International Review of Economics and Finance xxx (2012) xxx–xxx

Contents lists available at SciVerse ScienceDirect

International Review of Economics and Finance

journal homepage: www.elsevier.com/locate/iref

GFC-robust risk management strategies under the Basel Accord

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ARTICLE INFO

Article history:
Received 28 July 2011
Received in revised form 10 September 2012
Accepted 11 September 2012
Available online xxxx

JEL classification:
G32
G11
G17
C53
C22

Keywords:
Value-at-Risk (VaR)
Daily capital charges
Robust strategy
Basel II Accord
Global financial crisis

ABSTRACT

A risk management strategy is proposed as being robust to the Global Financial Crisis (GFC) by selecting a Value-at-Risk (VaR) forecast that combines the forecasts of different VaR models. The robust forecast is based on the median of the point VaR forecasts of a set of conditional volatility models. This risk management strategy is GFC-robust in the sense that maintaining the same risk management strategies before, during and after a financial crisis would lead to comparatively low daily capital charges and violation penalties. The new method is illustrated by using the S&P500 index before, during and after the 2008–09 global financial crisis. We investigate the performance of a variety of single and combined VaR forecasts in terms of daily capital requirements and violation penalties under the Basel II Accord, as well as other criteria. The median VaR risk management strategy is GFC-robust as it provides stable results across different periods relative to other VaR forecasting models. The new strategy based on combined forecasts of single models is straightforward to incorporate into existing computer software packages that are used by banks and other financial institutions.

1. Introduction

The Global Financial Crisis (GFC) of 2008–09 has left an indelible mark on economic and financial structures worldwide, and caused a generation of investors to wonder how things could have become so bad (see, for example, Borio, 2008). There have been many questions asked about whether appropriate regulations were in place, especially in the USA, to ensure the appropriate monitoring and encouragement of (possibly excessive) risk taking.

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http://dx.doi.org/10.1016/j.iref.2012.09.006

The Basel II Accord[1] was designed to monitor and encourage sensible risk taking, using appropriate models of risk to calculate Value-at-Risk (VaR) and subsequent daily capital charges. VaR is defined as an estimate of the probability and size of the potential loss to be expected over a given period, and is now a standard tool in risk management. It has become especially important following the 1995 amendment to the Basel Accord, whereby banks and other Authorized Deposit-taking Institutions (ADIs) were permitted (and encouraged) to use internal models to forecast daily VaR (see Jorion, 2000 for a detailed discussion). The last decade has witnessed a growing academic and professional literature comparing alternative modeling approaches to determine how to measure VaR, especially for large portfolios of financial assets.

The amendment to the initial Basel Accord was designed to encourage and reward institutions with superior risk management systems. A back-testing procedure, whereby actual returns are compared with the corresponding VaR forecasts, was introduced to assess the quality of the internal models used by ADIs. In cases where internal models led to a greater number of violations than could reasonably be expected, given the confidence level, the ADI is required to hold a higher level of capital (see Table 1 for the penalties imposed under the Basel II Accord). Penalties imposed on ADIs affect profitability directly through higher capital charges, and indirectly through the imposition of a more stringent external model to forecast VaR.[2] This is one reason why financial managers may prefer risk management strategies that are passive and conservative rather than active and aggressive (for more on this, see below).

Excessive conservatism can have a negative impact on the profitability of ADIs as higher capital charges are subsequently required. Therefore, ADIs should perhaps consider a strategy that allows an endogenous decision as to how often ADIs should violate, and hence incur violation penalties, in any financial year (for further details, see McAleer and da Veiga, 2008a, 2008b, McAleer, 2009, Caporin and McAleer, 2010a, and McAleer, Jimenez-Martin, and Perez-Amaral, 2010a). Additionally, ADIs need not restrict themselves to using only a single risk model. McAleer, Jimenez-Martin, and Perez-Amaral (2010b) propose a risk management strategy that consists in choosing from among different combinations of alternative risk models to forecast VaR. They discuss a combination of forecasts that was characterized as an aggressive strategy, and another that was regarded as a conservative strategy.[3]

Following such an approach, this paper suggests using a combination of VaR forecasts to obtain a crisis robust risk management strategy. The paper defines a crisis robust strategy as an optimal risk management strategy that remains unchanged regardless of whether it is used before, during or after a significant financial crisis. Parametric methods for forecasting VaR are typically fitted to historical returns assuming specific conditional distributions of returns, such as normality, Student-t, or generalized normal distribution. The VaR forecast depends on the parametric model, the conditional distribution and can be heavily affected by a few large observations. Some models provide many violations, but low daily capital charges. Additionally, these results can change drastically from tranquil to turbulent periods. In short, regardless of economic turbulence, is there a model to forecast VaR that provides a reasonable number of violations and daily capital charges?

We estimate several univariate conditional volatility models to forecast VaR, assuming different returns distributions (specifically, Gaussian, Student-t and Generalized Normal). Additionally, we present 12 new strategies based on combinations of standard model VaR forecasts, namely: *lowerbound*, *upperbound* (as defined in McAleer et al., 2010b), the *average*, and nine additional strategies based on the 10th, … 50th, … 90th percentiles. Models are compared over three different time periods to investigate whether we can find a risk management strategy that is robust over time (that is, crisis-robust). We provide evidence that using the median of the point VaR forecasts of a set of univariate conditional volatility models is a robust risk measure. A risk management strategy based on the median forecast is found to be superior to alternative single and composite model alternatives.

The remainder of the paper is organized as follows. In Section 2 we present the main ideas of the Basel II Accord Amendment as it relates to forecasting VaR and daily capital charges. Section 3 reviews some of the most well-known models of conditional volatility used to forecast VaR. In Section 4 the data used for estimation and forecasting are presented. Section 5 analyzes the robust VaR forecasts before, during and after the 2008–09 GFC. Section 6 presents some conclusions.

2. Forecasting Value-at-Risk and daily capital charges

The Basel II Accord stipulates that daily capital charges (DCC) must be set at the higher of the previous day's VaR or the average VaR over the last 60 business days, multiplied by a factor $(3+k)$ for a violation penalty, wherein a violation involves the actual negative returns exceeding the VaR forecast negative returns for a given day[4]:

$$DCC_t = \sup\left\{-(3+k)\overline{VaR}_{60}, -VaR_{t-1}\right\} \tag{1}$$

[1] When the Basel I Accord was concluded in 1988, no capital requirements were defined for market risk. However, regulators soon recognized the risks to a banking system if insufficient capital was held to absorb the large sudden losses from huge exposures in capital markets. During the mid-90s, proposals were tabled for an amendment to the 1988 Accord, requiring additional capital over and above the minimum required for credit risk. Finally, a market risk capital adequacy framework was adopted in 1995 for implementation in 1998. The 1995 Basel I Accord amendment provides a menu of approaches for determining market risk capital requirements, ranging from a simple to intermediate and advanced approaches. Under the advanced approach (that is, the internal model approach), banks are allowed to calculate the capital requirement for market risk using their internal models. The use of internal models was introduced in 1998 in the European Union. The 26 June 2004 Basel II framework, implemented in many countries in 2008 (though not yet in the USA), enhanced the requirements for market risk management by including, for example, oversight rules, disclosure, management of counterparty risk in trading portfolios.

[2] In the 1995 amendment (p. 16), a similar capital requirement system was recommended, but the specific penalties were left to each national supervisor. We consider that the penalty structure contained in Table 1 of this paper belongs only to Basel II, and was not part of Basel I or its 1995 amendment.

[3] This is a novel possibility. Technically, a combination of forecast models is also a forecast model. In principle, the adoption of a combination of forecast models by a bank is not forbidden by the Basel Accords, although it is subject to regulatory approval.

[4] Our aim is to investigate the likely performance of the Basel II regulations. In this section we carry out our analysis applying the Basel II formulae to a period that includes the 2008–09 GFC, during which the Basel II Accord regulations were not fully implemented.

Please cite this article as: McAleer, M., et al., GFC-robust risk management strategies under the Basel Accord, *International Review of Economics and Finance* (2012), http://dx.doi.org/10.1016/j.iref.2012.09.006