Risk Budgeting with Value at Risk Limits

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Abstract: Our analysis focuses on the risk budgeting process for banks using value at risk limits. In this context, we investigate three major practical problems: a) differences in time horizons between the bank’s total risk budget and the trading divisions’ activities; b) adjustment for accumulated profit and losses to risk budgets, and c) incorporation of correlations between assets into the risk budgeting process. To analyze these practical problems, we use Monte Carlo simulation. Thereby, it can be shown that differences in time horizons among risk budgets and trading units can be adjusted by the square root of time rule. Three types of limits are proposed for the adjustment of accumulated profit and losses: the fixed, stop loss and dynamic limits. While the two latter restrict the maximum loss to the ex ante specified limit and show a symmetric profit and loss distribution, the dynamic limit’s distribution is skewed to the right. We further illustrate that the average usage of total risk capital is only 31.45 % for a trading division with thirty independently deciding traders. This shortfall is due to diversification effects. This setting is compared with a benchmark model in which total risk capital is always used at the full capacity of 100 %. The comparison shows that the average profit in the former model is only 33.13 % of the generated profit in the benchmark model. The results may have interesting organizational implications on the banking sector.

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1. **Introduction**

Although the theoretical deficits of the value at risk concept are well known (Artzner et al. 1997; Artzner et al. 1999), value at risk has become the most popular risk measurement tool in the financial industry in recent years. While researchers have focused their investigations on approaches to compute value at risk (see for an overview for market risks Knobloch; Bilson as well as Overbeck; Frerichs and Wahrenburg for credit risks in this book), the risk capital allocation process has hardly been covered so far. This fact is surprising, as the 1996 Basle Committee on Banking Supervision amendment to the capital accord for the incorporation of market risks requires banks to install bank-wide value at risk limits to control the traders’ risk takings. The common risk budgeting process in banks is a top down allocation of capital from the top management down to the single business units. In this paper, a couple of important and unsolved risk budgeting issues will be further analyzed.

The first aspect to be discussed is the difference between time horizons for risk capital in the context of the banking business. Risk capital is allocated top down on a regular basis e.g. two or four times a year, whereas the time horizon of the business units, namely the trading divisions, is short, e.g. a couple of minutes only. Thus, the long time horizon for the capital allocation has to be transformed into an appropriate short time horizon. The next issue raised is the commonly used limit adjustment for realized profits and losses as a risk budgeting practice in banks. And the third most challenging problem is the incorporation of correlations between the exposures of business units and risk factors. It is a well known fact that asset correlations smaller than one require a bank with multiple businesses to hold less risk capital than would be required for the sum of these businesses on a stand-alone basis (Saita 1999). For instance, the diversified risk capital of a New York based investment bank with twenty trading businesses is only 29.8 % of the sum of the stand alone risk capital of all units (Perold 2001). In order to use the risk capital at full capacity, correlations have to be incorporated into the top down allocation process. We address these three aspects by presenting the key approaches and results of the simulation studies of Beeck et al. 1999 and Dresel et al. 2002.

In chapter 2 we briefly outline the theory behind value at risk limits and risk capital allocation. In chapter 3 we describe the simulation model, which will be used in the following chapters. The approaches for adjusting for differences in time horizons and for profits and losses will be considered in chapter 4. The incorporation of correlations among traders’ exposures will be discussed in chapter 5. Finally, we conclude our analysis in chapter 6.