Concentration risk

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Outline


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Measurement
• Heuristic measures
• Portfolio models
• Analytic adjustments to the ASRF model
Internal limits design

Introduction

Problems created by concentration risk have been identified long ago …

“But divide your investments among many places, for you do not know what risks might lie ahead.”

Ecclesiastes 11,2 (4th-3rd century b.c.)

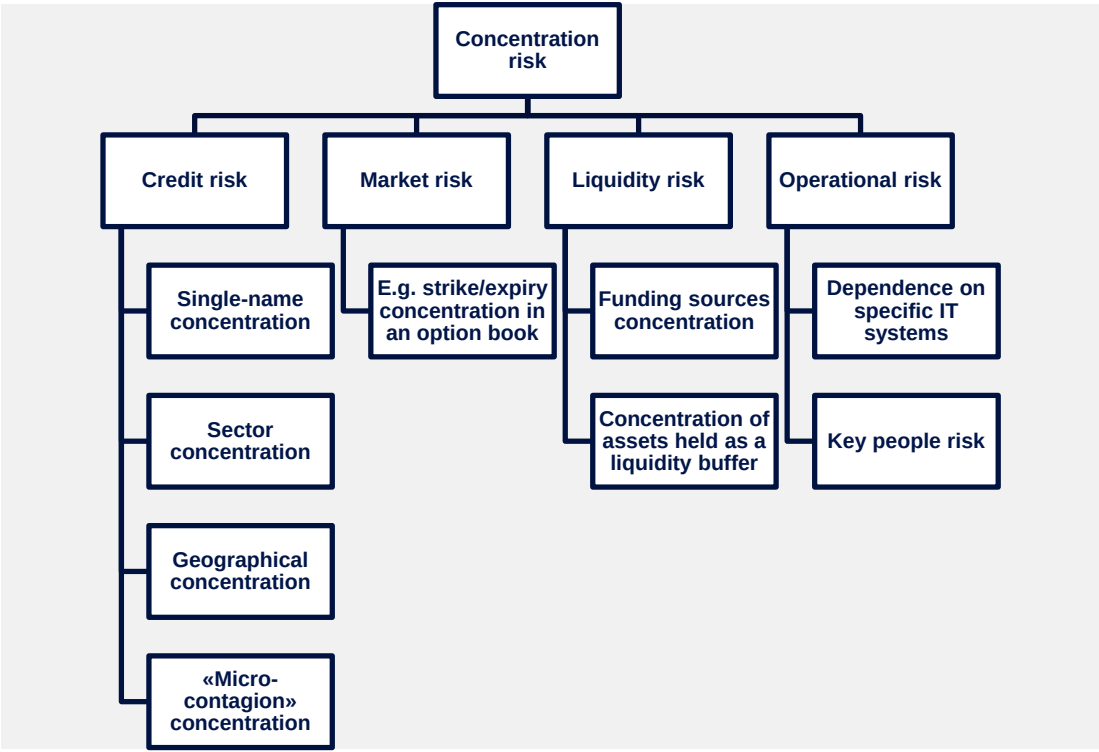
“If you owe the bank $100 that's your problem. If you owe the bank $100 million, that's the bank's problem.”

J. Paul Getty (1892 – 1976)

… however, both from a modeling point of view and in practice, our ability to manage this type of risk remains limited

Aspects of concentration Risk

Concentration risk arises in many contexts within a financial institution



This chart is an adaptation of a similar one shown in the Bundesbank report «Concentration risk in credit portfolios».

Credit concentration

Key principles

The "Principles for the Management of Credit Risk" document, published in 2000 by the Basel Committee on Banking Supervision, lists the most important principles for managing credit risk, closely linked with concentration risk management.

Key points:

- each financial institution should introduce total **credit limits** at the level of **individual counterparties** (or groups of related counterparties), aggregating for this purpose, in a comparable and significant manner, the different types of exposure arising from each type of activity;

- the granting of credit in a financial institution should be managed by ensuring that credit exposures are in line with the internal prudential rules as well as with the applicable prudential rules; to that end, the internal control system must ensure that any exceptions to the policies, procedures and limits are **promptly notified** to the bodies responsible for intervening;

Credit concentration

Key principles

- a financial institution must not create an **internal incentive system** in contrast with the credit risk management strategy and in particular it should not encourage short-term profit-seeking strategies deviating from credit policies or exceeding the existing limits;

- credit policies should ensure an adequate **portfolio diversification**, given the markets to which the financial institution that adopts them and its overall credit strategy is addressed; in particular, they should identify portfolio composition targets and introduce limits on dimensions such as (a) individual counterparties (or related counterparty groups), (b) sectors, (c) geographic areas, (d) specific products;

- In setting credit risk limits, a financial institution should also consider the consequences of **stress scenarios**;

Credit concentration

Key principles

- concentration risk can take **many forms** and may occur whenever a large number of exposures have common risk characteristics: in addition to the dimensions already mentioned ("single-name", geographical and sectoral concentrations), certain concentrations may occur in the type of underlying guarantees, the maturity, or the most complex and least obvious features;

- in many cases, because of the market segments where a financial institution operates, geographical location or lack of access to economically diverse borrowers or counterparties, **avoiding or reducing concentrations can be extremely difficult**. In addition, a financial institution may also determine that it is being adequately compensated for incurring certain concentrations of risk. Financial institutions should not necessarily forego booking sound credits solely on the basis of concentration: they may need to make use of alternatives to reduce or mitigate concentrations. Such measures can include pricing for the additional risk, increased holdings of capital to compensate for the additional risks and making use of loan participations in order to reduce dependency on a particular sector of the economy or group of related borrowers. Financial institutions must be careful not to enter into transactions with borrowers or counterparties they do not know or engage in credit activities they do not fully understand simply for the sake of diversification;

Credit concentration

Key principles

- Concentration management mechanisms such as **credit derivatives**, loan sales, **securitization** and other secondary market forms involve risk profiles that need to be properly identified and managed.

Concentration risk is difficult to handle because, very often, attempts to manage it after it has been taken entail other, more serious risks

Hence it is important to invest in a set of limits and decision-making processes that prevent excessive concentrations

Banking regulation

Background

In the last thirty years banking regulation has been shaped mainly by the Basel accords.

While the complexity and scope of Basel rules have increased dramatically over time, concentration risk has received relatively little attention, and remains an element of the so-called «second pillar» of the Basel II framework

	Basel I (1988)	Basel II (2004)	Basel III (2011)	"Basel IV" (2017)
Focus	• Minimum capital requirements	• «Full-fledged» framework on capital adequacy, supervision and disclosure	• Addressing the flaws in Basel II	• Addressing some of the remaining shortcomings in Basel III
Main changes	• 8% capital rule • Tier 1, Tier 2, Tier 3 capital concepts	• Minimum capital requirements for the main types of risks • Supervisory review process and market discipline	• Quality of capital • Capital buffers • Liquidity risk • Enhanced capital coverage • Leverage ratio	• Credit risk framework • Operational risk framework • Capital floor • Revised leverage ratio • Sovereign exposures
Risks covered	• Credit risk • Market risk covered through an amendment introduced in 1996	• Credit Risk • Market Risk • Operational Risk • Other «Pillar 2» risks (concentration risk, interest rate risk in the banking book, etc.)	• Everything that was already covered under Basel II • Liquidity risk • Excessive leverage risk • Some aspects of counterparty risk	• Same as Basel III

Measuring concentration risk

Four ways to do it

Very often, the best way to evaluate concentration risk in a credit portfolio is to go through the list of the top 20 exposures, analyzing information such as the counterparty rating, its group, sector and country, and the average recovery rate associated with existing exposures

In order to go beyond this view, several types of measures can be used:

	Heuristic measures	Portfolio models	Analytic adjustments suggested by the regulation	Other analytic adjustments
Single-name concentration	✓	✓	✓	✓
Sector concentration	✓	✓		✓
Geographic concentration	✓	✓		✓

Heuristic indicators

An overview

The document «Guidelines on the management of concentration risk under the supervisory review process» issued by CEBS (now EBA) in 2010, lists **a wide range of concentration indicators** used in the banking sector.

While in most cases these are simple heuristic measures, some of them, such as Moody's Diversity Score, are linked to a specific credit risk model and are based on assumptions on default correlations.

Some other measures listed in the document, such as correlations, are not concentration indicators, but rather parameters that have an impact on the level of correlation risk in a credit portfolio.

Annex 2. Examples of indicators used for concentration risk management

The following are examples of simple indicators of concentrations. When used and where applicable, concentration indicators should be based upon a risk sensitive measure (such as internal capital, risk-weighted assets or expected loss) rather than simply upon the size of an exposure:

- Commonly related to a relevant numeraire (e.g. size of the balance sheet, own funds, net profit):
  - Size of a certain number of large exposures (e. g. the ten largest exposures),
  - Size of a fixed number of large connected exposures,
  - Size of key sectoral/geographical concentrations,
  - Exposure to a specific financial instrument;
- Diversity scores, such as the Herfindahl Hirschmann index (HHI), Simpson's equitability Index, Shannon-Wiener index, Pielou's evenness index, Moody's Diversity Score, etc;
- Concentration curves[30];
- Gini coefficients[31];
- Portfolio correlations; and
- Variance/ covariance measures.

30 A concentration curve provides a means of assessing for instance whether a certain risk is more concentrated in some countries/sectors than in others.

31 Gini coefficient can be used to measure any form of uneven distribution. It is a number between 0 and 1, where 0 corresponds with complete risk homogeneity (where every exposure has the same risk) and 1 corresponds with absolute concentration (where one exposure carries all the risks, and the other exposures have zero risks).

Using heuristic indicators

An example

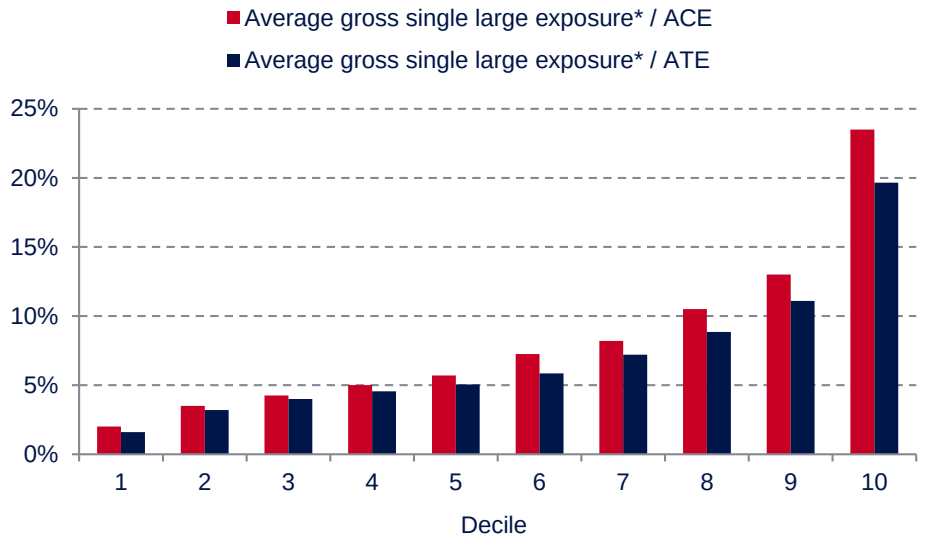
One of the simplest measures for single-name concentration is the ratio between:

- The average gross amount of the top 20 exposures
- A measure of a bank's own funds (e.g. common equity).

This indicator is, used, for example, by Standard & Poor's.

While very handy, this measure isn't risk-sensitive: it doesn't take into account how risky large exposures are, but only their size.

Concentration Risk at the 100 Largest rated banks in Western Europe



Adapted from Standard & Poor's Ratings Services. The 100 largest banks were determined by size of capital base. *Average gross single large exposure is the sum of the gross amounts of the 20-largest exposures divided by 20. ACE-adjusted common equity. ATE – adjusted total equity.

The Herfindahl-Hirschman index

Definition and meaning

The Herfindahl-Hirschman index is defined as:

$$HHI = \frac{\sum_{i=1}^{N} EaD_i^{\,2}}{(\sum_{i=1}^{N} EaD_i)^2} = \sum_{i=1}^{N} \left(\frac{EaD_i}{\sum_{i=1}^{N} EaD_i} \right)^2$$

EaD represents Exposure at Default.

The reciprocal of the index, *n*=1/HHI , can be* interpreted as the effective number of exposures in a portfolio.

For a portfolio with a single exposure, HHI equals 1, and n* is 1 as well.

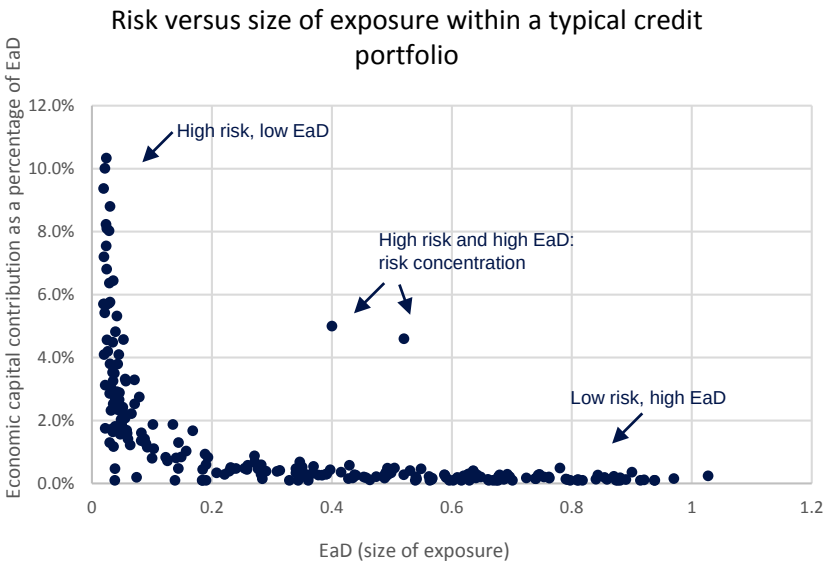
For a portfolio of 1000 loans of equal amount, HHI is 1/1000 , and n*=1000.

When a portfolio approaches infinite granularity, i.e. it is made of a very large number of very small exposures, HHI tends to zero.

Since HHI is the sum of squared exposure weights, it is intuitively linked to the variance of returns in a portfolio. In the case of a portfolio of *N* assets with uncorrelated returns and identical return variance σ^2, portfolio variance is given by HHI times σ^2.

Portfolio models

Models Such as CreditMetrics, CreditRisk+, Moody's KMV, etc. can be very effective in measuring concentration risk



Adapted from CreditMetrics technical document.

Starting from the '90s, several portfolio credit models have been developed.

Their effectiveness in capturing concentration risk depends on their structure and parametrization.

One of the most intuitive ways to analyze concentration risk using a portfolio model is to build a graph with the size of exposures on the x axis and a measure of relative risk contribution on the y axis.

For example, marginal standard deviation in percentage of exposure can be used as a relative risk contribution measure.

Another way to use a portfolio model for concentration risk assessment is to compute, for each counterparty, the following measure:

$$\beta_i = \frac{ESc_i / EaD_i}{ES_{port} / EaD_{port}}$$

Where ESc_i represents the contribution of an exposure to portfolio risk (as measured, for example, by Expected Shortfall), and ES_{port} is the corresponding measure for the whole portfolio.

This type of measure (se for example Buongiorno and Genero – 2008) is greater than 1 if exposure *i* is very risky and/or it adds concentration to the portfolio.

The ASRF model

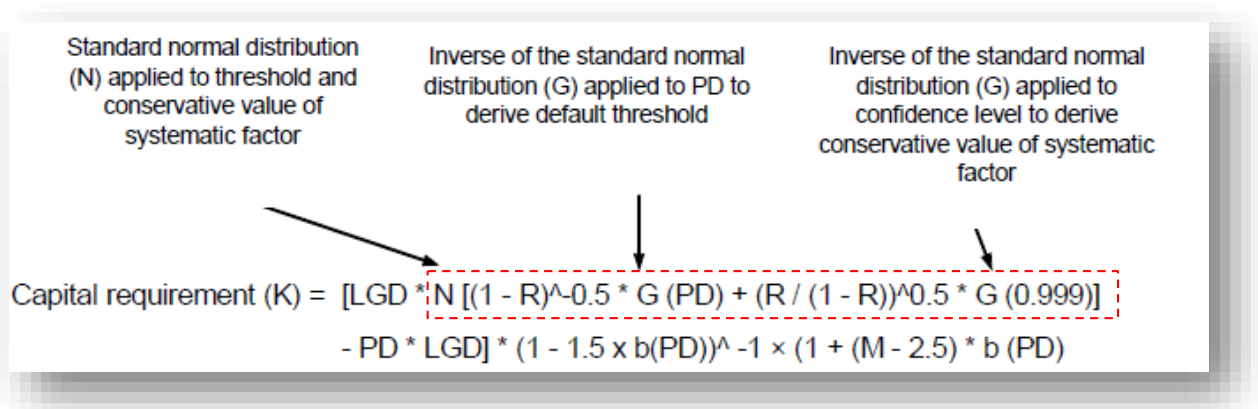
The asymptotic single risk factor (ASRF) model can be used to derive analytic risk measures assuming no concentration

In the "first pillar" of banking regulation, the one that deals with minimum capital requirements, the Basel Committee has not allowed banks to adopt portfolio models. Instead, they can use internal models for risk parameters (probability of default, loss given default, exposure at default) combined with a regulatory formula.

The model used to derive the regulatory formula is based on the Vasicek (1987) approach and is commonly referred to as "asymptotic single risk factor" or "ASRF" model. The "single risk factor" is the common driver of all default events, and it is combined, within the model, with as many idiosyncratic factors as the number of obligors.

$$Y_i = \sqrt{\rho} Z + \sqrt{1-\rho}\, \varepsilon_i$$

Given this very simple factor structure, if we assume that a default occurs when Y_i is below a certain threshold, it is possible to obtain a formula for VaR at a given confidence level in the limiting case of a portfolio with HHI approaching to zero.



Source: Basel Committee on Banking Supervision.

Analytic adjustments for concentration risk

The ASRF model can be “corrected” by adding a “granularity adjustments”

$$GA = C \times H \times \sum_{i=1}^{n} EAD_i$$

$$H = \frac{\left(\sum_{i=1}^{n} EAD_i^2\right)}{\left(\sum_{i=1}^{n} EAD_i\right)^2}$$

PD	0,5%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
C	0,704	0,764	0,826	0,861	0,883	0,899	0,911	0,919	0,925	0,929	0,931

Source: Bank of Italy.

The results obtained via the ASRF model can be interpreted as risk measures in the absence of concentration risk.

It is quite natural to attempt to «correct» these results in order to account for concentration.

Banking regulation describes a simple adjustment for single-name concentration, which is a linear function of the HHI.

$$\boldsymbol{ga = \frac{1}{2K^*} \sum_{i=1}^{N} w_i^2 \, LGD_i [\delta(K_i + LGD_i PD_i) - K_i]}$$

A more general single-name concentration adjustment is presented in Gordy e Lutkebohmert (2007), based on the CreditRisk+ model.

K_i is the capital charge according to the ASRF model, the w_i ‘s represent the EaD weights of each obligor, K^* is the weighted average of K_i ‘s according to w_i ‘s, and δ is a constant. LGD and the capital charge are expressed as a percentage of EaD, as well as the resulting *ga* (granularity adjustment).

For a 99.9% confidence level, Gordy and Lutkebohmert suggest a range for δ between 4.5 and 6.5.

Setting-up an internal limits system

The trade-off between risk-sensitivity and robustness

A financial institution will usually need to set-up a system of internal limits.

These will cover at least single-name concentration, and usually also sector concentration and/or geographic concentration.

When setting-up an internal concentration limits system, we can choose different measures.

The choice is based on a trade-off that can be described as follows:

Measure	Data requirements	Ability to deal with worst case scenarios
A. Gross Exposure	• EaD	●●●●●
B. Loss Given Default	• EaD • Recovery Rate	●●●●
C. Expected Loss	• EaD • Recovery Rate • PD	●●
D. Regulatory Capital	• EaD • Recovery Rate • PD • Regulatory capital rules	●●●
E. Economic Capital	• EaD • Recovery Rate • PD • Economic capital model	●●●

No risk differentiation

Full risk differentiation

This chart is an adaptation of a similar one shown in the KPMG paper «Managing Credit Risk – Beyond Basel II».

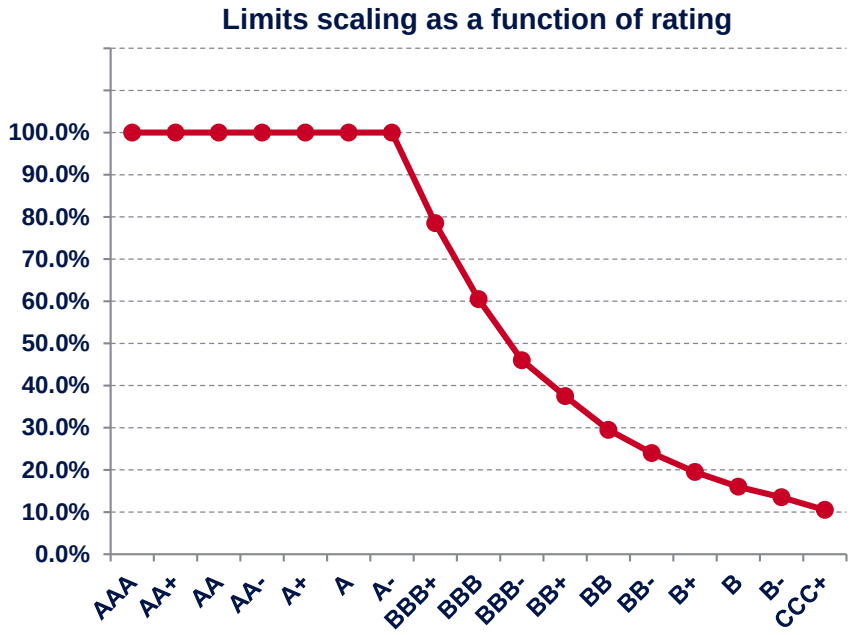
Setting-up an internal limits system

A “mixed” approach

A balanced solution to the trade-off between risk sensitivity and robustness can be found by taking into account several types of measures:

- for the highest rating levels (say above BBB+ or A-), robustness with respect to worst case scenarios is more important, therefore we can impose a sort of «backstop» based on gross exposure
- as we consider lower rating levels, it makes sense to have more risk-sensitive concentration limits, that scale-down as Value-at-Risk or Expected shortfall increases.

For scaling purposes, gross risk measures (expected loss + unexpected loss) or net risk measures (unexpected loss only) usually lead to better results that expected loss.



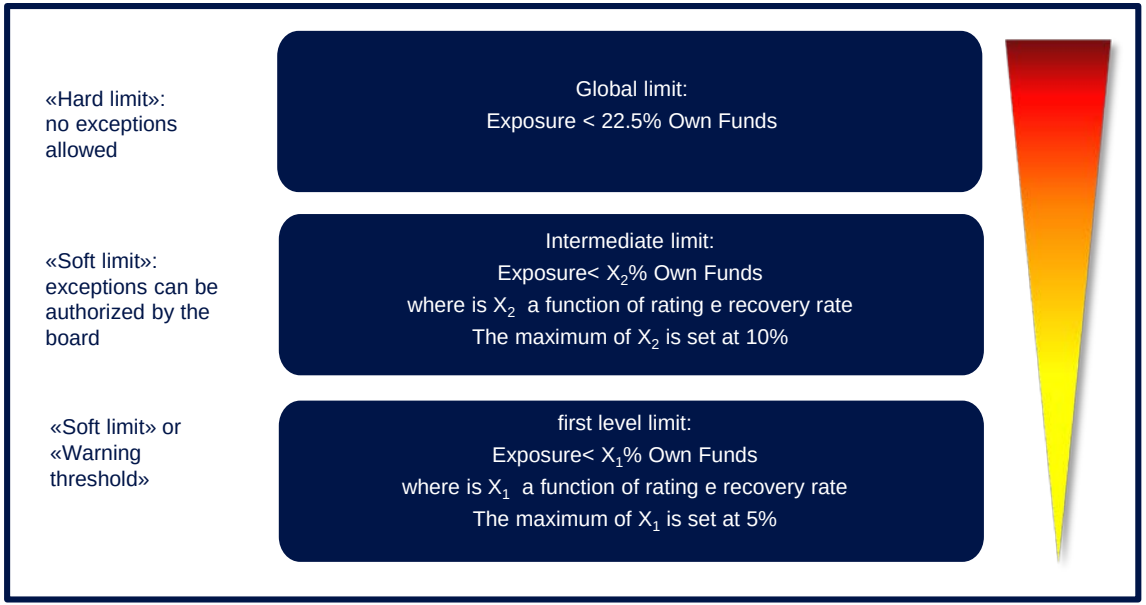
Setting-up an internal limits system

A “cascade” limit structure

- At the top level, a global limit is established; this could usually be slightly lower than the 25% regulatory limit and should be treated as a «hard limit» (i.e. not exceptions should be allowed).

- At an intermediate level, a «soft limit» is established; exceptions are allowed, but need to be approved by the board case-by-case; for high rating levels, this limit could be set near the «large exposure» threshold (10% of own funds).

- At the basic level, a further «soft limit» is established; exceeding this limit should require a «reinforced» approval process,, involving for example the Chief Risk Officer; for high rating levels, this limit could be set at about a half of the «large exposure» threshold (5% of own funds).



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