
FI observed that treasury operations tend to be separate from the other operations of the companies included in the investigation. FI identified exposures to cross currency basis swap spreads and credit spreads as two areas in which many companies need to improve their risk control.

The main responsibility of the treasury operations is to manage the company's borrowing and lending transactions and any differences in maturity and currency between cash flows. The treasury operations usually also include management of the company's liquidity reserve. In general, the treasury operations often represent a significant portion of the companies' total market risk, primarily in the form of interest rate risks, credit spread risks and cross currency basis swap spread risks.

In general, the treasury operations are separate from other areas of the company that generate market risk. This is evident in that both methods for and reporting of market risk often differ significantly from other areas of the company. During its investigation, FI observed that the treasury operations invariably demonstrated considerable less transparency in terms of risk than other areas of the companies. Less sophisticated methods and fewer risk measures are used, and as a result several significant risks are generally not identified.

CROSS CURRENCY BASIS SWAP RISKS

These risks arise in companies which borrow funds in a different currency than they lend funds. The interest rate risk that arises is normally hedged with an interest rate swap and the currency risk with a cross currency basis swap. The following figure shows a typical arrangement:



Explanation of the model

- Bank A issues a five-year fixed interest rate bond in EUR. However, the bank's lending is primarily in SEK with three-month maturities.
- To neutralise this discrepancy in maturity between borrowing and lending, Bank A enters into an interest rate swap in EUR where the fixed interest rate for the issued bond is transformed to a variable

EURIBOR-based interest rate.

- The currency discrepancy is neutralised via a cross currency basis swap where Bank A pays STIBOR and receives EURIBOR. In the above example, Bank A pays a spread in addition to STIBOR in the basis swap (encircled above).

In the example, all transactions are made to maturity, i.e. to five years. From a risk perspective, it therefore appears that borrowing and lending are fully hedged. At maturity, Bank A will receive the interest rate margin it locked in via swaps related to its borrowing and lending. However, changes in basis swap spreads result in gain/loss effects during the term of the hedge. According to applicable accounting rules, changes in market value attributable to changes in basis swap spreads have a direct effect on Bank A's profit/loss and often the capital adequacy as well. The investigation demonstrated that the incurred profit/loss risk is often significant.

FI's conclusions from the investigation

Cross currency basis swap spreads are affected by market fluctuations and have a direct impact on the companies' profit/loss and often the capital adequacy as well. FI noted during the investigation that few companies identified this risk in their risk controls. Since changes in basis swap spreads are a significant risk for most companies which apply a business model entailing foreign borrowing, these risks need to be measured, limited and controlled in the exact same manner as other significant risks.

CREDIT SPREAD RISKS

Credit spread from a specific bond is defined as the difference between the bond's market rate and the rate of a risk-free bond with the same maturity. Credit spread risk is the risk of loss in the form of a change in value of the bond when the credit spread changes. The credit spread is, as implied by its name, primarily attributable to the creditworthiness of the issuer.

Credit spread risks are not unique to the treasury operations; they are also found in many other areas of the companies. However, they are often of considerable size in the treasury operations, particularly in liquidity portfolios which often have large holdings in bonds.

A normal procedure within the treasury operations is to use interest rate swaps for liquidity portfolios to lower the maturity of the portfolio (often under 3 months) and thereby decrease the sensitivity to changes in interest rate levels. Credit spread risk, however, remains unchanged after such a procedure. The treasury operations focus in most cases specifically on the interest rate risk in the portfolio, which is often sharply reduced after hedging with swaps. The companies in the investigation placed considerably less importance on the credit risk spreads, which in some cases are actually larger than the interest rate risks. Usually a rough aggregate measure of sensitivity is reported for credit spreads, but some companies do not report credit spread risks at all.

FI's conclusions from the investigation

In companies with larger liquidity portfolios, credit spreads are often a significant risk. FI observed in several cases a need for improved transparency and improved risk controls for this risk related to several relevant aspects, e.g. credit spread sensitivity per maturity, per sector and per rating. In particular, there is a need to improve the maturity aspect of credit spreads in risk reporting.

Link between risk and reported profit/loss according to IFRS

FI believes it is important that there is a link between risk and reported profit in the risk control. To achieve this goal, risk measurement and risk reporting should take into account accounting classifications. As a minimum, it should be possible to identify via the reporting which risk exposures are based on instruments measured at fair value and which are not.

As described in Appendix 2, changes in value in financial instruments are treated differently depending on how they are classified by the international financial reporting standards (IFRS). In some categories, the instruments are reported at amortised cost and are not, from an accounting perspective, immediately affected by changes in market value, while instruments in other categories that are continuously marked-to-marked in the accounting often have a direct impact on the own funds and, subsequently, capital adequacy.

FI noted that many companies in the investigation do not take these effects into account in their risk measurement. The most common method is to consider all financial instruments as being measured at fair value and therefore as having a direct impact on equity. The problem with this approach is that the link between risk and profit is lost, which is an unfortunate development since this link functions as a method to validate if the risk measures are correct, comprehensive and relevant - a prerequisite for adequate risk control.

FI's conclusions from the investigation

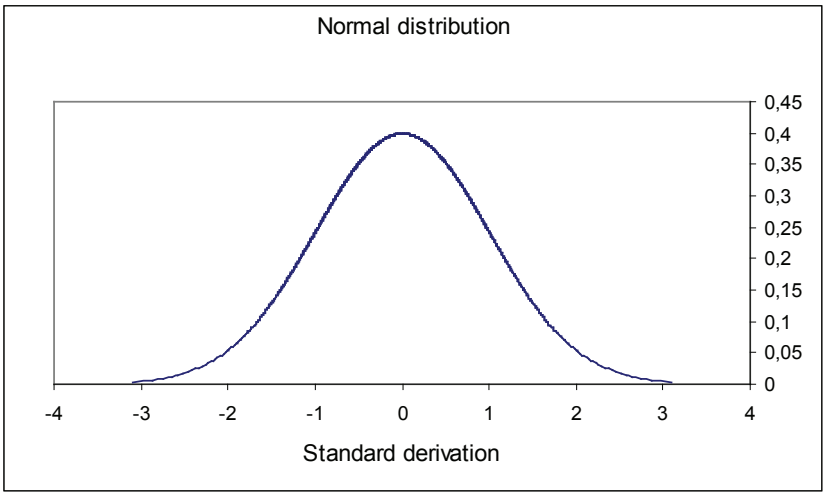
FI identified a need in several companies to compare and validate risk and profit against one another to ensure that the risk measures do not exclude significant risks. It is also important that management know from where and when events that can affect capitalisation may arise. To achieve this goal, companies, in addition to measuring the total risk of all holdings, can divide the instruments in their risk reporting into those that have a direct impact on profit/loss (categories measured at fair value) and those that do not (amortised cost) in order to illustrate how the effects on profit/loss and own funds may materialise over time.

APPENDIX 1: DESCRIPTION OF DIFFERENT VAR MODELS

Parametric VaR

Under this model, an assumption is made about the probability distribution applicable to the daily result. Input data required by the model includes standard deviations, means and correlations between the various risk factors. Instruments are not fully revalued individually, rather the model's calculations are based on sensitivity measures. During the investigation, FI found that the most common assumption is normal distribution, even if other distribution assumptions could be possible. For linear instruments, a method based on delta should be sufficient but if optionality or convexity is present in the portfolio, FI believes that a delta/gamma method should be used. The obvious disadvantage of this type of VaR model is the distribution assumption. After a number of financial crises, it has become generally accepted that few financial markets are characterised by normally distributed prices. Extreme fluctuations are much more common than what is indicated by a normal distribution. The true probability of observing a loss greater than the one predicted by the VaR model is therefore greater than the chosen degree of confidence.

This simplified figure illustrates a parametric model with normal distribution



Monte-Carlo Simulated VaR

This method simulates time series for various risk factors via a stochastic process. The "Geometric Brownian Motion" or a similar process is often used in the simulation. For each simulated outcome, each instrument in the portfolio is fully revaluated to identify effects on profit. The advantage of this method is that its simulation of exotic financial instruments is more accurate and therefore also appropriate for portfolios containing more complex instruments. The disadvantage of this model is that it also makes an assumption about distribution since the stochastic process must follow a probability distribution. FI observed during the investigation that a normal distribution is usually used for this method.

Historically Simulated VaR

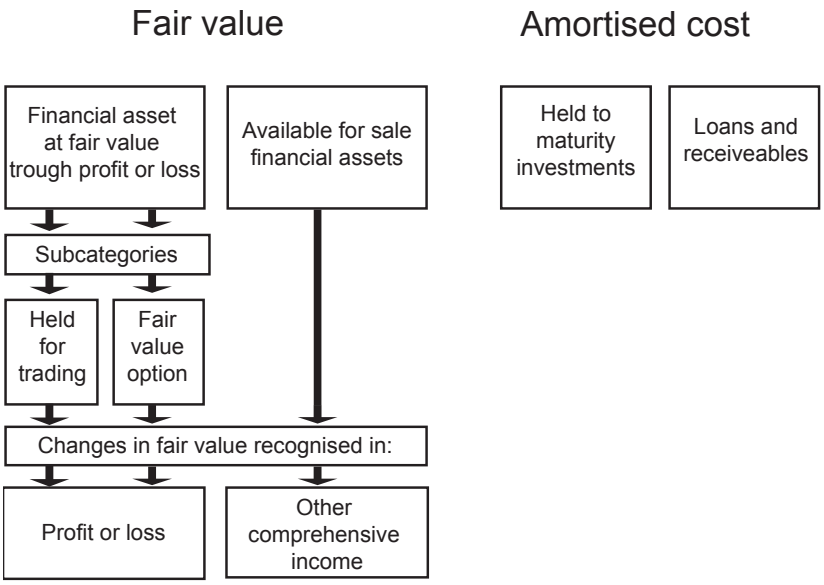
The most common type of VaR model used by the larger companies in the investigation is a model based on historical simulation. This model uses actual historical time series to identify changes in risk factors to which the portfolio is sensitive. The exposures are simulated by actual

historical scenarios which occurred within the historical period. A result is simulated for each day during the historical period and thus builds the distribution. The loss amount that corresponds to the degree of confidence chosen by the company is then sorted out and represents the VaR measure. This method does not require any assumptions about the distribution, which is a clear advantage. Full revaluation means that the model can also be used to simulate very complex instruments. The disadvantages are that this method requires considerable computer power to simulate large portfolios with complex instruments and it can be difficult or impossible to obtain sufficient historical data for certain instruments. This method is also particularly sensitive to the span of the historical period.

APPENDIX 2: CLASSIFICATION OF FINANCIAL INSTRUMENTS IN ACCORDANCE WITH IFRS

This appendix starts with a short overview of how financial instruments are classified under applicable accounting regulations, the IFRS framework, and the consequence this classification has on how the instruments are measured.

The following figure summarises the different classifications that can be used for financial instruments under the IFRS regulations.



The picture illustrates the different categories identified in IAS 39 Financial Instruments: Recognition and Measurement, which serves as the standard in the IFRS regulations that governs how financial assets should be recognised and measured in a company.

When acquiring a financial asset, a company must place the asset into one of the above categories. The category then determines how the financial asset will be recognised and measured after the date of acquisition. Two categories require fair value valuation – "Financial asset at fair value through profit or loss" and "Available-for-sale financial assets". The first category, as demonstrated in the above figure, is divided into two subcategories, "held for trading" and "fair value option".

Changes in fair value are reported differently depending on which category is being used. As implied by the name, changes in fair value in financial assets assigned as "Financial asset at fair value through profit or loss" are reported in the profit or loss, i.e. in the "traditional" income statement. Fair value changes in financial assets assigned as "Available-for-sale financial assets" are reported in other comprehensive income. In both cases, the change in value, with some exceptions in the latter case, affect the own funds.

Financial assets assigned to "Held-to-maturity investments" and "Loans and receivables" are recognised at amortised cost after the date of acquisition.

The category that should be used for each financial asset is regulated by IAS 39 and is normally determined by the company's purpose for acquiring the holding. Below is a brief overview of some of the rules that are characteristic for each category.

"Financial asset at fair value through profit or loss"

This category is used for financial assets that are held for trading or that upon initial recognition are designated as an item at fair value through profit or loss, i.e. the "fair value option". A financial asset is classified as held for trading if it

- a) was acquired or incurred principally for the purpose of selling or repurchasing it in the near future or
- b) at the time of acquisition was included in a portfolio of instruments managed together for profit-taking.

The fair value option may only be used if it eliminates or significantly reduces inconsistencies in the accounting. The fair value option may also be used when a group of financial assets is managed and evaluated on a basis of fair value in accordance with a documented risk management or investment strategy and this information is provided to the company's key management personnel. The fair value option can also be used under some conditions for embedded derivatives.

"Available-for-sale financial assets"

This category is used for financial assets that are designated as available for sale and are not classified as any of the above categories.

"Loans and receivables"

This category may not contain financial assets that are quoted on an active market. The asset must also have fixed or determinable payments to be assigned to this category.

"Held-to-maturity investments"

Financial assets with fixed or determinable payments and fixed maturity are assigned to this category. This category can also be used for financial assets quoted on an active market provided that the other criteria are fulfilled. The distinguishing characteristic for this category is that the investment must be held to maturity. If more than an insignificant amount was sold before maturity, the entire outstanding holding in this category must be reclassified as "Available-for-sale financial assets". The company is then also forbidden from using this category for a period of two years. There are of course some exceptions to this rule, for example when the sale occurs so close to maturity that changes in the market rate of interest would not have a significant effect on the fair value.

Other

Derivatives should always be measured at fair value. They should be recognised as "Financial asset at fair value through profit or loss" and "held for trading" with the exception of derivatives which constitute financial guarantee contracts and derivatives which constitute effective hedging instruments.

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