KPMG

Circular 2008/6 Interest Rate Risks – Banks

Measurement, Management and Monitoring
of Interest Rate Risks within the Banking Sector

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2 Other Languages

DE: FINMA-RS 2008/6 Zinsriken Banken 6.12.2012

FR: Circ. FINMA 2008/6 Risque de taux – banques 6.12.2012

IT: Circ. FINMA 2008/6 Rischi di tasse di interesse – banche 6.12.2012

Unofficial translation issued in December 2015

Circular 2008/6
Interest Rate Risks - Banks

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Reference:	FINMA circ. 08/6 Interest rate risks - banks
Issued:	20 November 2008
Entry into force:	1 January 2009
Last amendment:	6 December 2012 [amendments are denoted with an * and are listed at the end of document]
Concordance:	previously SFBC circ. 99/1 "Interest rate risks" of 25 March 1999
Legal bases:	FINMASA Article 7(1)(b) BO Article 12 SESTO Articles 19, 26 CAO Article 96
Annex:	Description of various measuring methods

Addressees

BA			ISA			SESTA		CISA									AMLA			OTHERS	
Banks	Financial groups and congl.	Other intermediaries	Insurers companies	Ins. groups and congl.	Distributors	Stock Exchanges and participants	Securities dealers	Fund management companies	SICAVs	Limited partnerships for CIS	SICAFs	Custodian banks	Asset managers CIS	Distributors	Representatives of foreign CISs	Other intermediaries	SROs	DSFIs	Entities under SRO supervision	Audit firms	Rating Agencies
X	X						X														

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I. Object and Scope of Application of the Circular

The present circular describes the minimum standards to be applied to measure, manage and monitor interest rate risks and thus substantiates the relevant provisions in the Banking Ordinance as well as the Stock Exchange Ordinance (Article 12 BO, Articles 19 and 26 SESTO or Article 96 CAO). 1

The scope of application of the Circular shall encompass on a mandatory basis all positions that do not meet the conditions pursuant to Article 5 CAO ("trading book"). However, periodically, all interest rate risks of positions on and off the trading book shall be subjected to an overall consideration (cf. Section V.A). 2

The measurement, management and monitoring of interest rate risks is to be performed at both single-entity and consolidated levels. Should interest rate risks assumed in controlled entities active in banking or finance be immaterial, viewed individually or in aggregate, in relation to those assumed by the bank, they do not need to be included in the aggregated view, subject to the consent of the audit firm. The bank shall ensure that these units do not enter into significant interest rate risks, by issuing directives, limits or other policies. 3

The Circular is not applicable to security dealers that do not possess a banking license, provided they assume no significant interest rate risks outside the trading book. The audit firm has to confirm this. 4

II. Basics

Interest rate risk is the risk that movements in market interest rates adversely impact a bank's financial situation. Banks are always exposed to interest rate risks whenever the income and net present values of their assets, liabilities and off-balance sheet items show different interest rate sensitivities. 5

A. Forms of interest rate risks

There are three forms of interest rate risks, i.e. interest rate re-pricing risk, basis risk and the risk of embedded options: 6

- *Interest rate re-pricing risk* results from mismatches in final maturity dates (for fixed-rate instruments) or in re-pricing dates (for floating-rate instruments) of assets, liabilities and off-balance-sheet positions. It manifests itself insofar that if interest rates change, for the bank, future income and current net present values change. In addition to parallel shifts in the yield curve, its slope or shape may also change. 7

- Even if different instruments present similar interest rate re-pricing characteristics, a change in interest rates will bring about different changes in earnings and net present values if there is an imperfect correlation of interest rates between these instruments. This is referred to as basis risk. A special form of *basis risk* exists where products, such as floating-rate mortgages or savings deposits and other deposits, have interest rates that follow the development of a reference rate or a combination of reference rates but where the timing of the rate changes is not fully synchronous. 8

- Interest rate risks also arise as a result of (implicit) options embedded in instruments. Among other types of products, this category includes various types of debentures and notes which grant the right of cancellation to the debtor or the creditor, credits where the debtor has a right of early repayment, as well as various deposit instruments without a fixed maturity date where depositors may withdraw funds at anytime, often without having to pay any penalty interest. If instruments with such implicit options are not managed appropriately, their asymmetric payment characteristics may constitute a significant risk, especially to those who sell them since, as a general rule, they are exercised to the advantage of the purchaser and thus to the disadvantage of the seller. 9

B. Action Mechanisms of Interest Rate Risks

In principle, when analyzing interest rate risk, it must be distinguished between two perspectives: the earnings perspective and the net present value perspective. 10

With the earnings perspective ("income effect"), the focus of the analysis is on the impact that a change in interest rates may have on current earnings. This approach is thus a rather short-term one. Should, for instance, the interest rates on the liabilities side be raised earlier than on the assets side, an interest rate increase may reduce the net interest income as financing costs will increase in comparison to the income from assets. As commissions and other non-interest income – e.g. fees for the administration of loans and securitized loans – also react to interest rate changes it may be advisable to take a broader view of total net earnings, encompassing both interest and non-interest-related income and expenses. 11

The net present value perspective ("wealth effect"), on the other hand, is designed to capture the potential impact of interest rate changes on the net present value of future cash flows and thus on the net present value of the bank's equity ("economic value of equity" or the "intrinsic value of a bank"). Changes in the interest rates[1] used for discounting will lead to changes in the net present value of future cash flows. In contrast to the period-related income effect, the wealth effect recognizes the aggregated impact over the total duration of a position on the net present value of the equity. This perspective provides a picture of the long-term impact of interest rate changes. If, therefore, a bank has liabilities whose interest rates change quicker than those of its assets, the net present value of equity will decline if interest rates rise. 12

The starting point in both analyses is the initial determination of the current net interest margin and the economic value of the equity using the current yield curve. The income effect and asset effect shall be computed based on this. 13

Changes in interest rates, in addition to the aforementioned impact on interest income and the net present value of equity, may indirectly lead to changes in the balance sheet structure ("structural effect") and the creditworthiness of debtors ("solvency effect"). 14

[1] A bank may use either interest rates reflecting the risks inherent to the debtors or to the category of debtor or risk-free interest rates may be used. Whilst the latter only measures the general interest rate risk, models based on risk-adequate interest rates also capture changes in net present value as a result of changing spreads or debtor-specific risk premiums.

The *structural effect* captures the shifts between balance-sheet items triggered by the changes in interest rates. Thus, in periods of high interest rates, for instance, shifts from savings deposits to fixed-term deposits can be observed and in periods of low interest rates, a shift from variable-rate mortgages to fixed-rate mortgages. These volume changes are the result of embedded options contained in various banking products in the form of cancellation, repayment and withdrawal options. 15

Finally, the solvency effect implies the changes in bank customers' creditworthiness due to changes in interest rates and shows that interest rate risks and solvency risks are interrelated. 16

III. Overview on the Management of Interest Rate Risks

The management of assets and liabilities and of the related interest rate risks is called "Asset & Liability Management". The following aspects shall be considered: 17

- appropriate monitoring by the Board of Directors and Senior Management (cf. Section IV)
- suitable systems to measure, monitor and report risks (cf. Section V)
- comprehensive internal controls and an independent audit (cf. Section VI)

These three aspects are presented below in detail. How a bank will implement these aspects to manage its interest rate risks shall depend on the complexity and nature of its holdings and activities and thus on the scope and complexity of the assumed interest rate risks. 18

IV. Monitoring of Interest Rate Risks by the Board of Directors and Senior Management

Effective supervision by the Board of Directors and Senior Management is of central importance for an appropriate management of interest rate risks. The members of these bodies must be aware of their responsibility and assume the tasks concerning the monitoring and management of interest rate risks. 19

A. Board of Directors

The bank's Board of Directors is responsible for defining a risk policy. Taking into consideration the bank's business strategy, it shall determine the bank's risk policy, the central aspects of the system of limits (including the measurement method) and the main aspects to be reported. Thus, it shall define to what extent and in which markets risks are to be assumed and hedged. The risk policy shall address both the earnings and net present value perspectives as well as how the bank shall report on these aspects. In addition, the risk policy must define the basic competencies and responsibilities for entering into, measuring, managing and monitoring the interest rate risks. The maximum interest rate risk exposure which may not be exceeded is to be formulated as a global limit (possible: limits for each currency) and to be defined as directly depending on the measurement system. When fixing the global limit, the bank's equity base and, depending on its structure, expected future earnings position, shall be of vital importance. 20

The Board of Directors shall therefore be responsible for defining the bank's general principles for interest rate risks and for ensuring that Senior Management assumes measures to identify, measure, manage and monitor interest rate risks. In order to meet its responsibilities, the Board of Directors must regularly be informed on the bank's interest rate risks. 21

The bank's Board of Directors (or a committee appointed by it) shall review and update the bank's risk policy and its activities to manage and monitor the interest-rate risks at least once a year. However, if a committee has been entrusted with the review, it cannot approve these as well. This assumes that the bank has in place an independent information system that regularly provides reliable and timely information about the risk and earnings situation in an appropriate form for this body. 22

B. Senior Management

Senior management shall be responsible for ensuring that the risk policy approved by the Board of Directors is implemented in the bank and complied with. The directives to be issued by Senior Management must address the following: 23

- the function and responsibilities of individual departments, employees and committees including the control function, including the related responsibilities and reporting duties;
- the list of counterparties with whom the bank may trade;
- suitable risk management systems and standards, also to assess assumptions and models used (cf. Section V.A);
- admissible instruments and hedging strategies;
- the acceptable level of risk positions according to business and product type (system of limits, cf. Section V.B), within the global limit approved by the Board of Directors;
- competencies and procedures to be followed in case limits or authorities are exceeded;
- the execution, analysis and reporting of stress tests (cf. Section V.C);
- standards for the valuation of positions;
- the reporting of interest-rate risks (cf. Section V.D);
- organizational requirements to ensure independence in control (cf. Sections IV.C and VI.A);
- the analysis of income and wealth effects.

Prior to introducing a new product, activity, strategy or hedging method, Senior Management shall ensure that the related interest rate risks are identified and understood and shall ensure an appropriate integration of these into the systems for measuring, managing and monitoring interest rate risk. Should a new instrument or strategy be under discussion, the following aspects must be taken into account: 24

- a detailed description of the instrument or strategy involved;
- information concerning the additional resources required for a sound and effective management of the interest rate risks associated with the new activity or instrument;
- an analysis of the reasonableness of the interest rate risks which the proposed activity could entail in relation to the bank's financial situation and equity base;
- the definition of the procedures required to measure, manage and monitor the interest rate risks associated with the proposed product or activity.

C. Internal Risk Control

Banks shall create specialized units for the control of interest rate risks whose size and terms of reference depend on the size and structure of the bank, of the complexity of the transactions entered into and the measurement procedures employed. 25

The measurement, monitoring of limits as well as reporting of interest rate risks is to be handled by a unit of the bank which is independent of those executing transactions. This unit shall also be responsible for ensuring that the interest rate risks are fully captured (all business areas) in the bank's risk control system. All notifications and risk reports prepared shall be submitted directly to the responsible members of Senior Management. 26

The employees entrusted with risk control must know and understand all types of interest rate risks throughout the bank. Adequate safeguards must be in place to prevent employees or committees that enter into risk positions from influencing important control functions, such as the monitoring of the compliance with guidelines and operating procedures, the reporting of risk to Senior Management and the carrying out of back-office functions. 27

V. Risk Measurement and Risk Monitoring Systems

A. Measurement of Interest Rate Risks

A measurement system shall 28

- capture all material interest rate risks of a bank arising from assets, liabilities and off-balance-sheet positions;
- dispose of parameters and assumptions that are substantiated, expediently documented and periodically reviewed for their appropriateness;
- measure interest rate risks, presenting fluctuations both in interest income as well as in the net present value of the equity.

The risk measurement system must capture all significant forms of interest rate risks i.e. interest rate re-pricing risk, basis risk and option risk. A measurement system must cover all of a bank's interest rate sensitive positions. In addition, the system shall include a detailed analysis of the instruments which could significantly affect the bank's overall position. Particular attention shall be paid to instruments with significant implicit options. 29

The measurement system must also cover the bank's full range of activities irrespective of whether individual transactions are attributed to the trading book or not. This does not preclude the use of differing measurement systems and procedures for the risk management of different activities. However, the risks must be aggregated periodically and appropriately so that Senior Management and the Board of Directors have a comprehensive overview of all interest rate risks that could affect the bank in its entirety. 30

a) Identification of Interest Rate Risks

In order to compute the interest rate risk of a position, its interest rate repricing period must be known. For products where the interest rate repricing period and capital tie-up period are fixed contractually so that the interest rate is based on a market interest rate and these contracts do not contain any options for early cancellation or amendments of the contract, the interest rate risks may be quantified directly in terms of the change in cash flows and their net present values depending on the changes in interest rates. 31

Non-maturity products (i.e. principally floating-rate mortgages and savings deposits), however, may not be captured based on their contractual conditions; for instance floating-rate mortgages could result in an interest rate repricing period of 1-3 months, as the bank may adjust the interest rate in this interval. In the case of savings accounts and demand deposits, the depositors usually have the possibility to withdraw funds at any time; thus, from the bank's point of view, the actual capital tie-up period is undetermined. Practice, however, shows that interest rates for mortgages are adjusted less often than would be contractually possible, and the actual capital tie-up period of savings and deposit funds is much greater than the contractually agreed one. The actual interest rate repricing period and the capital tie-up period must thus be estimated (see Annex). 32

Just like with other aspects of the measurement of interest rate risks, the quality of the assumptions made for the treatment of non-maturity products as well as assets and liabilities which are not directly interest bearing affect the quality of the measurement based thereon. Whether these assumptions are based on econometric or statistical analyses or on expert judgment is not decisive at first. It is more important that the assumptions made are justified economically, documented and disclosed in the internal risk reports, consistently complied with or only deviated from if this is objectively justifiable. 33

b) Determination of all Interest Rate Risks of On-balance Sheet and Off-balance Sheet Transactions

Complete, correct and current data is the prerequisite for measuring the risk pertaining to all interest rate sensitive positions. The characteristics of individual products which are relevant for interest rate risks must be taken into consideration. The data of all individual products must contain their cash-flow structures, i.e. interest payments and payment intervals, adjustment of interest rates, repayment of principal and withdrawal conditions, etc. Only authorized employees shall perform any manual corrections, especially the restatement of expected cash flows due to the early repayment of principal. All data corrections are to be documented so an audit trail is left, stating the reason as well as the exact content of the correction. 34

Banks with significant positions in various currencies must compute the interest rate risk exposure for each currency involved. If the appropriate methods and the necessary data are available, the interest rate exposures in the various currencies may be aggregated. In this case, the stability and accuracy of the assumptions used must be reviewed periodically. In particular, the bank must also estimate risk exposures for the purposes of stress testing (cf. section C) in case the assumptions regarding correlation between interest rates of various currencies can no longer be considered to be valid. 35

Several techniques and procedures are available to measure interest rate risks in the overall balance sheet – both from the earnings and net present value perspectives – which differ in their complexity and accuracy. They range from simple computations and static simulations to complex dynamic models. Frequent simplifications concern the mapping of specific characteristics of interest rate sensitive positions, such as, for example, the capture of option-like attributes, the aggregations of positions into broad categories, the type of interest rate movements, such as, for instance, the limiting to parallel shifts in the yield curve or the neglecting of imperfect correlation of interest rates for various positions of the same maturity (basis risk). The nature and scope of business activities determine the procedures to be followed. The more complex and extensive the interest rate risks of a bank are, the more accurately the risks should be measured, i.e. the more complex the procedures and techniques to be employed will be. Whether a technique leads to usable results depends not only on the measurement method but above all on the validity of the underlying assumptions and exactness of the methodology for model-based calculations. As measurement systems often encompass one or more sub-systems or methods, it is important to ensure that the various sub-systems interface and that they are compatible in all important aspects. 36

All methods to measure interest rate risks use scenarios or forecasts of potential future interest rate developments. The interest rate change taken as a basis must be sufficiently large to capture the risks in the bank's holdings. In this respect, it is important to use various scenarios involving both a possible change in general interest rate levels as well as the possible effect on changes in the relationship between interest rates (different maturities and instruments). Statistical analyses can play an important role when evaluating the relevant correlation assumptions. 37

To evaluate the measurement results of the interest rate risk, it is imperative that both risk management employees and Senior Management have an exact understanding of the assumptions underlying the measurement process. In particular, techniques applying complex simulations are to be used with prudence. Senior Management and employees entrusted with risk management must understand the underlying assumptions extremely well; moreover, these have to be reviewed periodically but at least annually. Furthermore, they must be well documented and their importance must be clear to all involved. The assumptions underlying the evaluation of the interest rate sensitivity of complex instruments and instruments with an undefined maturity profile must be particularly well documented and reviewed. 38

Various measurement techniques are presented in the Annex.

B. System of Limits

Risk management's objective is to keep the bank's interest rate risks within certain parameters defined by the bank itself for a series of possible interest rate changes. This objective is achieved with the aid of a system of limits. An expedient system of limits must enable Senior Management to control risk exposures and measure the actual risks assumed by using the limit values set by the Board of Directors. 39

The bank's limits must be consistent with its risk measurement procedures. If necessary, limits must also be established for individual products, portfolios and business areas. The degree of detail of the system of limits depends on the bank's business activity, the forms of interest rate risks entered into (cf. Section II.A) and its business volume. 40

The limiting of interest rate risks may depend on a number of factors, which, however, present varying degrees of suitability for their integration into the bank's overall risk policy. For instance, this could relate to the limiting of the maximum gaps for each time band, fluctuations of interest income as well as of the net present value of the bank's equity. 41

- *Gap limits* limit maturity mismatches of asset and liability positions within a time band. They are, however, inadequate insofar as they fail to consider the aggregated, overall risk exposure across the time bands. 42

- Limits related to the *fluctuations in interest income* limit the percentage variation in profitability for an assumed change in interest rates. Apart from net interest income (and the interest spread), it should also be verified whether the influence of non-interest income on net income should be taken into consideration. On the one hand, defining limits requires the determination of the interest rate change for which the fluctuation in interest income is computed. This may be a simple parallel shift in the yield curve or take into consideration complex changes (level, slope and curvature) including probability of occurrence. On the other hand, the bank must determine the maximum loss in interest income arising from maturity transformation to be tolerated. In its simplest form, an income limit stipulates that, for instance, for a change of +/-100 basis points within a year, no more than x% of net interest income may be lost. 43

- Limits which limit losses on the *net present value of bank's equity* take into account the fluctuations in the net present value of asset and liability positions brought about by interest rates. These may take on different forms. In the simplest case, again a certain parallel shift in the yield curve is assumed. More complex changes in the yield curve might also be taken into consideration. The changes in the net present value of the bank's equity thus computed, however, should be evaluated in consideration of the measurement methodology used by the bank (e.g. the assumed interest rate repricing period and capital tie-up period for non-maturity products and for positions which are not directly interest-bearing, the capture of implicit options, etc.) as well as the assumed interest rate scenarios. 44

Moreover, the bank must clearly stipulate how to proceed if limits are exceeded, i.e. whether, for instance, smaller deviations can be tolerated for short periods and how Senior Management is to be informed. If global limits are exceeded, the responsible persons in Senior Management and the Board of Directors shall be notified immediately. 45

C. Stress Tests

The risk measurement system must also enable a reasonable evaluation of the effects of distressed market conditions on the bank. Appropriate stress tests must take into consideration scenarios which could lead to extraordinary losses at the bank in question. The scenarios must thus cover extreme changes in market risk factors and scenarios which must be considered as being particularly serious in view of the bank's specific risk positions. Possible stress scenarios are, among others, 46

- an abrupt change in general interest rate levels,
- a change in the relationship between important market interest rates ("basis risk"),
- a change in the slope and shape of the yield curve,
- a tightening of liquidity on important capital markets or
- a change in volatility and correlations of market interest rates.

47 In addition, the possibility must be considered that in certain crises, certain assumptions and parameters suddenly no longer apply. A critical verification of its assumptions used to model illiquid instruments and non-maturity products is particularly important when determining the bank's risk profile. When carrying out stress tests, particular attention shall be paid to instruments or markets where concentrations exist as such positions that may be more difficult to liquidate in a crisis. Banks must review both worst-case scenarios as well as more probable but less extreme occurrences. Senior Management must periodically review the design and results of such stress tests, which provide information on the effects on the bank's profitability and financial situation and ensure that appropriate measures are taken.

D. Reporting of Interest Rate Risks

48 A precise, meaningful and timely management information system is of central importance for the monitoring and control of interest rate risks. It must be designed to keep responsible members of Senior Management informed on a weekly basis and to support the supervision of the compliance with the policy defined by the Board of Directors. So that Senior Management may evaluate interest rate risks in regard to form and amount, the reports must show both aggregates and sufficient granularity. Reporting must occur regularly and compare the current risk exposure with the limits set.

49 The reports concerning interest rate risks must be reviewed regularly by the Board of Directors and minutes must be kept of the decisions made. The reports which are prepared for the Board of Directors and for the various levels of Senior Management may differ in accordance with the bank's risk profile but must contain at least the following data:

- overview of the aggregate interest rate risk entered into by the bank;
- report whether the internal operating procedures and limits have been complied with;
- results of stress testing;
- summary of the results of verifications of internal directives concerning interest rate risks as well as the appropriateness of systems used for the measurement of interest rate risks including any findings made by Internal Audit, external auditors or external consultants.

VI. Comprehensive Controls and Audit

A. Documentation and Internal Control System

The risk monitoring system for interest rate risks must be integrated into the overall system of internal controls and be adequately documented. This applies in particular to: 50

- internal directives;
- responsibilities and competencies (internal organization);
- organizational workflows and
- the quantitative bases underlying the computations and analyses of risks as well as stress tests.

A well-structured internal control system must enable productive and efficient business operations, provide reliable reports concerning the financial situation and ensure compliance with the relevant laws, prescriptions and internal directives. 51

B. Independent Audit

Audit firms are to audit the compliance with the provisions of this circular according to the FINMA circ. 13/3 "Auditing" and present the findings of their audit procedures in the audit report. 52*

VII. Reports to the Swiss National Bank (SNB)

With the exception of branches of foreign banks, banks shall report their interest rate risks to the Swiss National Bank, within six weeks of the period end, using a form defined by FINMA. On a single-entity level, this information must be provided every quarter, at group level every six months. 53

Annex

Description of various measuring methods

The following text briefly describes different procedures used to measure interest rate risks. Every bank has to decide for itself which method is the most appropriate for it, depending on its business strategy, the complexity of the instruments held and the risks entered into (cf. Section V of this circular). Measurement procedures and methods must be best market practice. 1

I. Determination of Effective Interest Repricing Period

One possibility for determining the effective interest rate repricing period of non-maturity products is the use of replicating portfolios. The basic idea consists of simulating the position's interest rate repricing period and capital tie-up period behavior with the help of a benchmark portfolio, combining several different interest rates in the market in order to minimize the spread's variance between the interest rate offered to clients and the benchmark portfolio's yield. Historical product and market interest rates serve as a base for such a simulation. Another approach tries to directly model the options embedded in the products, i.e., the bank's possibility to adapt interest rates or to cancel contracts, and the clients' possibility of early withdrawal of funds or early repayment of the principal. 2

II. Simple Technique to Measure Income Effect

The simplest technique for the measurement of interest rate risks is the maturity method or time band approach. This method requires the allocation of the nominal values ("cash flows") of all interest rate-sensitive long and short positions, as well as the related interest payments arising from on- and off-balance sheet transactions taking into consideration their interest rate repricing period in the predefined time bands. Fixed income instruments are categorized according to their residual maturity and floating-rate instruments, taking into consideration their next interest re-pricing date. Assets and liabilities with an undefined maturity profile (i.e. demand deposits, savings accounts or variable-rate mortgage loans) or those with an actual maturity which may vary from the contractually agreed maturity are allocated to time bands based on the approach detailed in Section V.A.a. of this circular. The result is a balance sheet structured according to interest rate repricing periods, the so-called interest rate repricing gap profile. The difference between assets and liabilities in each time band equals the gap for each period. If assets are greater than liabilities, this is a positive gap, in the contrary case, a negative gap. This makes it possible to capture, above all, risks in connection with maturity mismatches. The number of time bands used determines the accuracy of the risk measurement. Should positions be regrouped into broader bands, the measurement becomes less accurate. 3

In order to evaluate the impact on the bank's income using the maturity method, the gaps of the various time bands are multiplied with the assumed change in interest rates; the result is an approximate value for the change in net interest income for a given change in interest rates. In case of a positive gap, increasing interest rates will cause an increase in net interest income, in case of a negative gap, a decline in net interest income. The income effect may easily be deduced with this gap analysis. Which interest rate changes should be used in the gap analysis should be determined based on prior experience, the expectation of future rates or on the basis of Senior Management's judgment. The gap computations can be enhanced with information concerning the average coupon rate for each time band in order to contextualize the change in net interest income from the gap analysis. 4

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Description of various measuring methods

Albeit widely used, this method presents a series of weaknesses. Firstly, the method assumes that all positions in a time band mature or are to be re-priced simultaneously. The more data is aggregated (i.e. the broader the time band), the less accurate the measurement. The opposite is also true: the more detailed the time band, the smaller the error as the exact payment date is disregarded. Secondly, changes in the spread between the interest rates (which may ensue if market interest rates are not perfectly correlated) are not taken into account ("basis risk"). Thirdly, because of the static approach to the balance sheet, the structural effect is not taken into account. Because of these weaknesses, this technique provides a only rough approximation of the actual change in net interest income resulting from the assumed change in the interest rate structure. A further weakness of this method is that it does not disclose the aggregated effect of a change in interest rates over the interest rate sensitive positions of all maturities. 5

III. Simple measuring technique used to determine the net present value effect

Contrary to the results-oriented analysis, the net present value perspective captures the net effect of any changes in interest rate levels on future streams of cash flows. In order to determine the effect of a change in interest rate structure on the net present value of the bank's equity, the change in the net present value is calculated, resulting from the discounting of cash flows with a changed interest rate structure in comparison to discounting the same cash flows with an unchanged interest rate structure. 6

Instead of using the exact maturities for each cash flow, the bank may use the same time bands which were used for the gap analysis. For this purpose, average discounting factors shall be computed for each maturity band. The greater the number of maturity bands used, the smaller the error resulting from the fact that the precise payment dates were not used. 7

The three weaknesses referred to in relation to the measurement of the income effect (Section II of the Annex) also apply to this method: the definition of the time bands leads to measurement imprecision, and both the basis effect and the structural effect are neglected. 8

A rough estimate to determine the effects a change in interest rate has on the net present value of the bank's equity is found in the duration, which approximates the non-linear relationship between interest rate and price change in a linear function. If the duration on the asset side is greater than that on the liabilities side (so-called positive maturity transformation), an increase in interest rates will lead to a reduction in the net present value of the equity. 9

IV. Simulation Techniques

It is more precise to analyze the potential effect on income and the market value of a change in interest rate levels by simulating the future development of interest rates and their impact on cash flows. 10

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First, the cash flows of the various categories for on- and off-balance-sheet positions are re-analyzed in order to incorporate specific assumptions concerning interest and principal repayments as well as non-interest related income and expenses from each type of position. Furthermore, the simulation technique can account for different and more specifically defined changes in the interest rate environment; this includes changes in the slope and shape of the yield curve to interest rate scenarios which are derived from Monte-Carlo simulations. Implicit and explicit options may also be taken into account. 11

In the case of the *static simulation*, only the current present long and short positions of on and off-balance sheet transactions are taken into account. For a simulation, an interest rate scenario is assumed which starts from a shift or tilt of the yield curve against a basis scenario or a change of spreads between various interest rates. The cash flows are simulated for the total duration of the bank's holdings and discounted to their present value. By comparing this net present value with the net present value arising from the basis scenario one arrives at the estimated change in net present value of the bank's equity. If an entire collection of scenarios is assumed to occur with a certain probability, one arrives at a probability distribution for the net present value of the bank's equity. In order to do this, it is important that the collection of scenarios is selected so that the interdependencies between various interest rates are reproduced correctly. 12

Dynamic simulation techniques also capture the bank's behavior (setting of interest rates determined by the bank) and the reactions of its customers triggered by interest rate variations ("structure effect"). The expected cash flows can be computed with the assumptions on future activities and re-investment strategies. This way, the bank can account for both, the dynamic interdependences between cash flows and the interest rates, and better capture the impact of embedded or explicit options. Thus, dynamic simulation models constitute a further development of the aforementioned approaches used to measure the interest-rate risks insofar that they extend the cash flow data into the future with the help of forecasts of future developments of the business. 13

The predictive ability of a simulation model depends primarily on the quality of the data, i.e. the degree of detail to which interest payment and payment frequencies, interest rate adjustments, repayment and withdrawal conditions etc. of a product are captured as well as the appropriateness of the assumptions concerning future business developments. This requires the definition of the following measures: 14

- forecast of interest rate development and development in the yield curve within the timeframe;
- development of conditions for new business transactions;
- modeling of customer behavior depending on the interest rate structure and the conditions for new business (taking account of clients' repayment and withdrawal behavior, determining the interest rate repricing period and capital tie-up period in respect of future business volumes);
- development of balance sheet volumes and balance sheet structure.

The movement of the yield curve within a timeframe is an important factor for the valuation of the portfolio. Interest rate structure models describe the behavior of the interest rate structure over time and are needed for the valuation of interest rate-dependent instruments, particularly interest rate derivatives, and for risk management. Selecting a suitable interest rate structure model depends on its specific application. Multiple-factor models permit a realistic description of the behavior of the yield curve. 15

Annex

V. Value at Risk

If the simple measuring technique is used to determine the net present value effect (as per Section III of the Annex), the change of the net present value of future cash flow streams is measured in view of a specific change in the yield curve. This method has the disadvantage that very many changes in interest rate are possible and it is not clear beforehand which ones are relevant. A bank may be immune to certain interest rate changes and experience gains or losses due to other scenarios. Moreover, it would often be important to have data not only on potential losses but also on the probability of such or even greater losses. The following approach presents neither of these two weaknesses. It makes it possible to aggregate various risks over several business areas and currencies into one single consistent, company-wide risk measure. 16

The Value-at-Risk (VaR) designates the estimated loss which may not be exceeded in a given portfolio of interest rate sensitive positions on and off the balance sheet of the bank over a predefined timeframe and at a predefined confidence level. To compute the VaR, as a first step, relevant risk factors influencing the market value of the portfolio must be determined. Examples of risk factors for a banking portfolio are the yield curve and exchange rates.[2] 17

Furthermore, relationships between market prices of the individual positions and the risk factors, i.e. the so-called valuation functions, must be determined. In the following step, scenarios are defined for the risk factors, which have a given probability of occurrence. After that, the individual positions are valued depending on the risk factors and the portfolio loss is computed. Finally, from the distribution of the possible portfolio losses the quantile is determined, which is not exceeded with the given probability. 18

Depending on the structure of the portfolio and underlying assumptions concerning the probability distribution of the risk factors, either analytical solutions exist to compute the VaR with statistical methods or it may be determined by strictly using simulation techniques (cf. Section IV of the Annex). While a historical simulation uses scenarios for the risk factors directly from the past, the MonteCarlo simulation generates these with mathematical models. 19

Should the VaR be determined over a longer period, it will have a bearing on whether the possible loss is defined on the current or the expected portfolio value; in the latter case, the expected income on the portfolio must also be taken into account. 20

[2] If all relevant risk factors should be considered, then the credit risk must also be taken into account. On the one hand, credit risks must take into consideration defaults leading to the loss of interest payments and a part of the principal; on the other hand, downgrading of ratings will lead to higher risk premiums and interest spreads and thus also to lower present values. If credit risk is not considered, it is assumed that the fixed cash flows are risk-free. As interest rate and credit risks are not separate issues, separate computations will lead to a different result than an integrated computation.

List of amendments

The circular is amended as follows:

The following amendments were decided on 1 June 2012 and they enter into force on 1 January 2013.

The references to the Capital Adequacy Ordinance (CAO; SR 952.03) have been adapted to the version entering into force on 1.1.2013.

These amendments were passed on 6 December 2012 and enter into force on 1 January 2013.

Amended margin no. 52

The references to the Banking Ordinance (BO) have been adapted to the version entering into force on 30 April 2014.

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