DIVERSIFICATION & AGGREGATION OF RISKS IN FINANCIAL CONGLOMERATES

Report of the Working group on Economic Capital Models [*]

The Working Group has been set up by *de Raad van Financiële Toezichthouders, de Nederlandse Vereniging van Banken* and *het Verbond van Verzekeraars*

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Table of content

SUMMARY & CONCLUSIONS

In an earlier study, WECM dealt with the question which risk categories can be distinguished and how risk can be assessed.[1] In order to determine aggregate economic capital for a financial institution, stand-alone economic capital numbers need to be combined in some way. The simple sum of stand-alone economic capital numbers of all units is an overestimation of the capital that is required at the aggregate level since it is highly unlikely that all worst-case scenarios will materialise at the same time. The difference between this simple sum and the true aggregated capital is the diversification benefit.

In investment theory, diversification means that a portfolio of risky investments will be less risky (as measured by, for example, standard deviation or value-at-risk) compared with the level of risk of the individual investments, due to the correlation structure of the investments. However, the accurate determination of diversification benefits is fraught with problems, as these benefits are least likely to be there when you need them most. The presence of diversification does not mean that events that have little or no correlation cannot happen at the same time. High losses in times of stress typically occur when imperfectly correlated loss events do happen at the same time. Crucially, required capital levels are determined for exactly such periods of stress and consequently measurement and modelling of correlation is paramount. Since theoretically correct measurement methods are very difficult to implement and/or parameterise within a financial conglomerate due to the large number of diverse risk drivers, in practice a pragmatic approach is taken by breaking the problem down into smaller parts. These smaller parts are easier to assess and next have to be aggregated.

The work done by the working group leads to the following conclusions:

1. The diversification effect within a financial conglomerate largely depends on the specific correlation values of all acknowledged risk drivers. Recognising diversification effects only makes sense if concentration and granularity are taken into account as well. Moreover, the measurement of diversification should take into account the increase in correlation that may occur during times of stress.

2. The current ‘best practice’ approach to calculate the diversification effect is to first aggregate risk types across bank and insurance and then to aggregate risk types on group level. This approach focuses on underlying risk drivers and thus on the crucial issue that the same risk is treated equally whether it occurs in banking or insurance. An aggregation approach that only at a final stage tries to assess the diversification benefit of combining bank and insurance activities in a single firm cannot properly capture the underlying risk fundamentals. Accurately capturing these risk fundamentals is essential for estimating diversification benefits.

3. Especially in the area of market risk/ALM, the combination of bank and insurance may potentially lead to substantial exposure offsets (or ‘netting’), that occur when

1 The WECM concentrates on the determination of economically (as opposed to regulatory) required capital and abstracts from issues regarding the exact definition and eligibility of different buffers and its interaction with accounting treatment.

we have opposite sensitivities to the same risk driver. Further diversification benefits may occur due to imperfectly correlated risk drivers.
Other clear benefits could come from diversifying the systematic risk of different businesses or strategies.
Such benefits, however, depend of estimating firms' sensitivities to individual risk factors and consequently a "one-size-fits-all" assessment is infeasible.

4. Actual calculations by the industry should provide an answer to the magnitude of the diversification effect, where the specific situation and outcome will differ from institution to institution. OWC estimated a diversification effect between bank and insurance parts of a conglomerate between 5 and 10%.[2] This effect refers to an ultimate aggregation step between economic capital of insurance and banking (and diversification between risk types is already realised on banking and insurance level). The fact that some risk drivers are unique to either banks or insurers and the observation that the sensitivity of bank and insurance to common risk drivers can differ considerably, may indicate that diversification benefits are, at least potentially, more substantial.

5. Until now, an industry standard still has to emerge from the variety of models and approaches in use. Proper measurement approaches should also consider estimation errors for data and model misestimation. In the long run it is desirable to assess the risks of bank and insurance simultaneously. This creates a tendency towards integrated central risk management, since only integrated risk management is capable of revealing the full diversification benefits. Supervisors, simultaneously, are increasingly relying on internal risk assessment and consequently are likely to move towards the evaluation of single, firm-wide integrated risk measures.

[2] Oliver, Wyman & Company (2001), Study on the risk profile and capital adequacy of financial conglomerates, by A. Kuritzkes, T. Schuermann, and S. Weiner.

1. INTRODUCTION

The WECM concentrates on the determination of economic capital, defined as the capital that covers the potential value loss based on the inherent risks and desired level of comfort of an institution, and its potential interaction with capital required by the regulator. In an earlier study WECM dealt with the question which risk categories can be distinguished and how risk can be assessed.[3]
In order to determine aggregate economic capital for a financial institution, stand-alone economic capital numbers need to be combined. The simple sum of the stand-alone economic capitals of all units will most probably overestimate the capital that is required at the aggregate level since it is highly unlikely that all worst-case scenarios will materialise at the same time. The difference between this simple sum and the true aggregated capital is the diversification benefit.

This working paper will research the theoretical and practical considerations of measuring diversification (correlation), in particular between bank and insurance activities. In *chapter 2* we will first elaborate on some aspects of diversification – correlation structure, netting effects, concentration and granularity – before we move to the general measurement approaches in *chapter 3*: a statistical approach and scenario-analysis. In *chapter 4* we explain that the modelling of correlation effects is, in practice, often broken down into smaller parts before these parts are again aggregated to top-level. The two basic approaches of aggregation, i.e. intra- and inter-risk diversification, are specified in *chapter 5*. *Chapter 6* deals with problems of allocation of diversification benefits to business units/entities at lower levels, while *chapter 7* addresses issues with regard to data quality and mis-estimation. Lastly, in *chapter 8*, we discuss some considerations on diversification benefits from the supervisory perspective.

2. CORRELATION, NETTING, CONCENTRATION AND GRANULARITY

In investment theory, diversification means that a portfolio of risky investments will have a lower risk (as measured by, for example, standard deviation or value-at-risk) compared with the simple sum of the risks of the individual investment titles, due to their correlation structure. Based on the correlation/covariance structure of the investments, risks can be mitigated. The remaining risk of the portfolio that cannot be 'diversified away' is called systematic risk.

Correlation is thus crucial to the determination of diversification benefits. Aggregate capital will only equal the sum of stand alone capital numbers if positions are perfectly correlated in times of stress. Since perfectly correlated risk drivers are rare, some diversification benefit will result in most cases. Generally it holds that the lower the correlation between risk drivers, the higher the diversification benefits. When correlation coefficients are negative, the aggregate capital required for two individual

[3] WECM concentrates on the determination of economically required (as opposed to regulatory) capital and abstracts from issues regarding the exact definition and eligibility of different buffers and its interaction with accounting treatment.

For earlier study see WECM paper 'Risk Measurement within Financial Conglomerates: best practice by risk type', DNB report 'Toezicht' nr 51, Feb. 2003.

positions may even be lower than the capital required for either position on a stand-alone basis.

The presence of diversification does not mean that events that have little or no correlation cannot happen at the same time. High losses, such as in the Asia crisis and LTCM crises, typically occur when different, imperfectly correlated loss events happen at the same time. Moreover, correlation between risk drivers may increase in bad economic times (as has been evidenced for stock price returns). Using an average correlation that does not take into account the increase in correlation that may occur in times of stress would result in underestimating the default risk of the institution.

Whereas correlation can only occur between risk drivers, diversification will also arise due to off setting exposures, so-called netting. An adequate economic capital framework will accurately capture these netting effects and the resulting diversification that arises. Such hedges arise because institutions simultaneously have exposures with opposite risk profiles, i.e. have an opposite reaction to the same risk driver(s). The familiar aggregate example is the life insurer taking on long term obligations with shorter-term assets. Banks generally have a reversed profile since deposits (i.e. liabilities) are short termed whereas assets typically have a much longer maturity (for more details on this see paragraph on Market Risk in chapter 5.1).

Diversification benefits will be smaller if there is a concentration of similar risk exposures in different businesses. Concentration risk is the risk resulting from a disproportionately large exposure to a common risk driver, or large exposures to highly correlated risk drivers.

Another aspect related to the size of diversification benefits is granularity. The level of granularity is determined by the number of risk positions in a portfolio or business unit on the one hand, and their relative sizes on the other. The larger the number of risk positions, and the more equal they are in size, the more granular a portfolio is, and the larger diversification benefits will be.
In many simulation models, such as the historical simulation method often used to calculate solvency capital for market risk, granularity in the risk positions will directly be taken into account. Some risk models, e.g. the internal rating-based model underlying the Basle II capital requirements, are theoretically only valid when the risk positions of portfolios are infinitely fine-grained. In practice, such models work reasonably well with a moderately large number of risk positions, i.e. a couple of thousands (note that risk positions do not refer to the number of business units, but to individual exposures such as loans). Those models are more accurate the higher the number of positions in a portfolio and granularity is an indication of the effective number of risk positions. The extent to which model outcomes may be biased due to limited granularity is called the granularity effect. This effect may be particularly pronounced for smaller and concentrated institutions and for institutions with relatively concentrated risk positions to single counterparties, which reduces the effective number of risk positions.[4] Note that granularity is required to fully diversify a portfolio and only be left with systematic risk (i.e. to get rid of idiosyncratic risk).

[4] If one institution has 1.000 risk positions, each of which may result in a loss of €10 and another institution has 1.000 risk positions and 999 carry a risk of €1 whereas its last position carries a risk of €9.001, both have 1.000 counterparties and both have a total risk position of €10.000. The second institution's risk, however, will be much larger than the first institution's risk, since its effective number of risk positions is rather small.

The relative sizes of risk positions within an institution/portfolio have a major influence on diversification; e.g. the aggregate firm diversification benefits between a small bank and a big insurance firm tend to be smaller than aggregate diversification benefits of an institution where bank and insurance are equally big.[5] If this is not accommodated in the aggregation of risk, diversification benefits may be overestimated.

3. MEASUREMENT APPROACHES

The general idea to quantify the diversification effect is to simultaneously model the correlation between all relevant risk drivers at any aggregation level possible.

For example, each business line may be assessed on the basis of its sensitivity to changes in the Dollar/Euro exchange rate. These sensitivities can be summed to provide a firm-wide assessment of the aggregate firm sensitivity to this exchange rate. At both the business unit level and at the aggregate level, such sensitivities could be fed into a VaR or stress test model to determine the amount of economic capital corresponding to this exposure. Importantly, if some business units are positively exposed to increases in the value of the dollar, while others are negatively exposed, the aggregate economic capital for this risk will be less than the sum of the individual business unit calculations.

Following through on this approach would result in each business being assigned a set of risk drivers, some of which will relate to market risk, some to credit risk, some to operational risk, and so on. Sensitivities to each of the risk drivers can be added up across all business units. The various risk drivers can be aggregated to arrive at an overall economic capital estimate by assessing the variability of risk drivers and correlation values between them.

The most straightforward measurement of risk starts at the lowest level where information is available that covers all relevant parameters and exposures to different risk drivers for the considered activity. By starting bottom-up one does not need to define the correlation between higher-level risk types, e.g. the general correlation between credit and market risk, or two business units since they are implied by the correlation between the lower level risk drivers.

In practice two methods are generally used to assess diversification effects:
- the statistical approach: a quantitative analytical or numerical solution, and
- the scenario analysis approach, that is mainly qualitative (i.e. based on expert judgement or historical experience).

In many institutions, these approaches are used in combination, where insights from the scenario analysis approach are supplementing the results from the correlation approach.

[5] A simple example: Assume a small bank with economic capital of 1 and big insurance with economic capital 9. In case correlation is 0 the total economic capital is slightly higher than 9 and diversification is less than 10%. But, in case that the bank and insurance are equally big with an economic capital of 5 each and no correlation is assumed, their total capital is app. 7 and diversification is 30%.

Statistical approach
The most common solution to estimate the diversification effect is to use a correlation-matrix. The correlation coefficient reflects the statistical interdependence between random variables. It measures the degree of linear dependency between two (or more) random variables. A correlation coefficient of one means that two random variables move exactly the same way ('perfect correlation'). Diversification occurs when correlation coefficients are less than 1 ('imperfect correlation').

A common (although not necessary) assumption is that the potential losses resulting from exposure to a particular risk driver follow a normal distribution. As a consequence, overall potential losses are assumed to follow a normal distribution as well. If risk capital is calculated as a multiple of the standard deviation, the overall risk capital is determined analytically by a function of correlation coefficients and the separate risk capitals.[6]
The main benefit of this approach is easy implementation. The primary challenge is the determination of the correlation values to be used. Average correlation values may be less suitable for times of stress. For these periods, it's more appropriate to use tail or stress correlation values although these are more difficult to estimate.

In reality, the normality assumption may not hold as potential losses exhibit fatter tails than is consistent with the normal distribution. When this is taken into account, there is usually no longer an analytic way to estimate the overall risk capital, and one has to resort to simulation. For such a numeric approach, one could generate e.g. 2000 scenarios over time out of the joint probability distribution of risk drivers and the worst five scenarios outcomes determine the capital needed at a certain confidence level (here 99.95%). The drawback of this approach is, however, that modelling the joint probability distribution simultaneously for all risk drivers over insurance and banking is very complex.

Another complication is that the correlation coefficient does not always capture the total dependence structure; as it is a measure for linear dependency that does not include extreme cases. This leads to a general tendency of underestimation of correlation coefficient and consequently to overestimation of diversification benefits. More general dependence structures such as Copulas can be used to incorporate that, but they are more difficult to work with in practical situations.

Scenario-analysis
Another approach to assess diversification benefits is to determine a set of scenarios that will provide the combined effect/result of different risk drivers. In general these scenarios are determined qualitatively through expert judgement.
These scenarios must then implicitly capture the correlation and diversification effects between certain risk drivers. The challenge of such a qualitative approach is to select an appropriate small set of base scenarios, per risk driver, by expert judgement or reflecting historical experience, which reflect worst-case scenarios of a specific probability, and then apply several methods to combine these scenarios.

[6] More precise: you need to pre- and post-multiply the correlation matrix with the vector of separate risk capitals per risk type, and subsequently take the square root. I.e., EC = $\sqrt{xTSx}$, with S the correlation matrix, and x the vector of stand-alone risk capitals per risk driver.

Generally, the effect of worst-case scenarios with a certain probability, which is tied to some rating level, is assessed. For example an AA-rating is often associated with a default probability of 0.05% per year. Defining a scenario, which has the matching probability is difficult, even more so when taking into account the instability of parameters over time. In such an environment, knowledge of the underlying probability distributions is essential.

An important consideration is to keep scenario analysis future oriented, rather than a reflection of previous 'wars'. Consequently, subjective considerations will play an important role, as some historical events are simply not possible anymore, while others may never have happened in the past but are not unlikely for the future. Additional difficulties may arise if the diversification effects are to be assessed separately because then the selected scenarios, reflecting a 0.05% default probability, have to be compared to the a normal, average scenario.

Nonetheless, the scenario approach can be very useful as a supplementary approach to obtain some more intuition for the results of the statistical approach.

4. AGGREGATION APPROACHES

To model diversification with measurement methods described in the previous chapter is very difficult within a financial conglomerate due to the large number of (divers) risk drivers. In practice the problem is often broken down into smaller parts where the correlation of risks can be addressed in a theoretically correct manner and then these parts are again aggregated to top-level. This approach allows for tailor-made risk measures, in order to accommodate variously shaped risk distributions. The different risks then have to be aggregated to a composite picture. Economic capital does provide such a "common currency" for risk aggregation. (See WECM paper 'Risk Measurement within Financial Conglomerates: best practice by risk type', DNB report 'Toezicht' nr 51, Feb. 2003.)

Usual practice for a stand-alone bank or insurance company is that the parameters that determine sensitivity to a risk driver for market risk is input into a market risk economic capital model. Similarly, the parameters for the other risks discerned are fed into their respective economic capital models. The result is a firm-wide measure of economic capital for market risk, a firm-wide measure of economic capital for credit risk, etc. Similar calculations can also be repeated at the individual business unit level, but again the result will be separate measures of economic capital by risk type. The final question in the aggregation problem is then how to aggregate measures of economic capital across risk types.

In general two aggregation approaches can be applied to arrive at an overall EC estimate at Group level:

1. First aggregate across risk types within the bank and the insurance firm and then aggregate the total economic capital for both the insurance firm and bank at group level.
2. First aggregate by risk type across bank and insurance. Then subsequently aggregate risk types at the group level.

A preference for either approach of aggregation is the outcome of information and data consistency. Obviously, data consistency is a pre-requisite for robust

aggregation. In a robust diversification model the total diversification effect should not be sensitive to the order in which items are added or whether items have first been clustered. Yet in practice, the quality and degree of integration of the available data is crucial in how the aggregation is performed between bank and insurance.

Notwithstanding the intuitive appeal of the second approach, firms may use the first approach because of practical considerations, e.g. organisational or managerial structure. Yet, the second approach is current 'best practice' in the industry as its application is more clear-cut. The approach is more consistent and less assumptions are necessary as it focuses on underlying risk drivers and thus on the crucial issue that the same risk is treated equally whether it occurs in banking or insurance.[7]

5. ESTIMATION OF DIVERSIFICATION BENEFITS

Before describing the best practice approach of aggregation and discussing the potential diversification benefit between bank and insurance we shortly define the two major levels of diversification, which at the same time are the steps of aggregation described above:

1. Diversification within a risk type (intra risk), e.g. market risk diversification between bank and insurance.
2. Diversification between risk types (inter risk), e.g. between market and credit risk. Again focus is on possible diversification benefits between bank and insurer.

5.1. Intra risk diversification

The intra risk diversification reflects the level of diversification within a single risk type. In the following all risk types are shortly defined and then we focus on possible diversification benefits between banking and insurance activities by risk type (for a detailed description on modelling and measuring economic capital by risk type we refer to the first working paper of WECM).

Market/ALM Risk

Market/ALM risk is described as the risk of adverse movements in market factors, i.e. asset prices, interest rates or foreign exchange (FX) rates etc. The term market risk is typically used by banks and refers to trading - usually a short-term activity. The term ALM risk is used by both banks and insurance firms and relates to the consequences of changes in market factors for all assets & liabilities of the balance sheet. ALM risk is typically substantial in terms of economic capital for both banking and insurance. Consequently, any diversification benefits within ALM can have a significant effect on the aggregate economic capital level for ALM/market risk.

Usually insurance firms are more or less exposed to the whole range of market factors, whereas banks market risk is normally concentrated within interest rate risk (ALM). Diversification benefits between bank and insurer emerge when interest rates (ALM risk of bank) are not fully correlated to other risk drivers such as stocks or real estate (market risk of insurer). For the Dutch market we observe that insurance firms typically face more real estate and equity risk than banks and thus there are more sensitive to stock (and real estate) market movements. As correlation values between different risk drivers are generally lower than 1, this certainly produces some

[7] Rabobank and Fortis follow this approach.

diversification benefits. Of course, the extent to which diversification benefits between banks and insurance firms are present depends on the composition of the exposures across markets; but it is clear that the source of the diversification is less than perfect correlation between different risk drivers.

A different kind of diversification effect is only related to the interest rate risk exposures. In general interest rate risk is a dominant risk factor for ALM risk in both industries. Yet, it is not correlation causing diversification but off-setting risk exposures so that the netted position has lower risk than the sum of two separate positions.
In terms of exposure to interest-rate risk, banks typically have long-term assets (loans) and short-term liabilities (saving deposits), whereas for insurers the liabilities (insurance policies) typically have a much longer maturity than the assets (investments). This implies that there are netting effects between the exposures of banks and insurers. For example, if interest rates rise, this will reduce the value of the liabilities for insurers, while, for the bank, it will increase the funding cost and decrease the value of the assets.

A complicating factor in quantifying correlation or netting is the presence of embedded options in both banking and insurance products and the fact that in certain scenarios optionality will be a risk for both banks and insurance firms alike. An example is the prepayment option of mortgages and the yield guarantees of life insurance; both options will be exercised when interest rates are low.

To sum up, ALM provides opportunities to realise substantial diversification benefits between banking and insurance, especially when ALM risk exposures of bank and insurance firm are of similar size. For full realisation of these benefits the ALM of bank and insurance needs to be done integrally on group level to incorporate all potentials.

Credit & Transfer Risk
Credit risk is defined as the possible decline in value of an institution's assets due to the failure of counterparties to honor their financial obligations. Typical risk drivers are adverse changes in the business cycle and sector developments. In addition credit risk is often reduced through the use of collateral, that on its own is dependent on certain risk drivers, e.g. prices of shares, bonds, commodities, commercial and residential real estate.

Closely related to credit risk is transfer or cross-border risk. Transfer or cross-border risk captures potential losses stemming from the possibility that funds in foreign currencies cannot be transferred out of a country as a result of action(s) by the authorities of the host country or by other events impeding the transfer. The main risk drivers are foreign exchange rates, interest rates, local business cycles and political developments. In the following transfer risk is not addressed separately but included as part of credit risk.

Credit risk is the main source of risk for banks in general – typically approx. 50% of total economic capital [8] – as lending activities are the main source of credit risk for

[8] See disclosures, e.g annual reports, of several bank/insurers such as Citygroup, Rabobank, JP Morgan Chase, Deutsche Bank, Barclays, Fortis, Nordea, INGBank, Fortis, and Allianz (& Dresdner).

most banks. For a typical P&C and life insurer, however, credit risk contributes only 10 to 20 percent to total risk capital. This contribution stems mainly from investment in credit assets, e.g. corporate bonds.
The crux of any portfolio diversification is the way the risk drivers, e.g. sectors, regions etc, are correlated with each other.
By simply merging a bank and an insurance company one would not expect to generate substantial diversification as it is likely that the bank's corporate lending and the corporate bond and equity investments of the insurer are exposed to similar risk drivers.

Diversification benefits in the credit risk area will not emerge with the combination of a bank and insurance firm per se. However, diversification benefits result if the credit risk exposure of the bank and insurer is sensitive to different risk drivers (e.g. the European vs. the Asian economy). Such benefits may well be material, but are not the result of combining a bank and an insurer as such. These benefits could also be obtained by merging two banks or insurers. In any case, in order to benefit systematically from diversification effects between bank and insurance credit risk exposures, active and integrated portfolio management paying active attention to the sensitivity to different risk drivers is a prerequisite.

Operational Risk
The new capital adequacy framework for banks (Basle II) defines operational risk as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Legal risk is included in the definition; strategic and reputation risks are not.[9] A number of insurance companies separately model operational risk in the same or similar way to the Basle definition. Solvency II, a future capital adequacy framework for insurers, has not yet given an indication on how it will deal with operational risk.[10]
Main risk drivers are the quality of control and the volume of cash flows or other business measures (for a detailed description on modeling and measuring correlation within operational risk we refer to the first working paper chapter 5).

Regardless whether it concerns banking or insurance, the challenge for operational risk is to construct reliable loss distribution models based upon the still moderate data sources available. More so, as operational risk has a broad definition and thus encapsulates a wide variety of events, it also will compromise some very low probability -but potentially very destructive- events. For such events, the high granularity assumption used for traditional analytical models will typically not be valid and needs to be taken into account explicitly. The increase in granularity may well be the main driver of a diversification benefit between insurance and banking entities within this risk category. This benefit, however, is also likely to be present when combining multiple entities from the same industry.

From a general point of view clear diversification benefits due to offsetting exposures between banking and insurance are not necessarily present as both banking and insurance is service (people) business with similar processes, systems etc.

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[9] Basle Committee on Banking Supervision (2001), *Working Paper on the Regulatory Treatment of Op. Risk.*

[10] Yet, it is expected that DNB's draft Financial Assessment Framework (Financieel Toetsingskader) of 2004, which interprets regulation of insurers and includes operational risk, will fit in the Solvency II framework.

Just as in case of credit risk, diversification benefits are not based on the nature of banking or insurance business but mainly on other business characteristics, e.g. cultural background or intensity of use of IT between two economies, that can lead to some diversification due to less than perfect correlation. As in case of credit risk we conclude that diversification benefits in operational risk area will not necessarily emerge from the combination of a bank and insurance firm.

Business Risk

Business risk is the risk underlying the business a company conducts, to the extent that it includes all residual risk not covered by other risk categories such as e.g. market/ALM, credit/transfer or operational risk. Defined more precisely, it is the exposure to loss of value due to fluctuations in volumes, margins, and costs stemming from decreased demand, competitive pressure, operational efficiency, changes in regulation, etc. These fluctuations can occur because of internal, industry, or wider market factors.

Here benefits are mainly dominated by diversifying the systematic risk of different businesses or strategies. For international business, the major benefit comes from diversification of national business cycles. The same argument applies in the case of different business units in different sectors (national or international) or different industries. Since banks and insurance firms still partly operate in different sectors, one would expect a diversification benefit from combining banking and insurance business in one institution as they are sensitive to different business risk drivers (e.g., stock markets versus interest rates and business cycle indicators e.g. GDP). Furthermore, this diversification benefit can be extended by the combination of strategies; e.g. a market leader position in one market/country can be a good diversification with a niche position or an aggressive newcomer position in a different market/country. Yet again, this is not specific for a combination of bank and insurer as such. Especially in case of diversified strategies, the quantification of diversification is an issue. A problem for the determination of diversification is that internal data series are often polluted by i.e. mergers or acquisitions and the relevance of external data (e.g. GDP national economies) for the business mix is difficult to assess.

Insurance risk

The typical core insurance risks are morbidity risk, mortality risk and P&C risk, which are defined as

- Morbidity risk being the risk of deviations in timing and amount of cash flow (i.e. claims) due to incident or non-incident of disability and sickness; risk drivers are morbidity and disability expectancy.
- Mortality risk being the risk of deviations in timing and amount of cash flows (premium and benefits) due to the incidence and non-incidence of death; main risk drivers are mortality and longevity expectancy.
- P&C risk comprising the risk of loss due to unforeseen increase in size and frequency of claims and time-to-payment of future claims, development of outstanding claims, and allocated loss adjustment expenses for P&C product lines. While it is difficult to identify specific risk drivers, changes in legislation, technology, and social/economic environment impact the relative frequency and severity of claims.

Commonly, within these three risk categories, correlation between banking and insurance is irrelevant, as a bank is normally not exposed to insurance risk.

Nevertheless there can be minor indirect links between insurance risks and ALM or credit risk. E.g., calamity risk that influences mortality is positively correlated with economic cycles. Of course economic cycles are also correlated with banking risks like ALM and credit risk. Yet, this correlation is an inter-risk diversification that will be addressed more completely in the next section.

5.2. Inter risk diversification

The difference in exposure to various risk types between insurance and banking is likely to dominate the diversification between the two. Credit risk is the dominant risk capital at the banking side, often followed by operational and ALM risk. For insurance it is the other way round; market/ALM risk is of prime importance, while credit risk is relatively smaller. Consequently all correlation coefficients used for any combination of these strongly affect overall diversification.

Estimating the size of the benefits from the imperfect correlation between risk types is very complex, and it is often assessed by top-down approaches in combination with simulations of correlation values.

It is intuitively clear that diversification between risk types is very much dependent on the context in which bank and insurer operate. This is especially the case for the combination of credit and ALM (and market) risk that is mostly assumed to move together in extreme situations. However, for interest-rate risk (which is the dominating ALM risk in banks), the opposite holds: interest (mismatch) income typically increases when credit losses increase, due to lower (short-term) interest rates and steeper yield curves in bad economic times.

The correlation between market-, credit- and/or business risk may be relatively high as all of these risks are primarily dominated by economic and financial developments. E.g., a bear equity market (‘market risk’) tends to reduce commission income (‘business risk’).
Higher diversification benefits may well result from the combination of operational risk with the other risk categories. One could argue that the risk of fraud or technical failures of systems is not correlated at all with the movements of e.g. interest rates (market risk) or the probability of default (credit risk) of a mortgage. However, there might be a low correlation between operational risks and other risks due to an indirect linkage by general economic circumstances. In times of an economic downturn, credit risk is high and cost cutting may take place. Tight budgets might lead to e.g. keeping older (riskier) systems longer in place than is prudent. Moreover, operational risk losses often only become apparent when credit or market losses occur as only then errors in e.g. documentation become apparent.

A similar argument holds for a relatively low correlation of insurance risk with the other risk types; e.g. morbidity risk is not correlated with currency risk (market risk) but calamity risk will be weakly correlated with financial markets.

To resolve problems caused by the perceived insufficiency of data, external indices (e.g. equity prices) can be used as proxies for empirical data on the behaviour of particular risks. But, even with straightforward, simple modelling the main challenge is to get adequate data on which to base estimates of inter-risk correlation.

6. ALLOCATION

Once diversification is properly taken in to account, total economic capital will be lower than the stand-alone economic capitals of business units. A question is whether to allocate the diversification benefits to the business units, or not.
If diversification benefits are not passed down to the business units, each unit is expected to operate on a stand-alone basis. The "optimal" level of group risk-taking can be achieved only when diversification benefits are allocated to business units. That is, it is preferable for each business unit to be assigned an economic capital allocation closer to its contribution to the total economic capital amount, as opposed to what its economic capital requirement would be on a stand-alone basis.

For investment decisions an assessment of diversification on a marginal basis is relevant, since this determines the marginal costs associated with the investment. This forms the lower boundary in the determination of a minimum required return. For performance management, i.e. the best incentives for efficient capital use, diversification benefits should be allocated completely to the business units.[11] Allocation of diversification benefits, however, complicates performance management, as diversification effects are difficult to manage for a business unit within a conglomerate.

Proper allocation should produce the right incentives ("less risk, less capital") and prevent capital arbitrage within the economic capital framework. For example, no portfolio should undercut the proposed allocation: an undercut occurs when a portfolio's allocation is higher than the stand-alone economic capital. The rationale is that the portfolio cannot justifiably be allocated more risk capital than it can possibly have brought to the firm.

Furthermore, allocation should be consistent with the risk measure used. For example, if risk is measured using standard deviation, then the risk allocation should be based on the contribution to the standard deviation Alternatively, if risk is measured using value-at-risk, then the risk allocation should be based on the contribution to the value-at-risk. Different risk measures will imply different risk contributions to the total risk for a particular unit.

7. DATA QUALITY & MISESTIMATION

It has been mentioned several times that a crucial issue for estimating diversification benefits is data quality. Adequate and sufficient representative data is necessary to have correct information on possible correlation of specific risk drivers.

In general two types of data problems can be identified:
1. Lack of data, e.g. for operational risk. This makes it difficult to assess the risks, especially in the tails of the risk distribution.
2. Inconsistency of data; this plays an important role when one aggregates risk positions and/or economic capital amounts to higher levels. The data used to calculate economic capital for the bank should be consistent with the data used

[11] If each business unit is simply assigned the marginal difference between the firm-wide economic capital calculated with and without the business unit, it will turn out that the sum of allocated capital of all individual business units will fall short of the firm-wide economic capital amount.

within the insurance firm(s) to estimate capital. Thus, for instance, the definition of default for mortgages used to determine credit risk capital should be the same.

To make matters even more complex, a trade off between the two problems exists. If data is generally collected at a very low and detailed level at all units, data consistency can be addressed relatively straightforward, as one can always drill down to the lowest data level. Then, if necessary, data information can be restructured to meet the desired definition before aggregating to higher levels. However, a detailed level of data information will probably result in missing data on tail events for many data categories. Thus, the modelling of the risk distribution is likely to be inaccurate. Furthermore, optimal data quality at the lowest level enabling models would require extensive information to describe all risk drivers completely. Such level of detail would be inefficient, as it would demand a prohibitive workload from the organisation. Yet, simple high-level data will definitely miss some crucial economic links on the lower level and lead to economically sub optimal decisions. In fact, each management layer has to find an optimal balance with regard to this trade-off for data gathering ('not too high level data because of consistency problems and not too low because data gets scarce and the workload high').

Closely related to the data quality issue is the problem of misestimation of models resulting in an over- or underestimation of diversification. Here the previously mentioned concentration and granularity issues come to the fore again. Especially due to the data problems and necessary simplifications it is clear that estimates of diversification are likely to be imprecise. In any case one should try to assess the effect of this possible estimation error in order to assure that it is relatively small.

8. REGULATORY CONSIDERATIONS

Diversification effects can currently be modelled in many ways and no dominant best practice with respect to modelling diversification has as yet emerged in the industry.

From the supervisory point of view the lack of comprehensive risk models is an issue. If models are incomplete, e.g. not all risk factors included, this could result in an underestimation of correlation, and consequently to an overestimation of diversification benefits. Given the uncertainties around present modelling, it is important to check the model for robustness; i.e. for sensitivity of model parameters. Also by back-testing the model, one could get more insight into the properties of various model choices.[12]

An additional supervisory concern is the plausibility of the model in times of (market) stress. Parameter values might change under stressed conditions (e.g. correlation). Moreover, especially in times of stress the underlying assumption of correlation estimates becomes strained. Most modeling assumes that there is a linear relation between risks. If the empirical relation is non-linear, the correlation may be underestimated and consequently the diversification benefits will be overestimated.

[12] In aggregating all risks in a comprehensive manner the institution may take into account correlation between risk types under the so-called Pillar II approach to capital adequacy; see compendium paper 'The Application of the Supervisory Review Process under Pillar 2', page 10, of the Committee of European Banking Supervisors (CEBS), 24th of May 2004.

An additional issue for internationally active financial conglomerates is that diversification benefits have to be acknowledged in numerous jurisdictions. This implies that the institution and all supervisors concerned will have to agree on the acceptable method and outcome. Such a consensus should be actively pursued to avoid duplication of "validation" of economic capital models. However, even if a consensus is reached about the appropriate method and amount of aggregate economic capital, host supervisors might require stand-alone capitalisation of subsidiaries in their jurisdiction. In case that diversification was fully taken in to account in the aggregate economic capital and has been allocated to the business unit, this might imply that some other part of the conglomerate would be undercapitalised. From a supervisory perspective, in such situations a trade-off between multiple supervisory goals exists. On the one hand, supervisors need to create the right incentives for the supervised institutions, which is an argument in favour of the allocation of diversification benefits. On the other hand legal restrictions, and in particular restrictions on the international "mobility" of capital within a financial institution in combination with the existence of consumer protections schemes, gives the supervisor less leeway than would be desirable from an economic perspective.