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Integrated models of capital adequacy – Why banks are undercapitalised

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ABSTRACT

With the majority of large UK and many US banks collapsing or being forced to raise capital over the 2007–9 period, blaming bankers may be satisfying but is patently insufficient; Basel II and Federal oversight frameworks also deserve criticism. We propose that the current methodological void at the heart of Basel II, Pillar 2 is filled with the recommendation that banks develop fully-integrated models for economic capital that relate asset values to fundamental drivers of risk in the economy to capture systematic effects and inter-asset dependencies in a way that crude correlation assumptions do not. We implement a fully-integrated risk analysis based on the balance sheet of a composite European bank using an economic-scenario generation model calibrated to conditions at the end of 2007. Our results suggest that the more modular, correlation-based approaches to economic capital that currently dominate practice could have led to an undercapitalisation of banks, a result that is clearly of interest given subsequent events. The introduction of integrated economic-scenario-based models in future can improve capital adequacy, enhance Pillar 2's application and rejuvenate the relevance of the Basel regulatory framework.
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1. Introduction

The Economic Capital (EC) concept is clear from a technical perspective – it is the capital that a financial institution requires in order to operate as a solvent concern at a specified confidence level over a given time horizon. In the banking sector, Pillar 2 of Basel II was specifically intended to focus on the regulatory review and internal risk assessment procedures, examining the extent to which risk management best practices are embedded into bank decision making. Economic capital modelling and the closely related requirement for stress testing have become fundamental planks of Pillar 2 compliance (Alexander and Sheedy, 2008). Moreover, banking institutions are required by Pillar 3 to disclose these risk assessments to external stakeholders. A fundamental problem, however, is that Pillar 2 EC calculation and Pillar 3 disclosure requirements exist without clear regulatory guidance as to the methodology that complex institutional capital models should employ to *integrate* risk effects across asset classes.

Broadly, EC encapsulates the concept of measuring risk across a financial institution and using the model and its outputs in risk-adjusted comparisons of performance to assist strategic decision making and deliver value for shareholders. In this paper, we will argue that the consideration of economic scenarios, their firm-wide effects and the dependencies they induce in asset performances should be the cornerstone of economic capital practice, and that this requirement should be more clearly articulated in regulation. In reviewing the current state of financial regulation Brunnermeier et al. (2009) find that "macro-economic analysis and insight has, in the past, been insufficiently applied to the design of financial regulation...the crisis which began in the US sub-prime mortgage market in early 2007 and then spread broadly and deeply was not the first banking crisis. It was closer to the 100th...".

A central question concerns the nature of integrated risk methodology used by financial institutions for economic capital calculation before and during the current crisis. How were/are risk effects considered across asset classes and then integrated into a coherent capital framework? A summary of methodological practice in the financial sector is presented in a comprehensive pre-crisis survey by the International Financial Risk Institute that included both banks and insurance companies. In this survey, the prevailing

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approach is reported to be assessment of risk through standalone models for broad asset classes (or in many cases crude risk categories like market, credit and operational risk) followed by integration using correlation matrices (see IFRI Foundation and CRO Forum, 2007). This approach to integration was favoured by over 75% of the surveyed banks with the others using simulation approaches or hybrid approaches. In the insurance industry there was more diversity in the approaches used for integration: around 35% of respondents used the correlation approach and about the same number used simulation; the remainder reported the use of copulas or hybrid approaches.

The correlation-based method favoured by so many of the IFRI respondents, and in particular the banks, is a modular calculation approach, widely used for its simplicity. In such an approach capital requirements are estimated on a per asset class basis using an appropriate risk model for that asset class and a risk measure such as Value-at-Risk (VaR). At the simplest level these per-asset-class capital requirements can be added although this tends on the whole (but not always) to overstate capital requirements (Alessandri and Drehmann, 2010; Breuer et al., 2010). Inter-asset diversification is typically superimposed using a matrix overlay of correlation coefficients between asset classes. In this way there is a resultant downward adjustment to the total capital charge applied to the institution as a whole. A good example of a very detailed application of the modular approach is Rosenberg and Schuermann (2006), which also shows how copulas can be used in place of correlations to take better account of dependencies in the tail.

While modular methods, when carried out carefully, may give adequate results in "normal" periods, it has become clear that the modular approach may prove unreliable in crises and that the complex interactions of macro-economic factors, financial risk factors, liquidity effects and asset valuations on which economic capital assessment depends cannot be underpinned by such a simplistic integration approach. Superimposed correlation numbers are hard to justify, subject to sampling error on account of scarce data, and, most importantly, make no attempt to tell the narrative of how correlation arises which is necessary for risk mitigation and management. In fact, it is essential to understand the sources of correlation if one wants to measure inter-asset dependencies and use this to reduce dependencies between different lines of business.

Integration is an extremely important methodological issue that requires urgent global regulatory guidance. In a report of the Financial Stability Forum (2008) supervisors have acknowledged the need for Pillar 2 principles to strengthen banks' risk management practices, to sharpen banks' control of tail risks and to mitigate the build-up of excessive exposures and risk concentrations. Addressing the methodological deficiencies of current treatments of integration is a major part of this challenge. Our contention in this paper is that fully integrated factor models based on scenario generation are the key to addressing this issue. Aggregate risk capital should depend on changes in the valuation of asset positions which are driven by vectors of risk factors calibrated to real-world economic conditions. Capital held to support asset positions should only be reduced by diversification due to differences in risk driver dependencies from position to position. This reflects the fact that, although it may be possible for banks to limit risks by not holding certain asset classes, it is not possible for bank assets to fully avoid the pervasive systematic effects of risk factors describing interest rates, inflation, credit, equity and property risk (Alessandri and Drehmann, 2010; Drehmann et al., 2010).

Although our focus in this paper will be *fully-integrated models at institutional level*, this work is taking place against the backdrop of a wide-ranging review of regulation that raises important questions about the future of so-called micro-prudential regulation. Brunnermeier et al. (2009) suggest that regulation has been excessively focussed on seeking to improve the behaviour and risk management practices of individual banks. However, the fully-integrated approach described in this paper has its counterpart in integrated models of system-wide risk with additional feedback effects that are being developed by central banks to shed light on systemic crises and macro-prudential regulation.

The main contributions of this paper are: (i) to demonstrate the feasibility of fully-integrated economic capital modelling by applying the methodology to a composite balance sheet derived from a sample of European banks from the pre-crisis period; (ii) to show how the results suggest a much higher level of capitalisation would have been desirable than that implied by a typical modular correlation-based approach (i.e. the approach currently used by the majority of institutions – see IFRI Foundation and CRO Forum (2007)); (iii) to show how the fully-integrated approach allows the allocation of this capital to asset classes to gain deeper insights into the issue of diversification. We conclude that there is little surprise that current practice in enterprise risk management failed to insulate the banking sector against the extreme capital losses that were incurred.

The paper is structured as follows. In Section 2 we describe the derivation of an "average" European bank which will be used for the empirical investigation of capital adequacy. In Section 3 we summarise the fully-integrated methodology of the paper, contrast it with more modular approaches, and describe the architecture of the economic scenario generation model that we will use. Results are presented in Section 4 where we devote particular attention to discussions of fully-integrated projection and fair capital allocation at the institutional level. Section 5 concludes.

2. Construction of an average European bank

To provide empirical insights into the differing effects of implementing both modular and fully-integrated approaches to capital, we construct a composite 2006 balance sheet of a representative European bank (EuroBank). Balance sheets for 51 European banks for the year 2006 are selected to provide a cross-sectional assessment of capital adequacy prior to the credit crisis. Summary statistics presented in the Fifth Quantitative Impact Study, (QIS5, Basel Committee, 2006) inform our split of aggregate asset positions by exposure type and credit class, ensuring consistency with asset profiles held by European banks.

The reason we specifically select European banks as at 2006 is that Europe offers a fertile ground for investigating the basic effects of diversification on EC in the context of implementing Basel II Pillar 2 regulations. Our data enables a pre "credit crunch" view of sector capital adequacy.

We reformulate individual bank balance sheets into a format that can be utilized to compare EC approaches. Thomson Worldscope database is used to collect an initial sample of 90 banks whose primary listings are the six largest banking nations in Europe: the United Kingdom (GBR), France (FRA), Germany (GER), Italy (ITA), Spain (ESP) and the Netherlands (NED).We exclude small banks (defined as banks with less than £500 million in total assets), retaining banks which are engaged in at least one of the following activities: investment banking, deposit-taking or loan-making. Institutions classified as Islamic banks are also excluded as their asset accounting information does not allow the use of QIS 5 asset mapping characteristics. After exclusions the sample set is reduced to 51 banks, with the majority of their assets regulated in the UK and the Euro-zone, and therefore subject to Basel II Pillar 2. Categorisation of individual banks' balance sheet items into broader asset classes is informed by notes accompanying the

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