Practice Papers

Active capital management: Optimising returns in a multiple stakeholder context

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Michael Zerbs

is the President and Chief Operating Officer of Algorithmics. Since joining the firm in 1989, Michael has led both product and marketing initiatives for the company's risk management solutions. Previously, he was Vice President of Research and Product Marketing at the firm, responsible for the strategic direction and conceptual development of Algorithmics' solutions. He has authored several papers on pricing models and risk management and is a co-author of *Mark-to-Future: A Framework for Measuring Risk and Reward.* He holds several degrees, including a PhD in economics from Kepler University in Linz, Austria and an MBA with specialisation in finance from the University of Toronto.

Helmut Mausser

is Mathematician–Technical Director at Algorithmics. His areas of expertise include optimisation and risk attribution. Helmut joined Algorithmics in 1997, after completing his PhD in operations research at the University of Colorado. He has also worked as a quantitative analyst in the telecommunications industry, an information systems analyst and, more recently, has lectured in the Master of Mathematical Finance programme at the University of Toronto. Helmut holds an undergraduate degree in mathematics and a master's degree in management sciences, both from the University of Waterloo.

Martin Hansen

is former Senior Manager for Risk Management Strategy at Algorithmics, with particular focus on credit risk and capital management. Previously he was a director in Fitch Ratings' credit policy group, researching Basel II's impact on credit markets and securitisation. Martin has also worked as a senior financial analyst at the Federal Reserve Bank of New York, where he was actively involved in the development of Basel II, serving on the Basel Committee Credit Risk Mitigation Sub-group. Martin earned an AB in politics, cum laude, from Princeton University and a master's degree in international economics and finance from the Fletcher School, Tufts University.

Algorithmics, Inc, 185 Spadina Avenue, Toronto, Ontario, Canada M5T 2C6; Tel: +1 416 217 1500; Fax: +1 416 971 6100; E-mail: michael.zerbs@algorithmics.com; helmut.mausser@algorithmics.com; martyhansen@alumni.princeton.edu

Abstract Current approaches to economic capital management focus on the risk capital needed to maintain solvency and on portfolio management (eg hedging and diversification). These approaches 'passively' allocate capital to subportfolios subject to hurdle rates (eg risk-adjusted return on capital), implying that debt-holders provide a binding constraint on the institution's risk appetite based on the target credit rating and its assumed quantile. The emergence of 'active' value creation — that is, pursuing optimal asset returns while managing capital structure in relation to stakeholder risk appetite — moves from an implicit debt-holder orientation to one that combines the perspectives of all stakeholders within a multi-tiered capital structure. The analysis illustrates the potential application of scenario-based constrained optimisation techniques to jointly evaluate the risk-return preferences of multiple stakeholders. Assessing investment (asset allocation) and funding (capital structure) decisions simultaneously suggests that optimal portfolio choices change significantly when stakeholders' different risk perspectives are considered together. While optimisation techniques are used to formalise the decision-making process, the results apply to any decision rule — whether optimisation-based, analytical or heuristic. The implication is that management decisions that consider debt and equity-holder perspectives jointly are better aligned with equity-holders' preferences (while respecting debt-holder constraints) than decisions based solely on debt-holders' risk preferences.

Keywords: *capital management, risk-return optimisation, integrated debt-holder and equity-holder analysis*

INTRODUCTION

Current approaches to economic capital management focus primarily on the amount of risk capital needed to maintain solvency and on portfolio management (eg hedging and diversification of risk concentrations). This focus is motivated partly by regulation (Basel II and Solvency II) but more fundamentally by a view that integrated management of assets and liabilities (and, concomitantly, of risk and return) creates economic value.

While the *potential* benefits of enterprise capital management are well established, the systematic application of the resulting insights into value-added management decisions is challenging in practice, for the reasons described below.

First, economic capital models must incorporate all material information relevant for decision making. For example, a model that considers industry risk factors but ignores geographic risk factors will generate results not fully reflective of dependencies within the portfolio. Similarly, using probability of default (PD) or loss given default (LGD) inputs not 'fit for purpose' generates misleading portfolio-level results. These execution issues are being intensely discussed by practitioners, academics and regulators, but have tractable solutions and ultimately will be resolved.

A second more fundamental reason for these challenges is that, while economic capital models are intended to provide decision support across a number of management contexts (eg maintaining solvency, maximising risk-adjusted return on capital (RAROC), meeting regulatory requirements, or achieving target rating expectations), they are often implicitly rooted in a view of risk consistent with only one management context. Inconsistencies arise when the model is applied more broadly without reassessing the underlying assumptions.

For example, internal capital strategies based on targeted external ratings ('we want to hold risk capital consistent with an AA rating') consider the perspective of liability-holders (such as debt-holders, depositors or insured clients) or of regulators, 'backstopping' those liabilities to minimise negative externalities from bank failures. However, they do not necessarily consider the equity-holder perspective. The objective of risk measurement in this context is to limit the high-quantile unexpected loss that debt-holders might suffer; it is not to identify investment strategies that satisfy the risk-return preferences of equity-holders.

Models in social sciences are low-dimensional representations of reality built for one specific management purpose. Different management purposes require either different models or, if decisions are interdependent across management contexts, an increase in the dimensionality of the model. What is needed is a framework integrating the risk-return preferences of stakeholders from multiple financial institutions, jointly addressing their respective objectives and constraints.

The issue is both conceptually interesting and increasingly relevant for senior management, for the closely-related reasons described below.

First, capital management is evolving from a 'passive' function focused primarily on capital adequacy to 'active' management of returns and allocation of risk capital, comparable to an asset management business model. Rather than treating risk as a by-product of business activities that needs to be 'disposed of', institutions focus on outperforming passive investment strategies and compete against the 'buy-side' (eg hedge funds and asset managers). With financial product innovation and more 'complete' financial markets, the core mandate extends beyond 'defensive' diversification and hedging to the maximisation of risk-adjusted returns, jointly considering investment (asset) and funding (liability and capital) choices. Implicit is that the cost of failure or recapitalisation, taxes and market imperfections cause deviations from the Modigliani-Miller framework (otherwise, decisions on the capital structure financing the firm's assets would be irrelevant).

Secondly, broadening the function's mandate necessitates integration of multiple stakeholder perspectives within capital management. Financial institutions, more than other sectors, must satisfy stakeholders beyond equity-holders and debt-holders — including investors in 'hybrid' capital instruments (such as trust preferred securities), depositors and regulators. While these multiple stakeholders share a common preference for the institution to operate as a profitable, well-managed going concern, there are subtle yet important differences in their respective risk appetites.

Under 'traditional' approaches to capital management, capital is allocated 'passively' to subportfolios subject to hurdle rates (eg RAROC). The RAROC denominator implies that debt-holders provide the binding constraint on the institution's risk appetite based on the target credit rating and its assumed quantile. 'Active' value creation — ie achieving optimal asset returns while managing the capital structure in relation to stakeholder risk appetite — moves from an implicit debt-holder (or depositor) orientation to one that combines the perspectives of all stakeholders within a multi-tiered capital structure. Ultimately, the creation of economic value through 'active' capital management depends on the integration of internal management processes for risk management, capital budgeting and capital structure strategy, particularly between the risk and finance functions.[1]

This new paradigm for 'active' capital management necessitates new approaches for measuring and managing risk and return on an enterprise-wide basis. The following analysis illustrates the potential application of scenario-based constrained optimisation techniques to explicitly consider and jointly evaluate the risk-return preferences of multiple stakeholders. This analysis builds on earlier credit optimisation work by Mausser and Rosen.[2,3]

Assessing investment (asset allocation) and funding (capital structure) decisions simultaneously, this analysis demonstrates that optimal portfolio choices change significantly when stakeholders' different risk perspectives are considered together. Management decisions that consider debt and equity-holder perspectives jointly are better aligned with equity-holders' preferences (while respecting debt-holder constraints) than decisions based solely on debt-holders' risk preferences.

While this analysis is based on optimisation techniques to formalise the decision-making process, the results apply to any decision rule — whether optimisation-based, analytical or heuristic. The central point is that the risk dimensions of the economic capital model are extended to incorporate multiple stakeholders' views explicitly.

MODELLING AND ANALYSIS

A worked example (based on the stylised leveraged balance sheet of a hypothetical financial institution) illustrates the practical application of optimisation techniques to 'active' capital management. Two cases are considered.

In the first case, scenario-based optimisation identifies the asset portfolio that generates the highest expected returns, subject to risk constraints defined by debt-holders. In the second case, the optimal portfolio is identified, now subject to risk constraints defined by both debt and equity-holders.

A revealing result is that the optimal portfolio in this second case differs from the optimal portfolio in the first case — indicating that equity-holder risk preferences matter. This finding contravenes conventional wisdom that the risk tolerance of debt-holders is the sole stakeholder constraint on risk-return management.

A similar result was reached by Zhu (2007), who developed a stochastic dynamic model to examine the impact of capital regulations on banks' financial decisions, with lending (asset) decisions, leverage ratios (funding decisions) and failure probabilities jointly determined.[4] Zhu finds that a non-binding (regulatory) capital constraint in equilibrium implies that banks adopt an active portfolio strategy.

These findings present a compelling case for the practical application of scenario-based optimisation techniques to capital management — and to achieving a more holistic asset allocation strategy that explicitly embeds the differing risk appetites of an institution's multiple stakeholders.

A practical example

The following assumptions are made about the financial institution's balance sheet and investment strategy:

- The capital structure consists of 5 per cent equity and 95 per cent debt financing.
- Investments can be allocated across equity indices (DAX, NKY and SPX) and call and put options on those indices (available investment choices are detailed in the appendix).
- A 60-day investment horizon (and no multiplier) is assumed, comparable to a ten-day holding period (and multiplier of 3), as the example is based on liquid capital market products.
- Equity-holders' risk tolerance is assumed to be consistent with a B to CCC

conservative bond holder, corresponding to a 60-day default rate of approximately 0.87 per cent (see appendix for further explanation of mapping between equity-holder constraint and credit ratings analogue).

- A choice of funding strategies for the 95 per cent debt financing ranges from AA to CCC. Funding costs are based on credit spreads observed in the second quarter of 2007 (as indicated in Fitch Ratings, 'US Corporate Bond Market: A Review of Second Quarter 2007 Rating and Issuance Activity'[5]).

For each of the two cases, the optimisation analysis is performed over 10,000 scenarios of correlated risk factor outcomes driving the future value of each asset in each scenario. A number of trading activity constraints are applied, namely, 'shorts' are not permitted and the total value of trades cannot exceed the value of assets.

The example is designed to be intuitive and tractable; a number of extensions that could provide additional insights but would not change the fundamental results include the explicit consideration of:

- additional assets, including debt instruments;
- a capital structure with multiple tiers (stakeholders) or structured credit products;
- regulatory (eg Basel II) capital constraints (representing additional stakeholders); or
- alternative definitions of risk (such as tracking error over a benchmark, or segmentation into diversifiable and non-diversifiable components).

Case 1: Optimise portfolio returns, subject to debt-holder risk constraint

The first optimisation example illustrates the 'classic' debt-holder-oriented view of capital management — namely, that only bond-holders impose a stakeholder constraint on the institution's risk appetite, defined by the institution's target credit rating. In this paradigm, higher (lower) target ratings are associated with lower (higher) PDs and hence lower (higher) risk appetites for asset allocation.

The optimisation process identifies the asset allocation that satisfies the following functions:

- *objective:* maximise expected returns;
- *constraint:* limit losses for debt-holders to their risk tolerances at different rating levels.

The debt-holder risk constraint is defined by the historical default rate associated with each rating grade for financial institutions (see Table 1).[6]

Given a 60-day horizon, the annual default probabilities are scaled accordingly. Thus, an AA rating implies that the probability of losing an amount

Table 1: Credit ratings, annual probability of default and 60-day probability of default assumptions

	AA	A	BBB	BB	B	CCC
Default probability (annual), %	0.10	0.40	1.00	2.00	4.00	8.00
Default probability (scaled to 60-day horizon), %	0.02	0.07	0.17	0.34	0.68	1.38

exceeding the equity capital in the next 60 days is 0.02 per cent.

For computational tractability, 'probability of default' is replaced with a slightly different risk measure. Instead of ensuring that the probability of losing an amount exceeding the equity capital is below an acceptable threshold P (eg $P = 0.02\%$ for an AA rating), what is required instead is that the average of the worst P losses does not exceed the equity capital. While the former represents a constraint on the value-at-risk (VaR), the latter constrains 'expected shortfall' (ES), or 'conditional VaR', of the profit-and-loss distribution.[7] ES is being adopted increasingly for managing economic capital, as exemplified by the Swiss Solvency Test for the insurance industry.[8] Note that for a given threshold P, $\mathrm{ES}(P) \geq \mathrm{VaR}(P)$, implying that the analysis takes a conservative view of risk.

The scenario optimisation is performed at several levels of credit rating, generating an asset allocation and profit and loss (P&L) distribution for each rating level (see Figure 1) and, when aggregated, an efficient frontier of optimal portfolio returns against each rating and risk level (see Figure 2).

As illustrated in Figure 1, the P&L distributions for optimal portfolios at lower rating levels exhibit longer tails than the P&L distributions for higher ratings levels. This difference illustrates the trade-offs accepted by the more risk-tolerant holders of lower-rated debt — namely, the greater amount of risk represented in the left-tail of the distribution is compensated by the higher potential upside represented in the right-tail.

Consistent with expectations, higher (lower) default probabilities translate into higher (lower) expected returns, as observable in Figure 2. For example, as detailed within the optimisation results in Table 2, at the AA level of risk, the expected return of the optimal portfolio satisfying the debt-holder-only risk constraint is approximately 4.8 per cent (including the cost of financing).

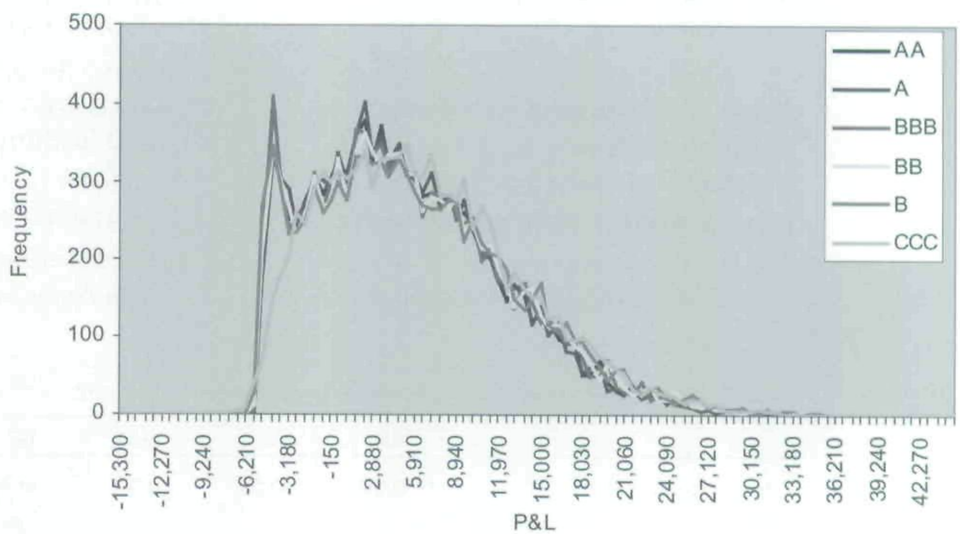

Figure 1: Profit and loss distributions for optimal portfolios at each target rating level (based on debt-holder-only constraint)

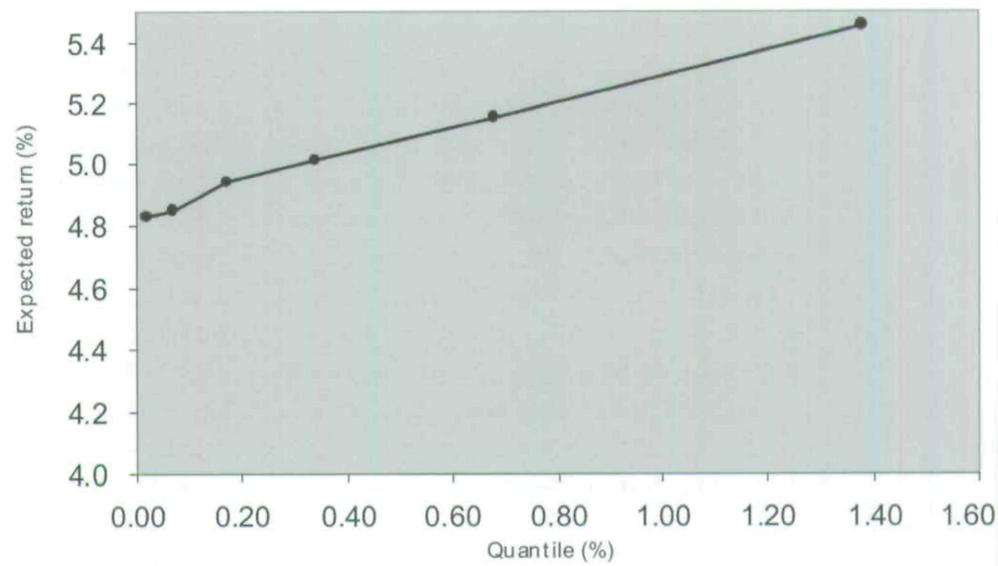

Figure 2: Efficient risk-return frontier for optimal portfolios (based on debt-holder-only constraint and reflecting the impact of debt expense)

Because the efficient frontier also includes the impact of financing the 95 per cent debt, with higher (lower) financing costs at higher (lower) default probabilities, the combined asset allocation and financing strategy that best matches the equity holder's risk-return profile can be selected from the efficient frontier (detailed results of optimal portfolio decisions are provided in Table A1 in the appendix).

Case 2: Optimise portfolio returns, subject to integrated analysis of debt-holder and equity-holder risk constraints

This next case represents the 'active' capital management paradigm of optimising portfolio returns within a multiple stakeholder context. Rather than assuming that the debt-holder constraint is the only stakeholder constraint, the portfolio that generates the optimal expected returns relative to both debt-holder and equity-holder constraints is identified.

The optimisation process identifies the asset allocation that satisfies the following functions:

- *objective:* maximise expected returns;
- *simultaneous risk constraints:*
  - — *for debt-holders:* limit losses to debt-holder risk tolerances at different rating levels (as before in Case 1); and simultaneously
  - — *for equity-holders:* limit losses such that

Table 2: Optimal expected returns for each target rating

	AA	A	BBB	BB	B	CCC
Default probability (scaled to 60-day horizon), %	0.02	0.07	0.17	0.34	0.68	1.38
Expected return (after debt expense), %	4.83	4.85	4.94	5.01	5.15	5.45

the average of the worst 20 per cent of all asset returns does not fall below –2 per cent (an expected shortfall constraint).

The debt-holder constraint is defined in the same manner as in the first case (ie a default rate is associated with each target rating).

For equity-holders, the risk constraint is defined by a default probability that is derived from the above expected shortfall constraint, comparable to approximately a B to CCC rating level (derivation is provided in the appendix).

As in the first case, the optimisation analysis is performed at different levels of credit rating, generating an asset allocation and resulting P&L distribution (see Figure 3) for each rating level and the corresponding efficient frontier of optimal portfolio returns for different levels of default risk (see Figure 4). Consistent with expectations, higher (lower) default probabilities translate into higher (lower) expected returns (detailed results of optimal portfolio decisions are provided in Table A2 in the appendix).

The results from the integrated debt and equity-holder case differ from the debt-holder-only case (except at the CCC level, as the equity-holder constraint is already satisfied when solving the debt-holder optimisation). For example, at the AA level of risk, the expected return of the optimal portfolio satisfying this integrated debt and equity-holder risk constraint is approximately 4.2 per cent, whereas the comparable expected return in the debt-holder-only case was 4.8 per cent. At the same AA level of debt-holder risk, the optimal portfolio's expected returns fall from 4.8 per cent to 4.2 per cent when explicitly integrating the B to CCC-like risk constraint of equity-holders. Jointly considering the risk constraints of equity-holders and debt-holders shifts the efficient frontier 'down' compared with the debt-holder-only case.

Given commonly-held assumptions that debt-holders impose the only stakeholder risk constraint on financial

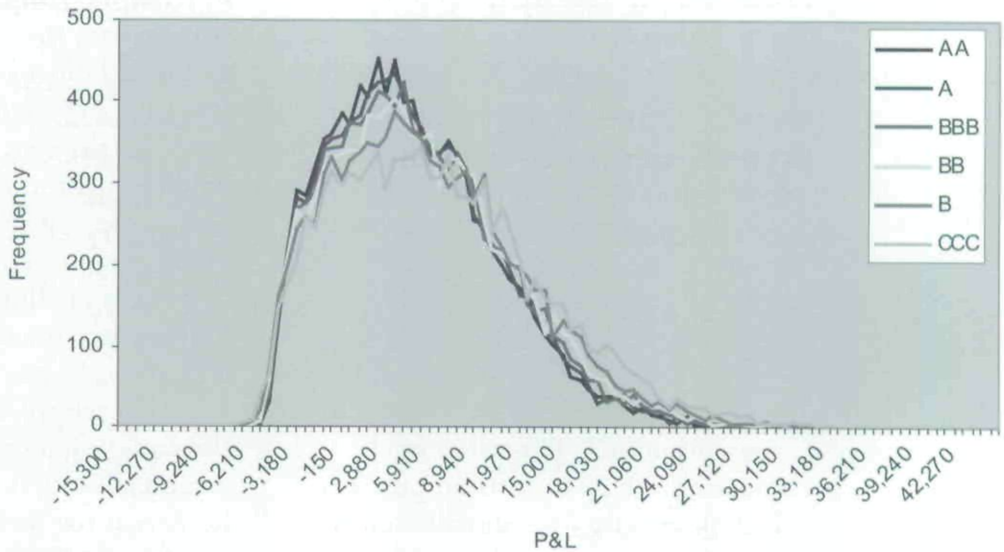

Figure 3: Profit and loss distributions for optimal portfolios at each target rating level (based on integrated debt-holder and equity-holder constraints)

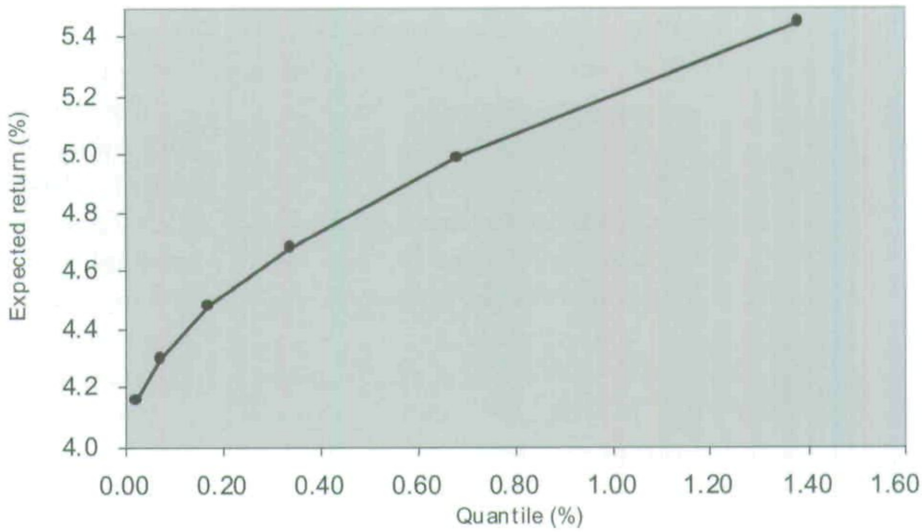

Figure 4: Efficient risk-return frontier for optimal portfolios (based on integrated debt-holder and equity-holder constraints and reflecting the impact of debt expense)

Table 3: Optimal expected returns for each target rating

	AA	A	BBB	BB	B	CCC
Default probability (scaled to 60-day horizon), %	0.02	0.07	0.17	0.34	0.68	1.38
Expected return (after debt expense), %	4.16	4.30	4.49	4.68	4.99	5.45

institutions, this result initially appears counterintuitive. The result is, however, broadly consistent with risk preferences of debt-holders relative to equity-holders. Debt-holders generally seek to avoid 'tail' losses that fully deplete the capital of the firm and that reduce recoveries, but are less sensitive to smaller 'first' losses absorbed by equity-holders. Equity-holders seek to avoid 'tail' losses as well, but once capital is fully depleted they are indifferent to the size of loss. Equity-holders are, however, relatively more sensitive to small and medium-sized losses absorbed by equity capital.

This intuition is illustrated by comparing the P&L distributions. The debt-holder-only P&L distribution is quite wide and average losses (or expected shortfall) for the worst 20 per cent of outcomes are much higher than the desired –2 per cent threshold, approaching –3 per cent across the AA to BBB spectrum of rating levels. By comparison, the integrated equity-holder and debt-holder case shows that average losses (or expected shortfall) for the worst 20 per cent of outcomes are by definition constrained to –2 per cent and, accordingly, the P&L distribution is much narrower than in the first case.

Both asset allocations meet the debt-holders' risk tolerances. The first allocation, however, 'buys' higher expected returns by increasing risk to the equity-holders only, whereas the second allocation reduces risk to equity-holders at the 'cost' of lower expected returns. An RAROC approach (using a traditional definition of risk in the denominator) would have provided a result comparable to the first solution — low risk for debt-holders but higher than tolerated risk for equity-holders.

By developing risk-return frameworks that incorporate the perspectives of all stakeholders, management is better able to evaluate on whose behalf and in which context investment and funding strategies are selected.

RISK-RETURN ANALYTICS FOR 'ACTIVE' CAPITAL MANAGEMENT

This analysis quantifies the trade-offs between increasing expected returns versus decreasing credit quality. Given the cost of debt for different credit ratings, the institution can choose the optimal rating that maximises expected returns on equity.

These examples analyse investment and funding choices jointly, assuming that credit quality is driven by asset mix, not by the leverage itself. This approach can be extended to evaluate different potential leverage ratios to identify the optimal combination of capital structure, asset mix and target rating.

Management is ultimately responsible for maximising shareholder value within a level of risk acceptable to all stakeholders. A risk measure developed primarily for debt-holders (eg traditional RAROC) or for regulators (ensuring financial system soundness and minimising the risk and cost of public intervention) cannot in isolation drive an asset allocation process that trades off risk and return for equity-holders.

Further evolution towards 'active' management of risk and return will benefit from optimisation tools and analytics that explicitly recognise important nuances in the risk profiles of multiple stakeholders. The natural extension of these analytics is to extend the optimisation to multiple risk constraints, fine-tuned to each tier in the capital structure and to regulatory capital constraints — enabling management to consider the optimal risk-return portfolio strategy for all stakeholders, rather than focusing on the risk tolerance of one stakeholder group at the exclusion of others.

This analysis has significant implications for the design of enterprise risk and economic capital management solutions. Solutions should be designed from the ground up to allow for a range of different risk measures that are comparable and consistent within the same asset allocation framework.

APPENDIX: DERIVING RISK CONSTRAINTS FOR EQUITY-HOLDERS

The equity-holder's risk constraint is translated into analogous target ratings using the following approach (see Figure A1 for reference):

- holding period is assumed to be 60 days (no VaR multiplier);
- mean (expected) return of investing in equities is 7 per cent (or 1.2 per cent mean return for a 60-day horizon);
- equity-holder risk constraint is set such that the average of the worst 20 per cent of all asset returns does not fall below –2 per cent;
- asset returns of –2 per cent cause a drop in equity of 40 per cent, given the 5 per cent equity ratio;
- given a 20 per cent probability that average returns are –2 per cent, solving for the probability that average asset returns are –5 per cent eliminates the entire equity capital (assuming

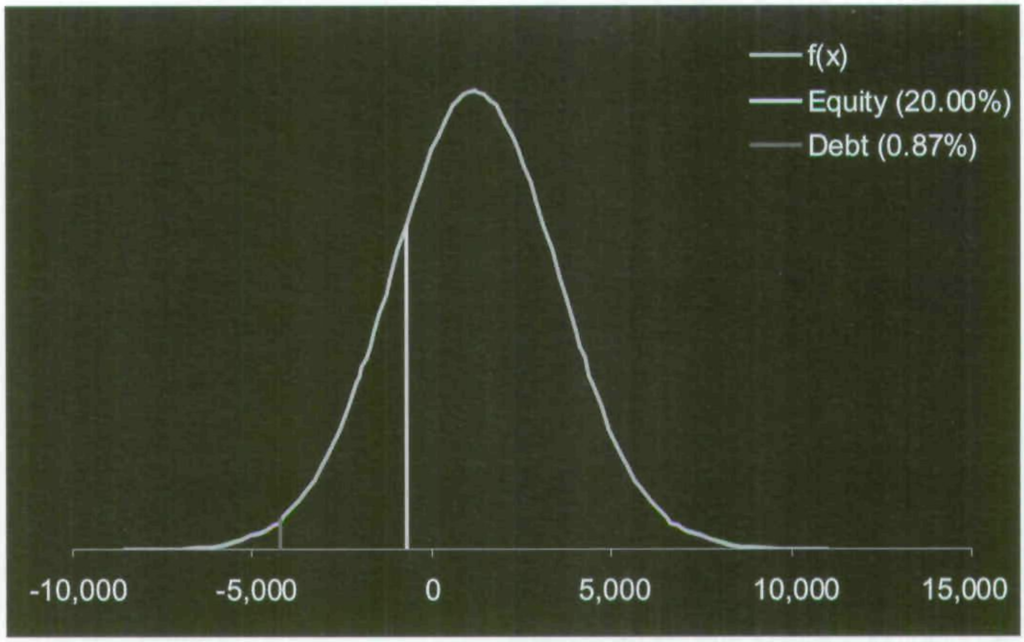

Figure A1: Translation of equity-holder risk constraint into analogous credit rating

Table A1: Optimal portfolio investment choices for debt-holder-only risk constraints

Final position (Deltas equivalents)	AA	A	BBB	BB	B	CCC
DAX	0.50	0.21	0.66	0.38	0.46	1.21
NKY	76.63	97.62	65.09	85.03	79.35	243.64
SPX	51.15	51.16	51.18	51.16	51.06	30.72
DAX ATM Call	3.44	3.57	3.48	3.74	3.97	3.57
DAX ATM Put	−0.31	−0.04	−0.43	−0.25	−0.36	−0.79
NKY ATM Call	0.00	0.00	0.00	0.00	0.00	0.00
NKY ATM Put	−0.32	−0.35	−0.19	−0.21	−0.19	−0.40
SPX ATM Call	0.00	0.00	0.00	0.00	0.00	0.00
SPX ATM Put	−22.69	−22.93	−22.94	−22.60	−22.63	−10.37

Table A2: Optimal portfolio investment choices for integrated debt-holder and equity-holder risk constraints

Final position (Deltas equivalents)	AA	A	BBB	BB	B	CCC
DAX	0.15	0.39	0.16	0.34	0.32	1.21
NKY	163.59	160.61	170.91	178.94	199.59	243.64
SPX	45.64	44.34	44.93	42.87	41.00	30.72
DAX ATM Call	2.71	2.67	2.99	3.17	3.52	3.57
DAX ATM Put	0.00	0.00	0.00	−0.23	−0.16	−0.79
NKY ATM Call	0.00	0.00	0.00	0.00	0.00	0.00
NKY ATM Put	−0.40	−0.40	−0.38	−0.36	−0.40	−0.40
SPX ATM Call	0.00	0.00	0.00	0.00	0.00	0.00
SPX ATM Put	−20.63	−19.70	−19.32	−17.67	−16.53	−10.37

normality) — under the given assumptions, the average of the worst 0.87 per cent losses is equal to the full equity capital;

- at this stage, the target credit rating consistent with equity holder risk constraints can now be inferred, as the full loss of equity capital would also cause debt default. A quantile of 0.87 per cent maps (roughly) into between a B to CCC target rating.

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