Diversification and Value-at-Risk

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ABSTRACT

A pervasive and puzzling feature of banks’ Value-at-Risk (VaR) is its abnormally high level, which leads to excessive regulatory capital. A possible explanation for the tendency of commercial banks to overstate their VaR is that they incompletely account for the diversification effect among broad risk categories (e.g., equity, interest rate, commodity, credit spread, and foreign exchange). By underestimating the diversification effect, banks’ proprietary VaR models produce overly prudent market risk assessments. In this paper, we examine empirically the validity of this hypothesis using actual VaR data from major US commercial banks. In contrast to the VaR diversification hypothesis, we find that US banks show no sign of systematic underestimation of the diversification effect. In particular, diversification effects used by banks are very close to (and quite often larger than) our empirical diversification estimates. A direct implication of this finding is that individual VaRs for each broad risk category, just like aggregate VaRs, are biased risk assessments.

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1. Introduction

Most modern commercial banks routinely publicly disclose their aggregate, firm-level Value-at-Risk (VaR). The latter measures the maximum trading loss that a bank can face over a given horizon (usually one day) and under a specified confidence level (usually 99%). A pervasive and puzzling feature of banks’ VaR is its abnormally high level. Indeed, Berkowitz and O’Brien (2002) show that US banks’ 99% VaR systematically exceed the actual 99 percentile of their trading revenues and that GARCH-based VaR models fitted to actual daily trading revenues lead to smaller VaR estimates. Pérignon et al. (2008) find that, because of VaR overstatement, market risk charges of Canadian banks are much larger (five times larger for some banks) than it would be with unbiased VaR estimates. Out of the 7354 trading days analyzed in their study, there are only two exceptions, or days when the actual trading loss exceeds the VaR, whereas the expected number of exceptions with a 99% VaR is 7.6. The direct cost for the bank to over-report its VaR is to maintain an excessively high regulatory capital since its level is given by a positive function of the bank (average or most recent) VaR. A first attempt to quantify empirically the cost of VaR over-reporting can be found in Pérignon et al. (2008).

An increasing number of banks also report an individual VaR for each broad risk category (e.g., equity, interest rate, commodity, credit spread, and foreign exchange). In their international survey, Pérignon and Smith (forthcoming) find that 68% of their sample firms publicly disclose individual VaRs. This particular disclosure format allows outsiders to have a good understanding of the current exposure of bank’s trading portfolio with respect to the main sources of risk in the economy. As acknowledged by the Basel Committee on Banking Supervision (1996) in the Amendment of the Basle Accord, banks have discretion to recognize empirical correlations within and across broad risk categories when computing their aggregate or diversified VaR. In practice, because the correlation across the risks is less than perfectly positive, the aggregate VaR will be less than the sum of the individual VaRs.

A possible explanation for the tendency of commercial banks to overstate their aggregate VaR is that they incompletely account for the diversification effect among broad risk categories (see Berkowitz and O’Brien, 2002; Pérignon et al., 2008). We refer to this conjecture as the “diversification hypothesis.” Under this hypothesis, even with unbiased individual VaRs, the aggregate VaR will be too large and the number of exceptions too small. If the diversification hypothesis is valid (i.e., biased correlation structure),

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1 See Pérignon and Smith (forthcoming) for further international evidence of VaR over-reporting.
2 This phenomenon has been labeled by Bakshi and Panigrahi (2007) as the “Capital Adequacy Puzzle.” Bresler et al. (2009) argue that simply adding market and credit risk charges tend to underestimate aggregate capital requirements.