A Multi-objective Approach to Integrated Risk Management

Frank Schlottmann[1,2], Andreas Mitschele[1,2], and Detlef Seese[2]

[1] GILLARDON AG financial software, Research Department,
Alte Wilhelmstr. 15, D-75015 Bretten, Germany
Frank.Schlottmann@gillardon.de
[2] Institute AIFB, University Karlsruhe (TH), D-76128 Karlsruhe
{mitschele, seese}@aifb.uni-karlsruhe.de

Abstract. The integrated management of financial risks represents one of the main challenges in contemporary banking business. Deviating from a rather silo-based approach to risk management banks put increasing efforts into aggregating risks across different risk types and also across different business units to obtain an overall risk picture and to manage risk and return on a consolidated level. Up to now no state-of-the-art approach to fulfill this task has emerged yet. Risk managers struggle with a number of important issues including unstable and weakly founded correlation assumptions, inconsistent risk metrics and differing time horizons for the different risk types. In this contribution we present a novel approach that overcomes parts of these unresolved issues. By defining a multi-objective optimization problem we avoid the main drawback of other approaches which try to aggregate different risk metrics that do not fit together. A MOEA is a natural choice in our multi-objective context since some common real-world objective functions in risk management are non-linear and non-convex. To illustrate the use of a MOEA, we apply the NSGA-II to a sample real-world instance of our multi-objective problem. The presented approach is flexible with respect to modifications and extensions concerning real-world risk measurement methodologies, correlation assumptions, different time horizons and additional risk types.

1 Introduction

In the recent study *Trends in risk integration and aggregation* [1] that has been conducted with 31 financial institutions worldwide the Working Group on Risk Assessment and Capital of the Basel Committee on Banking Supervision reports about two major trends in financial risk management. Firstly, the study has identified a strong emphasis on the management of risk on an integrated firm-wide basis. The second emerging trend comprises rising efforts to aggregate risks through mathematical models. At the end of the day banks are highly motivated to approximate their required capital base[1] that serves as a buffer against unexpected losses even more accurate.

[1] In internal banking models this is called economic capital.

C. A. Coello Coello et al. (Eds.): EMO 2005, LNCS 3410, pp. 692–706, 2005.

While banks undertake high endeavors to gain an integrated sight of their entire business this aim in reality usually still rather resembles a mere vision. In real-world applications different types of risk are still assessed and controlled in a more silo-based manner[2], i.e. market risk is measured separately from credit risk etc. Assuming perfect correlation the resulting risk numbers are often just added up to get an aggregate risk measure. It is clear that this simple method only means a first step to true integrated risk management.

A multi-objective approach is obviously more appropriate under these circumstances. Thus, we propose a MOEA application which supports the silo-based approach currently adopted by many banks. Moreover, our approach allows the use of the Value-at-Risk which is also a commonly used risk measure in many financial institutions (and which we will explain in more detail below).

The remainder of this contribution is organized as follows: In the next section we give a short introduction to the key concepts which constitute integrated risk management. After that, we provide an overview of recent research in the area of integrated risk management and point out important obstacles in real-world applications. In the succeeding section we present our multi-objective approach which fits into current risk management practices and avoids some of the problems mentioned before. The application of a MOEA in our setting is then illustrated for a sample bank by applying the NSGA-II to recent market data. Finally, we give a conclusion and an outlook on possible future developments.

2 Integrated Risk Management

The Basel Committee on Banking Supervision [1] proposes the following definition: "An integrated risk management system seeks to have in place management policies and procedures that are designed to help ensure an awareness of, and accountability for, the risks taken throughout the financial firm, and also develop the tools needed to address these risks."

The core of such an integrated risk management[3] system is represented by an appropriate risk aggregation methodology. In the Basel Committee report [1] this is explained as follows: "Broadly, *risk aggregation* refers to efforts by firms to develop quantitative risk measures that incorporate multiple types or sources of risk. The most common approach is to estimate the amount of *economic capital* that a firm believes is necessary to absorb potential losses associated with each of the included risks."

Risk aggregation makes sense in a variety of different aggregation levels. To obtain a total bank risk measure the risk across different business units and risk types are summarized. Further possibilities include a measure for the total risk in one risk category or an aggregate measure by product or by business unit.

[2] Cf. Pézier [2] and Kuritzkes et al. [3].

[3] Similiar terms are *consolidated (financial) risk management* or *enterprise-wide risk management* (cf. Cumming & Hirtle [4]).