

Concentration risk in credit portfolios

Concentration risk in credit portfolios comes into being through an uneven distribution of bank loans to individual borrowers (single-name concentration) or in industry and services sectors and geographical regions (sectoral concentration). It may be prudent for specialised banks and credit institutions operating at a regional level to accept credit concentrations so as to benefit from information advantages, for example, familiarity with local conditions. However, in the past 25 years, numerous banking crises have arisen from an increased concentration of risk. The effective management and limitation of this risk by the banks themselves is therefore of fundamental importance. Besides simple model-free procedures, relatively advanced modelling approaches can be used for measuring and managing single-name concentration. By contrast, no generally accepted standardised methods for risk-sensitive treatment of sectoral concentration and the performance of suitable stress tests have yet emerged. Concentration risk and the internal methods used to manage it will, amongst other things, be covered by the Supervisory Review Process (Pillar 2) in future. Furthermore, the current large exposure limitation provisions of the German Banking Act (*Kreditwesengesetz*) also apply under Basel II.

Definition of concentration risk

Definition

The term "concentration risk" in the context of banking generally denotes the risk arising from an uneven distribution of counterparties in credit or any other business relationships or from a concentration in business sectors or geographical regions which is capable of generating losses large enough to jeopardise an institution's solvency.

Concentration risk from a micro and a macro perspective

Concentration risk can be considered from either a macro (systemic) or a micro (idiosyncratic) perspective. From the point of view of financial stability (macro perspective), the focus is on risks for groups of banks which, for example, emerge from a joint concentration in certain business lines or a joint regional concentration in lending. Economic disruptions which affect the group of joint borrowers or the region can therefore jeopardise the solvency of an entire group of banks and thus put financial stability at risk.¹ By contrast, the primary focus in internal risk management and from a supervisory point of view is on concentration risk at the level of individual institutions (micro perspective). This risk is not limited to credit portfolios and may stem from various sources (see the chart on page 37).

Concentration risk in lending business, ...

In lending business, not only a concentration of borrowers but also a concentration of counterparties in trading activities or of certain collateral instruments or collateral providers may occur. Market risks – for example, large exposures in a particular currency – may also lead to concentration risk.

Concentration in liabilities, such as a concentration of certain refinancing instruments or of investors or depositors, may also play an important role. These concentrations belong more to a bank's general liquidity risk, however. Furthermore, concentration risk is also inherent in the area of operational risk, for example, through dependence on a particular IT system.

... in liabilities and in business operations

This article focuses on concentration risk at the individual institution level (micro perspective), specifically on concentration in credit portfolios, as this is generally considered to be the most significant source of risk to the solvency of banks.²

Focus on concentration in credit portfolios

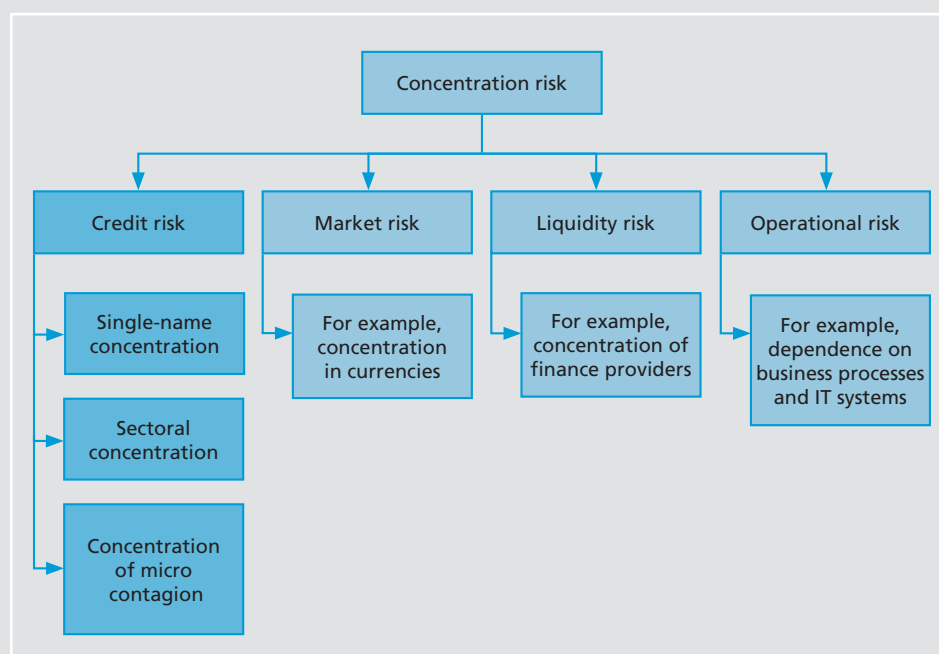
Traditionally, a distinction is made between a concentration of loans to individual borrowers – also termed single-name concentration or granularity – and an uneven distribution across sectors of industry or geographical regions (sectoral concentration). A further risk category consists of risks arising from a concentration of exposures to enterprises connected with one another through bilateral business relations. The resultant danger of contagion effects in the event of default on the part of one of these borrowers has, how-

Single-name concentration vs sectoral concentration

¹ However, concentration risk on the part of individual institutions can also be important from a macro perspective if these institutions are relevant from a systemic risk point of view.

² See Basel Committee on Banking Supervision (2005), *Bank Failures in Mature Economies*, Working Paper No 13 (http://www.bis.org/publ/bcbs_vp13.pdf) and Basel Committee on Banking Supervision (2004), *International Convergence of Capital Measurement and Capital Standards: A Revised Framework (Basel II)*, paragraph 770.

Overview of concentration risk



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ever, received attention only in recent research.³

This classification of concentration risk in credit portfolios into three categories essentially matches that contained in the Basel II Framework.⁴ Moreover, the Framework defines concentration in respect of individual collateral providers or certain kinds of collateral as a further risk category. They constitute an indirect concentration risk as they have an impact only in the event of default.

This article sets forth reasons for the emergence of concentration risk. It also provides an overview of model-free and model-based approaches to measuring such risk as well as empirical results for the German banking sector. It concludes by showing how credit con-

centrations are taken into account in banks' internal risk management as well as how they are treated by banking supervisors.

Emergence of concentration risk

The emergence of concentration risk is closely linked to the business strategy orientation of banks. In the 1970s, the acquisition of market shares through an expansion of business volume increasingly came to the fore. Banks proceeded to grant long-term and sometimes unsecured loans of considerable nominal amounts without taking due account of the

Volume-oriented strategy can foster credit concentrations

³ See, for instance, D Egloff, M Leippold and P Vanini (2004), A simple model of credit contagion, Working Paper, University of Zurich.

⁴ See Basel Committee on Banking Supervision (2004), loc cit, paragraph 773.

credit risk. In many cases, a concentration in individual economic sectors or certain groups of borrowers also emerged. This resulted in large loan losses, leading to numerous bank insolvencies and, in some countries, to banking crises. During the US savings and loan crisis of the 1980s, for example, more than 1,000 institutions operating at a regional level became insolvent owing to a high sectoral concentration. In the mid-1990s, Scandinavia saw numerous bank failures following a housing crisis. It was possible to avert banking crises in other countries, including in Germany; however, in these countries, too, the banks had to build up large loss provisions in their lending business, not least as a consequence of concentration risk.

Change to a shareholder value-oriented business policy

Over the past few years, banks have been making greater efforts to identify and limit concentration risk or to demand appropriate risk premiums.⁵ In this context, their business policy has developed from a purely volume maximisation stance into an earnings and value-oriented business strategy.

The specialised bank principle, ...

However, credit concentrations can certainly also be pre-planned and part of a bank's business philosophy. Mortgage banks as well as building and loan associations are examples of specialised banks which deliberately incur credit concentrations so as to benefit specifically from information advantages gained from focusing on selected products and certain categories of borrowers. The specialised expertise of these banks may even mean that their portfolios are of a particularly high quality and thus have low default rates despite

the existence of considerable credit concentrations.

The regional principle of savings banks and cooperative banks is a further example of the fact that a business model can foster credit concentrations, especially (regional) sectoral concentration. Concentration risk may have a particularly severe effect in regions with a monotonic economic structure. However, the narrow regional focus is offset by information advantages owing to greater familiarity with the clients' local environment.

... the regional principle and ...

Relationship banking – which has traditionally played an important role in Germany – can likewise foster the emergence of concentration risk. Under the “house bank principle”, banks are prepared to assume special responsibility for enterprises to which they lend, even in crisis situations. In some cases, this may lead to banks granting loans which, as individual transactions, would appear to be economically unprofitable or ought to be refused in view of the risk involved because they, for instance, increase single-name concentration or sectoral concentration.

... relationship banking as causes of credit concentrations

The aforementioned examples are not unique in showing that the avoidance of concentration risk is not a general objective. Some papers in finance literature reach the conclusion that – under certain model assumptions – diversification may even be attractive only for banks with a moderate level of risk. For instance, diversification through lending in additional industry sectors or geographical re-

Theoretical studies ...

⁵ See H Schierenbeck (2003), Ertragsorientiertes Risikomanagement, Vol 1 and 2, 8th edition, Wiesbaden.

gions in which a bank has only very little business experience can diminish the effectiveness of a bank's risk management and, thus, increase the total risk.⁶

... and empirical evidence

A number of empirical studies also suggest that sectoral concentration can be advantageous for banks provided that suitable risk management procedures are used. It has been shown – for Italian banks, for instance – that institutions with a high level of risk can improve their risk/return profile by focusing on certain sectors.⁷ A study based on the credit portfolios of German banks concludes that higher concentration on certain sectors and regions – as a rule – is associated with greater profitability, even in risk-adjusted terms.⁸

The above-mentioned historical examples as well as more recent cases such as the insolvencies of Enron, Worldcom and Parmalat, however, also show the dangers emanating from concentration risk. The incurrance of concentration risk, therefore, requires this risk to be measured as precisely as possible, managed effectively and restricted in size.

Single-name concentration

Definition

The term "single-name concentration risk" denotes the firm-specific (idiosyncratic) risk in a credit portfolio which arises from the credit risk of large borrowers. Firm-specific risk comprises the risks resulting from the potential default of a single borrower or a legally connected group of borrowers. The term "single-name concentration risk" is used if

the exposures to large individual borrowers account for the bulk of all loans in a portfolio.

By contrast, systematic risk – the second risk component of a credit portfolio – comprises all of the risks affecting several legally independent borrowers or the entire portfolio, for example, the state of the economy or industry-sector-dependent risks. Single factor risk models such as the Asymptotic Single Risk Factor (ASRF) model⁹ – which also serves as the foundation for the Internal Ratings-Based (IRB) Approaches for the calculation of Pillar 1 capital requirements under Basel II – are suitable for modelling this risk. The ASRF model assumes the existence of an infinitely granular portfolio, ie a large portfolio in which each individual loan constitutes an insignificantly small share of the total portfolio exposure.

Definition and modelling of systematic risk

As the ASRF model does not take into account the firm-specific risk arising from a concentration of single-name exposures, the portfolio's overall risk can be underestimated. One solution is to extend this model by means of a granularity adjustment. The following section first of all describes heuristic methods of measuring concentration risk be-

Effects of single-name concentration

⁶ See A Winton (1999), Don't Put All Your Eggs in One Basket? Diversification and Specialization in Lending, Working Paper No 00-16, University of Minnesota.

⁷ See V Acharya, I Hasan and A Saunders (2006), Should Banks Be Diversified? Evidence from Individual Bank Loan Portfolios, *Journal of Business*, Vol 79, No 3, pp 1355-1412.

⁸ See E Hayden, D Porath and N v Westernhagen (2006 forthcoming), Does Diversification Improve the Performance of German Banks? Evidence from Individual Bank Loan Portfolios, Deutsche Bundesbank, Discussion Paper, Series 2.

⁹ See M Gordy (2003), A risk-factor model foundation for ratings-based bank capital rules, *Journal of Financial Intermediation*, Vol 12, pp 199-232.

fore moving on to a granularity adjustment for the ASRF model.

Methods of measuring single-name concentration/granularity

Borrower level is relevant

It is advisable to examine single-name concentration risk at the borrower level, including all relevant exposures. If a measurement is performed on the basis of the individual exposures in a portfolio, however, the actual concentration risk could be underestimated. This is because this risk does not lie in the potential loss of a single exposure but in the loss of all the credit exposures to the same borrower.

The approaches for measuring single-name concentration can be broken down into model-free (heuristic) and model-based methods.

Heuristic methods of measuring granularity, eg ratios, ...

Ratios provide a simple approximation for measuring exposure or borrower concentrations; for instance, the sum of the exposures to the 20 (30, 50 etc) largest single borrowers can be expressed in relation to a capital figure. However, this capital covers not only credit risk, but also other banking risks, such as those from trading activities. A comparison of banks on the basis of this ratio may consequently be distorted.

... the Gini coefficient ...

The Gini coefficient provides a further method of measuring single-name concentration. This ratio can be interpreted as a concentration index, ie a measure of the deviation of a distribution of exposure amounts

from an even distribution. A coefficient close to zero signifies a homogeneous portfolio in which all of the exposure amounts are distributed equally; a coefficient close to one points to a highly concentrated portfolio. A fundamental disadvantage of using the Gini coefficient to measure concentration, however, is the fact that the size of the portfolio is not taken into consideration. For example, a portfolio with a few equal-sized loans has a lower coefficient than a better-diversified, larger credit portfolio containing loans of different amounts. Moreover, the Gini coefficient may rise if a relatively small loan to another borrower is added to the portfolio despite the fact that this diminishes the concentration. For these reasons, the Gini coefficient is only of limited suitability for measuring single-name concentration risk.

The Herfindahl-Hirschman Index (HHI) is another simple model-free approach for quantifying undiversified idiosyncratic risk. The HHI is defined as the sum of the squares of the relative portfolio shares of all borrowers. Well-diversified portfolios with a very large number of very small firms have an HHI value close to zero whereas heavily concentrated portfolios can have a considerably higher HHI value. In the extreme case of a single borrower, the HHI takes the value of one.

... and the Herfindahl-Hirschman Index

Neither the HHI nor the other aforementioned model-free methods of measuring exposure concentration can show the effects of different credit qualities, which are reflected, for example, in varying probabilities of default or in the collateral provided. One advantage of the model-based measurement of single-

name concentration risk is the fact that they are taken into consideration, for instance, via a granularity adjustment. Furthermore, model-based methods allow the single-name concentration risk to be expressed directly as economic capital, which is defined as the difference between the Value-at-Risk¹⁰ at a given confidence level and the expected loss.

Granularity adjustment in the ASRF model

The granularity adjustment for the ASRF model constitutes an approximation formula for calculating the appropriate economic capital needed to cover the risk arising from the potential default of large borrowers. The theoretical derivation of this method is explained briefly in the box on page 41. The advantages of the granularity adjustment as a formula-based solution are that it avoids relatively time-consuming Monte Carlo simulations and simplifies sensitivity analyses.

Suitability of granularity adjustment in practice

A specific proposal to incorporate single-name concentration risk into the minimum capital requirements under Pillar 1 of Basel II was proposed in the second Consultative Document but later abandoned,¹¹ not least because of the extensive data requirements and the high implementation burden. Both of these objections could be reduced considerably if only loans of or above a certain minimum amount were taken into account in calculating the granularity adjustment. However, this approach would result in a higher capital

¹⁰ Value-at-Risk is a measure of the absolute loss of a risk position which, with a predefined probability (confidence level), will not be exceeded at the end of a specified risk horizon.

¹¹ See Basel Committee on Banking Supervision (2001), The New Basel Capital Accord, <http://www.bundesbank.de/download/bankenaufsicht/pdf/basel03.pdf>.

Granularity adjustment in the Basel II IRB model

The granularity adjustment (GA) is an extension of the ASRF model which forms the theoretical basis of the Internal Ratings-Based (IRB) Approaches. Through this adjustment, originally omitted single-name concentration is integrated into the ASRF model. The granularity adjustment can be calculated as the difference between unexpected loss in the real portfolio and in an infinitely granular portfolio with the same risk characteristics.

In the following, $\alpha_q(X)$ denotes the q -th quantile of the systematic factor X which is modelled as a random variable. Since no analytical formula for the unexpected loss of the actual portfolio exists in general, an asymptotic approximation of the granularity adjustment such as that presented by Wilde¹ is used.

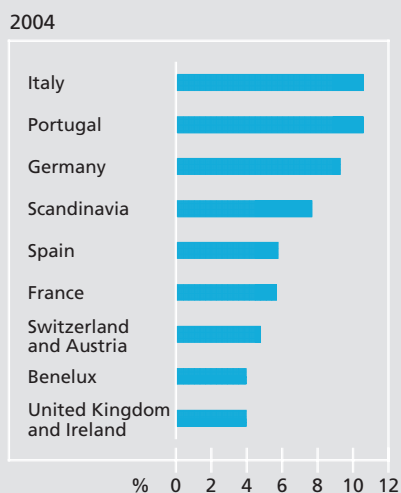
An approximation formula for the granularity adjustment is derived by applying a second-order Taylor expansion to the quantile of the portfolio loss L . It can be shown that the first derivative in this Taylor expansion is equal to zero since the expected firm-specific risk – conditional on the systematic factor – disappears. Furthermore, the second derivative in the Taylor expansion can be written as

$$GA_n = \alpha_q(L) - \alpha_q(E[L | X]) \\ \approx \frac{-1}{2h(\alpha_q(X))} \cdot \frac{d}{dx} \left(\frac{V[L | x] \cdot h(x)}{\frac{d}{dx} E[L | x]} \right) \Bigg|_{x = \alpha_q(X)}$$

where h denotes the density of the distribution of the systematic factor X . $V[L | x]$ denotes the variance of L conditional on $X = x$. If appropriately parameterised, this formula for GA_n provides, for example, the granularity adjustment explained in the second Consultative Document.²

¹ See T Wilde (2001), Probing granularity, Risk Magazine, Vol 14, No 8, pp 103-106. — ² See Basel Committee on Banking Supervision (2001), The New Basel Capital Accord, <http://www.bundesbank.de/download/bankenaufsicht/pdf/basel03.pdf>.

Median degree of single-name concentration of the largest west European banks according to countries*



Source: Standard & Poor's. — * The degree of single-name concentration is the mean of the 20 largest exposures against adjusted common equity. The size of the banks was measured using the value of their capital base.

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requirement than that calculated precisely taking all exposures into account.

Empirical studies on single-name concentration

Credit concentration in large European banks

A study conducted by Standard & Poor's¹² in 2004 compared the concentration of the credit portfolios of the 100 largest rated west European banks. The degree of concentration was calculated as a percentage using the average of the 20 biggest loans to non-banks and the capital ratio of the relevant bank. The median concentration for this group of banks

¹² See P Tornquist (2004), Concentration Risks Remain High at European Banks, Standard & Poor's, <http://www.ratingsdirect.com>.

was about 6.6%. The results for each country are shown in the chart on page 42.

In a cross-country comparison, the participating German banks had an above-average concentration of exposures. However, the informative value of the study is limited by the fact that it focused only on the exposure amounts but failed to take into account the individual probabilities of default and the expected recovery rates.

In a recent Bundesbank in-house analysis of 58 real bank portfolios based on data on loans of €1.5 million or more¹³ from 2002, both the HHI and the granularity adjustment were used to examine single-name concentration. The increase in the Value-at-Risk owing to the granularity adjustment – ie for idiosyncratic risk – which thereby came to light ranged from 3% to 8% for portfolios with at least 1,000 exposures. This result somewhat tempers the significance of single-name concentration as a risk category for portfolios of this size.

Empirical results for single-name concentration based on data from the German credit register

Furthermore, it was possible to establish an approximately linear relationship between the granularity adjustment and the HHI for these portfolios (see the chart on page 43). At first glance, this indicates that the HHI is suitable as a measure of single-name concentration, in particular in view of its relatively simple calculation method.

However, in the case of small portfolios, which usually have a higher HHI value, differ-

Information advantage of the granularity adjustment over the HHI

¹³ All loans of €1.5 million or more are recorded in a dedicated database.

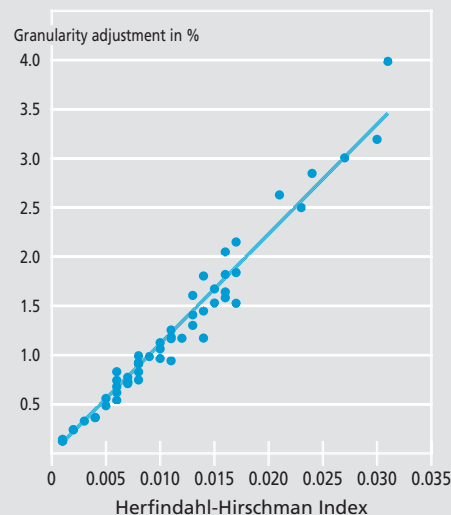
ent borrower-specific probabilities of default play a greater role than in the case of large portfolios with low HHI values. Thus, for such small portfolios, the granularity adjustment leads to a wider dispersion around the linear regression line than in the case of more diversified portfolios with low HHI values, in which the effects of the different probabilities of default tend to be evened out. This finding shows that, at least for relatively small portfolios for which idiosyncratic risk plays a greater role, a granularity adjustment holds out more promise for providing information than the HHI.

Sectoral credit concentrations

Differences between industry and regional concentration despite similar modelling

Sectoral concentration in credit portfolios can be broken down into concentration in certain sectors of industry and concentration in individual countries or regions. While commercial credit risk models widely used in the financial sector usually measure both kinds of sectoral concentration using a similar methodology, there are many differences from a theoretical point of view. Credit concentration in industry sectors is a typical risk driver of corporate loans, while public and private borrowers can also play a key role in the case of country risk. Moreover, country risk is a generic term for different, partly interdependent risk categories, eg political risk and transfer risk. By contrast, concentration risk from exposures to industry sectors arises from credit dependencies between enterprises, resulting from a common sector affiliation and the prevailing economic environment in that sector.

Link between the granularity adjustment* and the Herfindahl-Hirschman Index**



* Add-on for idiosyncratic (firm-specific) risk measured relative to the risk-weight function in the Basel II IRB model. — ** Sum of the squared relative portfolio shares of the individual loans.

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In the ASRF model – on which the IRB risk-weight functions are based – all loans are assumed to be dependent on the same systematic risk factor. This model feature ensures that the economic capital can be determined separately for every individual loan without taking the portfolio structure into account. Owing to the presupposed uniform correlation structure, the credit risk of a portfolio with an uneven sectoral distribution may be either overestimated or underestimated. The risk contribution of sectoral concentration to a portfolio's overall risk can therefore be established only if the model framework is enlarged.

Differences in concentration not indicated by the IRB risk-weight functions

Methods of risk measurement for sectoral concentration

Basic conditions for sectoral classification ...

An essential precondition for measuring sectoral concentration risk is a suitable sectoral classification. The definition of the sectors should ideally enable direct allocation to individual risk factors. To put it simply, a sectoral classification is ideal if the asset correlations¹⁴ are high within a sector and low between different sectors. Asset correlations within a sector are often described in terms of statistically calibrated functions, for example, depending on corporate turnover, while correlations between sectors can be estimated, for example, from the time series correlations of the relevant sectors' stock index returns.

... and data availability

The number of sectors is limited by data availability and the objective of a stable correlation estimation. The official statistics in Germany provide different and, in some cases, very detailed sector schemes, for example, in the form of the economic sector key. These sector definitions were not developed with risk measurement in mind, however, and therefore do not necessarily fulfil a crucial criterion for measuring risk, namely to combine within a sector those enterprises whose credit risk is linked or dependent on the same risk factor owing to their activities in the same economic sector.

HHI as a measure of sectoral concentration

The model-free measurement of sectoral concentration risk uses, for example, measures based on the HHI. For the purposes of measuring sectoral concentration, the HHI is derived from the summation of the sectors' squared relative shares of the credit portfolio.

If the portfolio shares are weighted with a rating or if risk-weighted assets are used instead of the exposure amount, such a measure can also take into account the riskiness of the individual exposures.

Heuristic measures such as the HHI, in principle, can provide a ranking of portfolios in the order of their concentration risk. However, they have two limitations: firstly, they do not take into consideration any differences in credit risk dependence between the sectors and, secondly, the HHI does not supply any information on the economic capital needed to cover the risks.

Limitations of heuristic measures

By contrast, traditional multi-factor models take sectoral concentration into account by assigning sectors to risk factors. The amount of risk hinges on the correlations between the individual factors (see the box on page 45). This model framework can be used to determine the (marginal) risk contribution of the individual loans to the overall portfolio's economic capital. To put it simply, the marginal risk contribution in this case describes the additional risk which arises when a further loan is added to the existing portfolio. In these models, sectoral concentration risk is implicitly factored into the marginal risk contributions.

Sectoral concentration in traditional multi-factor models

Multi-factor models are typical examples of model-based approaches to measuring sectoral concentration. This category of approaches also includes simplified procedures, the goal of which is to apply transparent,

Multi-factor models vs simplified methods

¹⁴ The term "asset correlation" denotes the correlation between the asset value returns of two firms.

A multi-factor model for the measurement of sectoral concentration

The simplified model below shows the basic structure of multi-factor models often used in banking practice. These models can be used to determine the total risk of a credit portfolio, taking single-name and sectoral concentration into account. For simplicity, we consider only default risk and not the risk of rating migrations. Furthermore, each borrower can be uniquely assigned to one of a total of S sectors. Under these assumptions, a latent variable $X_{s,i}$, which describes the solvency of enterprise i in sector s , can be modelled as a linear function of a sectoral factor Y_s and a firm-specific disturbance variable $\varepsilon_{s,i}$:

$$X_{s,i} = r_s Y_s + \sqrt{1 - r_s^2} \varepsilon_{s,i}.$$

The coefficient r_s is the sector-specific factor weight. $X_{s,i}$, Y_s and $\varepsilon_{s,i}$ are standard normally distributed. The correlation between the sectoral factors is given by an $S \times S$ correlation matrix Ω .

The asset correlation ρ^a between two enterprises i and j in sectors s and t is then given by

$$\rho^a(X_{s,i}, X_{t,j}) = r_s r_t \Omega_{s,t}.$$

The dependency structure of the credit portfolio is completely described by the asset correlations and the factor weights r_s .

M_s is the number of borrowers in sector s , $w_{s,i}$ is the share of the credit exposure of the i -th enterprise in sector s in the overall portfolio, $p_{s,i}$ is the corresponding probability of default and $\psi_{s,i}$ the relative loss given default. Using this notation, the percentage portfolio loss L at the end of the risk horizon, which is usually one year, can be determined as follows:¹

$$L = \sum_{s=1}^S \sum_{i=1}^{M_s} w_{s,i} \psi_{s,i} 1_{\{X_{s,i} \leq N^{-1}(p_{s,i})\}}.$$

For simplicity, it is assumed that the loss ratio $\psi_{s,i}$ is independent of the default event and can be replaced in a sufficiently granular portfolio by its expected value $E(\psi_{s,i})$ for risk measurement purposes. Economic capital is then derived by deducting expected loss (EL)

$$EL = \sum_{s=1}^S \sum_{i=1}^{M_s} w_{s,i} E(\psi_{s,i}) p_{s,i}$$

from the 99.9% quantile of the distribution of L . This quantile can be determined by Monte Carlo simulations. For this purpose, in each simulation step, Y_s and $\varepsilon_{s,i}$ are drawn at random while taking factor correlations into account, the default condition $X_{s,i} \leq N^{-1}(p_{s,i})$ is tested for each borrower and the loan losses upon realisation are aggregated to the portfolio loss. The empirical distribution of L is derived from the portfolio losses calculated in this manner.

¹ N^{-1} denotes the inverse of the standard normal distribution.

formula-based measurement techniques with as few data requirements as possible. Extensions to the ASRF model are an example of this.¹⁵ A similar course is being followed with models which retain the structure of a multi-factor model but are easier to apply in banking practice owing to reduced data requirements.¹⁶ The suitability of such simplified models, especially their accuracy in measuring portfolio risk, is still the subject of ongoing research.

Simplified model as a benchmark

An important application purpose of simplified, formula-based models with parsimonious data requirements is as a benchmark for more complex models. Moreover, credit institutions for which more complex models would not be suitable from a cost-benefit perspective may gain more information from simplified models than from the heuristic methods which they may previously have applied.

Empirical studies on industry concentration

Regional diversification does not always improve industry diversification

A more recent empirical study on industry concentration and its significance for banks' credit risk is based on the distribution of loans in the corporate sectors of the Belgian, French, German and Spanish banking systems (broken down into 11 industry sectors).¹⁷ Although there were slight deviations for individual countries, all in all a fairly similar sectoral distribution came to light for these four European countries. This allows two conclusions to be drawn. Firstly, naive portfolio diversification across national borders does not

necessarily also improve industry diversification. Secondly, it is to be expected that the following results on the amount of sectoral risk could be applied to other countries in a similar way.

The presented aggregate sectoral distribution of the German banking system had an HHI value of 18% (calculated from the portfolio shares of the individual sectors); individual banks reported a much higher HHI value for their bank-specific portfolios, however. In the case of a portfolio of corporate loans with an HHI value of just under 70% – which, according to individual studies of banks, is quite realistic – economic capital would be around 37% higher compared with a portfolio which reflects the aggregate sectoral distribution of the German banking system (see the box on page 48).

Impact of sectoral concentration on economic capital

However, in order to be able to classify the observed marked increase in economic capital owing to sectoral concentration in terms of its significance for the overall bank's risk profile, it should be borne in mind that corporate loans usually account for only a part of the credit portfolio. Especially in the case of

¹⁵ See, for example, J C Cespedes, J A de Juan Herrero, A Kreinin and D Rosen (2005), A Simple Multi-Factor "Factor Adjustment" for the Treatment of Diversification in Credit Capital Rules, unpublished working paper, http://www.bundesbank.de/download/vfz/konferenzen/20051118_eltville/paper_cespedes.pdf.

¹⁶ See, for example, K Düllmann and N Masschelein (2006 forthcoming), Sector Concentration Risk in Loan Portfolios and Economic Capital, Discussion Paper, Series 2, Deutsche Bundesbank and Nationale Bank van België/Banque Nationale de Belgique.

¹⁷ For further explanations regarding the empirical study on which the information is based and the data set used, see K Düllmann and N Masschelein (2006), The impact of sector concentration in loan portfolios on economic capital, Financial Stability Review, Nationale Bank van België/Banque Nationale de Belgique, June 2006.

smaller regional banks – for which a higher industry concentration tends to be expected – retail business is, as a rule, much more important than corporate loan business. As retail business is only weakly correlated with the industry sectors, this alleviates the capital effect for the bank as a whole. However, the measured increase in economic capital shows that industry concentration is a source of risk that has to be taken seriously.

Credit risk owing to regional concentration

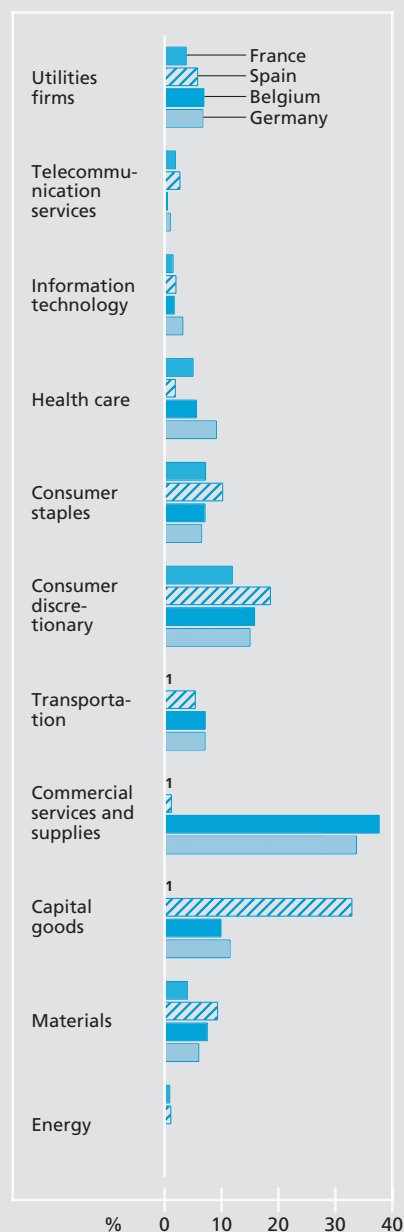
Asian crisis as an example of risks arising from regional concentration

Alongside industry concentration, regional concentration is a further key element of sectoral concentration. The risks resulting from regional concentration are different from the risks arising from industry concentration in that, for instance, the risk of contagion for other regional sectors and/or countries is of particular importance. For example, the Asian crisis of 1997-98 spread from Thailand across the entire East Asian economic area and intensified the crisis which the Japanese banking sector had been suffering since the beginning of the 1990s.

Risk components

The term “country-specific risk” covers all of the risks in connection with international business, the direct cause of which lies in the economic, social and/or political environment of a particular foreign country and which are specific to that country or geographical region. “Country risk” includes, for instance, legal risk, sovereign risk and transfer risk.

Sectoral distribution* of loans in selected countries



Source: Credit register of the respective central banks (2004-05 aggregation). — * Sectoral classification according to the Global Industry Classification Standard (GICS). — 1 No data are available for the transportation, commercial services and supplies, and capital goods subsections in the case of France. However, at 63.2%, the composite sector of industry accounts for a share that is similar in size to that of Germany (52.3%), Belgium (54.8%) and Spain (48.5%).

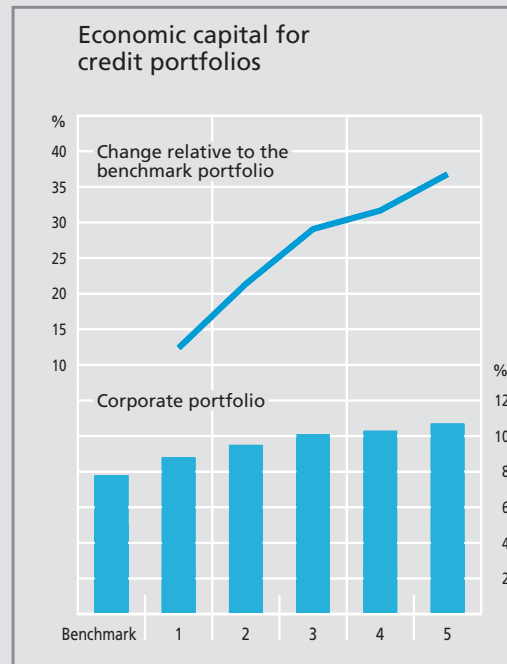
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Sectoral concentration and economic capital

To identify the impact of higher sectoral concentration on economic capital, a series of six credit portfolios of increasing sectoral concentration is examined. The benchmark is the portfolio already used for the comparison across countries; it is created by aggregating the sectoral distribution of 2,224 German banks and will hereinafter be referred to as the benchmark portfolio. The sample portfolios 1 to 5 are obtained from this benchmark portfolio by gradually increasing the portfolio share of the capital goods sector. The portfolios 1 to 5 obtained in this fashion display visible similarities to the sectoral distribution of selected banks. The table below shows the sectoral distribution in the individual portfolios and the Herfindahl-Hirschman Index, which is calculated as the sum of the squared relative sector shares in the credit portfolio.

The adjacent chart shows the economic capital for the six corporate credit portfolios. If the economic capital ratio calculated for portfolio 5 is compared with the benchmark portfolio, a rise from 7.8 to 10.7 percentage points, ie a relative increase of 37%, is established.

Economic capital is defined as the difference between the Value-at-Risk at a 99.9% confidence level and the expected loss and calculated in a multi-factor model using Monte Carlo simu-



lations. The factor and sectoral correlations are estimated from time series of stock index returns of the respective sectors. The asset correlation between two enterprises in different sectors ranges from 3% to 23% and averages 14%. By construction, there is a uniform asset correlation of 25% within each sector. For all borrowers in a portfolio with negligible single-name concentration, a uniform probability of default of 2% and a uniform expected loss given default of 45% are assumed.

Percentages

Sectors	Benchmark portfolio	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Energy	0.2	0.1	0.1	0.1	0.1	0.0
Materials	6.0	4.0	3.0	2.0	1.5	1.2
Capital goods	11.5	41.0	55.8	70.5	77.9	82.3
Commercial services and supplies	33.7	22.4	16.8	11.2	8.4	6.8
Transportation	7.2	4.8	3.6	2.4	1.8	1.5
Consumer discretionary	15.0	10.0	7.5	5.0	3.8	3.0
Consumer staples	6.5	4.3	3.3	2.2	1.6	1.3
Health care	9.0	6.1	4.5	3.0	2.2	1.8
Information technology	3.2	2.1	1.6	1.0	0.8	0.6
Telecommunication services	1.0	0.7	0.5	0.4	0.3	0.2
Utilities firms	6.7	4.5	3.3	2.2	1.6	1.3
<i>Memo item</i>						
Herfindahl-Hirschman Index	17.6	24.1	35.2	51.5	61.7	68.4

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*Modelling
country-specific
concentration
risk*

As in the case of industry or single-name concentration, various model-free methods – for example, the HHI – and model-based approaches can be used to quantify country-specific concentration risk. The methods are largely the same as those for industry concentration.

*Determination
of cross-
country inter-
dependencies is
a core problem
when
measuring
country risk*

A core problem when modelling country concentration risk lies in the modelling of complex interdependency structures and contagion effects between individual countries. Moreover, the individual components of country risk are difficult to quantify. Against this background, country risk is often subsumed into a single risk factor. Interdependencies with other countries can then, for example, be determined from the correlation between the stock index returns of the country in question and those of other countries. This basically allows country risk to be incorporated into a multi-factor model in the same way as industry concentration risk.

Concentration risk from contagion effects between enterprises

*Contagion
effects from
bilateral
business
relations*

More recent empirical studies conclude that interdependencies between the credit risks of individual enterprises cannot be fully explained by observable risk factors such as sector-dependent stock indices.¹⁸ Interdependencies between enterprises owing to bilateral business relations also contribute to the emergence of risks. Concentration in firms which are connected through business relations is more risky than lending to enter-

prises without such ties. This is also referred to as micro contagion.

This kind of concentration risk at the micro level is, in terms of the strength of dependencies, positioned between single-name concentration and sectoral concentration. In the case of single-name concentration, enterprises are classified as a single risk entity if they are so closely interlinked that, were one enterprise to fail, the other enterprises would also most likely fail. By contrast, sectoral concentration takes weaker interdependencies into account, namely affiliation to the same economic sector.

The measurement of micro contagion risk is fraught with considerable difficulties. The mathematical structure of the models discussed up to now is, in some cases, very complex and difficult to implement empirically. The availability of suitable data on bilateral business relations and the resultant interdependencies represent a key problem. Compared with the measurement of granularity and sectoral concentration, there is still a long way to go before generally accepted models for micro contagion risk are available.

*No standard
model for micro
contagion risk*

Inclusion of concentration risk in banks' internal risk management

Increasing risk orientation in lending business as a result of large loss provisions in the past

*Banks' internal
credit limits for
single-name
concentration*

¹⁸ See S R Das, D Duffie, N Kapadia and L Saita, Common Failings: How Corporate Defaults are Correlated, unpublished working paper, http://www.bundesbank.de/download/vfz/konferenzen/20051118_eltville/paper_kapadia.pdf.

has heightened the focus on concentration risk in banks' internal risk management strategies. A classic instrument for restricting concentration on individual counterparties or sectors is the strict use of internally defined credit limits. These are traditionally applied to geographical regions and also serve to limit single-name concentration. It should be borne in mind, however, that these credit limits are not only set according to the risk involved but may also reflect a bank's strategic objectives.

The fact that banks choose different reference measures makes it more difficult to compare their upper credit limits. Credit limits may differ, for example, with regard to the amount of undrawn commitments which are taken into account or the extent to which and at what value collateral is included. Another key issue concerns the bank's internal definition of the borrower, ie to what extent are persons or enterprises other than the contracting party, whose default risk is closely linked to that of the contracting party, included.

Additional ways of limiting single-name concentration through innovative financial products

Apart from credit limits, new innovative financial products may also offer additional means of limiting concentration risk. These include, for example, portfolio diversification through the sale or securitisation of sub-portfolios and the purchase of credit derivatives. Initial steps towards an intra-group transfer of risk with the aid of structured financial products also appear promising with a view to reducing single-name and sectoral concentration, especially in the case of credit

institutions whose lending is confined to borrowers from a certain region.

If concentration risk is to be limited effectively, it must first be measured adequately. As a general rule, it must be borne in mind that the type of business and, in particular, the scope and diversity of the lending operations mean that the methods applied by the industry in measuring and managing concentration risk may vary considerably in terms of their complexity. Cost considerations undoubtedly also play a role in this respect. For instance, the lending business of an internationally operating investment bank with a multitude of capital market-oriented and mark-to-market transactions places different demands on risk management and the risk models which it uses than the classic, book-value-oriented lending business of a small credit institution operating at a regional level.

It is to be expected, however, that, as innovative, often capital market-based financial products become more and more widely used, smaller credit institutions will in future also increasingly use model-based methods of internal risk measurement and management. Internal risk models can be either developed in-house or acquired from commercial providers. Hybrid forms are also possible. Typical examples are the above-mentioned multi-factor models which, in individual cases, may differ from one another substantially, for instance, with regard to the number of risk factors or their definition.

Besides offering a relatively precise risk measurement on a single exposure basis, risk

Link between the complexity of banking business and risk measurement methods

Proliferation of model-based measurement approaches

Inclusion of concentration risk in lending terms and conditions

models have the advantage of being able to support risk management activities with respect to the allocation of capital for the individual operations. They thus also provide a means of allowing concentration risk to be incorporated into the terms and conditions. This does not mean that the terms and conditions are already prescribed by the model, but rather that customer account managers have a model-based, risk-sensitive terms and conditions proposal at their disposal.

Inclusion of sector interdependencies through stress tests

Stress tests are a further key element of the risk management of credit concentrations. They can be used, for example, to establish the impact of certain stress scenarios on sectoral concentration. Possible loan losses may, for instance, spread further owing to interdependencies between sectors. Thus, a crisis in the automotive industry can spill over to ancillary industries, such as mechanical engineering and the chemicals industry, and also lead to loan losses there. The inclusion of such complex interdependency structures imposes high demands on the performance of stress tests. Conversely, stress tests can bring hidden interdependencies to light.

Supervisory treatment of credit concentration risk

Various standard risk limits for credit concentration have resulted from banking supervisors' interest in institutional protection. Apart from the restriction of large exposures to individual borrowers or single borrower units, the focus is on transparency with regard to single-name concentration risk. Thus,

for instance, a duty to report large exposures to the Reichsbank was already introduced in the early 1930s in reaction to bank failures during the Great Depression. Since the Fifth Act amending the Banking Act came into force in 1994, the provisions of the German Banking Act have essentially been based on EC legislation.¹⁹

Nowadays, credit institutions which – pursuant to section 2 (11) of the Banking Act – are exempted from having to apply the provisions of the Banking Act concerning trading book business are obliged – pursuant to section 13 of the Banking Act – to notify the Deutsche Bundesbank of exposures to a single borrower which amount to or exceed 10% of their liable capital. The individual large exposure limit is set at 25% of liable capital; the overall large exposure limit, ie the sum of all large exposures, is set at 800% of liable capital (standard quantitative limits). Large exposures may be incurred only on the basis of a unanimous decision by all of an institution's managing directors. Exposures which exceed the individual large exposure limit require the approval of the Federal Financial Supervisory Authority (BaFin). Moreover, the amount by which a large exposure exceeds the individual large exposure limit is to be backed in full by liable capital. In the case of trading book institutions, the aforementioned limits apply to the banking book; however, for overall business – consisting of banking book and trad-

Large exposure rules limit single-name concentration

¹⁹ See the Banking Directive (Directive 2000/12/EC of the European Parliament and of the Council of 20 March 2000 relating to the taking up and pursuit of the business of credit institutions) and the Capital Adequacy Directive (Council Directive 93/6/EEC of 15 March 1993 on the capital adequacy of investments firms and credit institutions).

ing book business – the focus with regard to limits is not on liable capital but on own funds.

These quantitative stipulations are supplemented by the organisational requirements regarding risk management laid down in section 25a (1) of the Banking Act which originated from the requirements concerning the monitoring of large exposure risks.

Transparency with regard to country risk

In order to identify country concentration risk at German banks at an early stage and prudentially monitor it, pursuant to the German Country Risk Regulation (*Länderrisikoverordnung*), credit institutions must also submit quarterly reports on the volume of external loans in accordance with section 25 (3) of the Banking Act. This concerns credit institutions whose lending volume to borrowers domiciled outside the EEA, Switzerland, the USA, Canada, Japan, Australia and New Zealand exceeds a total of €10 million.²⁰

Review of the large exposure rules at the European level

The Committee of European Banking Supervisors (CEBS) is at present reviewing the effectiveness of the large exposure rules in force in Europe. CEBS is not confining itself to the current approach but is also examining – in consultation with the banking industry – how regional and sectoral concentration risk can be captured and managed. This review serves the purpose of advising the European Commission which, pursuant to Article 119 of the amended Banking Directive, must present a report on the functioning of the large exposure rules by 31 December 2007.

Concentration risk will also be taken into consideration in the Supervisory Review Process (SRP) in future. The term “concentration risk” is broadly defined in the new Basel Framework and covers on and off-balance sheet assets and liabilities, including internal processes and transactions; in this context, lending business is seen as the most important source of risk.²¹ Banks are urged to consider concentration risk in their internal risk management and their assessment of capital adequacy under Pillar 2.²² In particular, regular stress tests of major areas of credit concentration are recommended.²³ This is consistent with the goal of improving the risk sensitivity of the minimum regulatory requirements. CEBS is currently consulting the banking industry with regard to implementing these stipulations, but also in respect of the monitoring of concentration risk under the SRP. At present, credit institutions are merely required – as part of the Minimum requirements for risk management (*Mindestanforderungen an das Risikomanagement*) (qualitative standard), which serves to implement Pillar 2 at a national level – to manage their key risks and the associated concentration risk (General part 2.2 Risk, paragraph 1 of the Minimum requirements for risk management). As for counterparty risk, suitable measures are needed to ensure that key overall business

Concentration risk in Pillar 2 of Basel II

²⁰ See the Regulation on information about loans to foreign borrowers pursuant to the Banking Act (*Verordnung über Angaben zu den Krediten an ausländische Kreditnehmer nach dem Kreditwesengesetz*) of 19 December 1985, last amended on 30 July 2003.

²¹ See Basel Committee on Banking Supervision (2004), loc cit, paragraph 771.

²² See Basel Committee on Banking Supervision (2004), loc cit, paragraph 772.

²³ See Basel Committee on Banking Supervision (2004), loc cit, paragraph 775.

risks (eg sectoral risk, the distribution of exposures by size category and risk category, and, where appropriate, country risk and other concentration risks) can be managed and monitored (Special Part BTR 1 Counterparty risk, paragraph 6 of the Minimum requirements for risk management).

Disclosure requirements for concentration risk

The monitoring of concentration risk is supplemented by the disclosure requirements provided in Pillar 3. In future, credit institutions will also have to submit information about concentration risk in their reports on counterparty risk. Thus, for instance, they must disclose the pattern of exposures across key regions, in each case broken down by key asset classes. Added to this is the pattern of exposures to sectors and groups of borrowers. Finally, they must also report on impaired and past due items, broken down by key sectors, groups of borrowers and important regions.

Outlook

Interaction of standard supervisory limits and market discipline

The limitation and prudent management of concentration risk in credit portfolios is a key element of risk management in all credit institutions irrespective of their business policy orientation. Banking supervisors, for their part, contribute to this by setting large expos-

ure limits and monitoring banks' internal management of concentration risk as part of the Supervisory Review Process. Furthermore, market discipline – which has a direct impact on refinancing terms – can provide additional incentives to avoid concentration risk. This is the case, for example, if external credit assessment institutions take credit concentration into account for a bank's rating or if concentration risk is disclosed under Pillar 3 of Basel II.

Concentration risk will remain a particular challenge for the risk management of credit institutions and for banking supervision in future. The relatively general requirements and freedom of choice regarding methodologies in Pillar 2 of Basel II allow new knowledge to be taken into account in the measurement and management of concentration risk. At the same time, credit institutions and banking supervisors have a common interest in the development of adequate management procedures and should continue their dialogue.²⁴

Challenge for risk management

²⁴ In November 2005, an international workshop was held at the Deutsche Bundesbank's Training Centre in Eltville with the aim of discussing the issue of "Concentration Risk in Credit Portfolios" from a research point of view. Selected model theory approaches to measuring concentration risk were presented and discussed. The workshop met with great interest among the participating representatives from credit institutions, supervisory authorities and academia. See <http://www.bis.org/bcbsevents/rtf05concentrisk.htm>.