Studienreihe der Stiftung Kreditwirtschaft an der Universität Hohenheim

Jan Müller

Optimal Economic Capital Allocation in Banking on the Basis of Decision Rights

Verlag Wissenschaft & Praxis

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FOREWORD

The Studienreihe Stiftung Kreditwirtschaft aims at offering banking and finance subjects from the University of Hohenheim's research to interested expert readers. The publications are meant to promote the exchange of ideas between University and practice.

The banking regulation today forces to provide more economic capital in order to increase the ability of banks to cover unexpected losses on their own, to guarantee their going concern and prevent bankruptcy with a high probability. In this context, banks regularly choose their existing overall portfolio as a starting point in order to determine their economic capital requirements.

However, a strict risk-return-management perspective suggests the reverse procedure. In this case the available economic capital represents the starting point. The capital then undergoes an allocation among the bank's business fields while maintaining a certain confidence level and maximizing the bank's overall expected return. Finally, this procedure determines the business fields' business volumes and thereby induces an overall bank management according to risk-return aspects.

Neither research nor practice so far provide clear and preferential overall bank management approaches of that type. This might be caused by the underlying problem's comprehensiveness that immediately arises if the problem's consideration correctly and necessarily applies a portfolio theoretical perspective. However, the pressure of the surging equity requirements on Banks' profitability after the financial crises even increases the need for such integral overall bank management systems.

The present work emphasizes the crucial points to be addressed in context with an optimal economic capital allocation. In doing so, the focus lies on the immanently important consideration of decision makers and their autonomous decision making's implications. The work makes a valuable contribution to the understanding of the struggles banks face today on the field of overall bank management driven by a changing economic and regulatory environment.

This volume represents a further contribution to our successful promotion of exchanging ideas between University and practice in highly relevant fields from banking and finance.

Hohenheim, June 2015
Prof. Dr. Hans-Peter Burghof

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ALGORITHMS

1 INTRODUCTION

1.1 Problem and research question

The financial crisis revealed, among other things, in particular one shortcoming of the financial system: Banks do not provide enough liable equity in order to cover unexpected losses and guarantee their going concern with sufficient certainty. As a consequence, the Basel Committee of Banking Supervision introduced a new accord, known under the term Basel III.[1] The accord's main concern refers to the increase of the liable equity of banks and the improvement of the equity's quality. The guidelines demand the capital adequacy ratio (CAR) of the banks to increase especially for systemically important banks. The CAR measures the ratio of liable equity to risk weighted assets (RWA). The increase of the liable equity causes a considerable cost pressure on the financial institutions, the quality improvements not to mention. In order to keep their profit margins, the institutions will be increasingly forced to strictly manage their institution-wide businesses according to risk-return aspects in a portfolio theoretical sense. This, however, demands for a comprehensive ex-ante-equity management.

The present approach of research describes such a system of corporate management on the basis of a model. The model exclusively takes into account the available equity of a bank and completely dispenses with funding issues. In order to be able to extensively examine the portfolio theoretical aspects of this system of corporate management, the model chooses the economic instead of the regulatory perspective. As a consequence, the model focusses on the economic equivalent of liable equity in the form of economic capital.[2] The economic perspective assesses risk by downside-risk measures instead of using the RWA-methodology.[3]

The present corporate management system allocates the risk-bearing potential of the economic capital to the business units by value at risk (VAR) limits. This enables the units to take risks and operate business according to their respective limit's extent. The transmission of the business strategy from the central management to the decentralized decision makers[4] therefore manifests by the strate-

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1 See Basel Committee of Banking Supervision (2011) for the Basel III accord and Deutsche Bundesbank (2011) or Auer and Pfoestl (2011) for overviews concerning the Basel III guidelines.

2 See chapter 2.1 for details on the definition of economic capital.

3 See chapter 2.2 for an introduction of the downside risk measures VAR and expected shortfall (ES).

4 The following uses the expressions "decision maker" and "business unit" synonymously.

gic setting of the limits. The VAR limits finally represent decision rights determining the range for the autonomous decision making by the business units.

Nevertheless, this kind of corporate management bears conflicting objectives.[5] For the consideration of portfolio theoretical aspects, the central management requires precise information concerning the correlations between the returns of the business units' business opportunities. The use of delegation advantages, however, depends on the autonomous decision making of the business units which are free to choose long or short positions. Unfortunately, this autonomous decision making causes unstable correlations between the units' businesses which significantly complicates an optimal corporate management in the portfolio theoretical sense. Further difficulties represent the portfolio theoretical consideration of the decision makers' individual prospects of success and their interactions[6] potentially influencing their decision making.

The differentiated modeling of such a corporate management system is technically demanding. The consideration of the decision makers' individual prospects of success causes the business units' returns to follow non-elliptical distributions. This fact excludes the use of common analytical optimization to achieve the most advantageous limit allocations. The non-elliptical distributions turn the underlying optimization problem into a global problem requiring heuristic optimization for proper solving. The present model of optimal allocation of economic capital uses the threshold accepting (TA) algorithm for heuristic optimization. However, compared to the relevant literature, the present implementation of the TA-algorithm requires certain modifications.[7]

The central research question of the present approach concerns whether the optimal allocation of economic capital according to portfolio theoretical aspects represents the superior corporate management approach. The research approach addresses this question under the model assumption of strictly rational behaving players. The central research question subdivides into several partial objectives.

The first step consists in developing a consistent model reflecting the situation of corporate management by economic capital allocation sufficiently detailed. From the modeling of the economical processes also different technical challenges arise.

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5 See Froot and Stein (1998) identifying these conflicting objectives in their final conclusions and emphasizing the need for further research on this conflict's proper consideration by integral bank management approaches in the portfolio theoretical sense.

6 See Burghof and Sinha (2005) modeling this interaction in the form of herd behavior and identifying correlations between decisions as the main risk drivers. Their analyses, however, dispense with the optimization of the VAR limit system in a portfolio theoretical sense.

7 See Gilli et al. (2006) applying and developing TA in context with portfolio optimization under downside risk constraints. Besides the high relevance of their approach for the present implementation of TA, there are significant differences compared to the present optimization of VAR limit systems.

Technical challenges arise from the fact that the present approach addresses the optimization of VAR limits instead of common portfolio optimization under a VAR constraint.[8] As a consequence, the extents of the decision variables in the form of the limits do not depend on a known budget constraint but on unknown diversification effects. This requires modifications of the implementation of TA compared to the case of common portfolio optimization under a VAR constraint.

The finished model then allows addressing the central concern of the present research on the basis of different model analyses. These analyses successively adjust the setting for the optimal allocation of economic capital by imposing more restrictive and realistic conditions.

A central adjustment refers to the replacement of an informed central management by an uninformed one. In contrast to the informed management, the uninformed one has to acquire the relevant information concerning the business units by rational learning. The model case enables analyzing whether an optimal allocation of economic capital is still relevant under the more realistic scenario of increased uncertainty arising from less precise information.

A second central adjustment compared to the initial model case concerns the independent and autonomous decision making of the business units. Therefore, the independent decision making undergoes restrictions by the introduction of herd behavior. Herd behavior manifests in the present model by decision makers imitating investment decisions observed from their colleagues as soon as following their individual information appears less promising from a rational perspective. This influences the correlations between the investment decisions and induces additional uncertainty. The model case aims at analyzing whether corporate management on the basis of VAR limit systems fundamentally accomplishes anticipating herd behavior of the decision makers.

The present modeling and analysis of optimal corporate management by VAR limit systems generally aims at disclosing the requirements of such a corporate management approach.

1.2 Organization of the research

The research subdivides into nine chapters. After this introduction two further preparatory chapters describe the basic issues of economic capital allocation and the implications of the literature of related fields of research. Subsequently, three chapters address the modeling and implementation of the relevant econom-

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8 See Burghof and Müller (2012) for insights on the differences between common portfolio optimization under a VAR constraint and the optimization of VAR limit systems in context with the use of TA.