Credit Risk and Banking Regulation

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FECHA DE LECTURA Mayo de 2006.

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This dissertation deals with two topics: credit risk and banking regulation. The first one, credit risk, presents an empirical analysis of the degree in which the credit risk of different firms is related, finding that credit risk correlations between firms are substantial and stem from just a common risk factor affecting the credit risk of all firms. The second one, banking regulation, involves two theoretical models which address two important questions related with the New Basel Accord for banking regulation and supervision, Basel II: *i)* What will be the impact of Basel II on banks' risk taking incentives? To answer this question we carefully analyze the role of ratings-based regulatory measures within Basel II; *ii)* How will Basel II affect banks' capital levels? We analyze the impact of Basel II on banks' economic, regulatory and actual capital and check whether, as argued by regulators and academics, Basel II will narrow the gap between economic and regulatory capital. All the three chapters are self-contained.

The title of the first paper (Chapter 2) asks: «Do we need to worry about credit risk correlations?». The answer will be «Yes, we do». First, let us clarify what we mean by credit risk and by credit risk correlation. The credit risk of a firm is defined as the probability of the firm defaulting times the losses to bondholders in case of default, i.e. credit risk measures probability and severity of default. The term correlation can be misleading when one first approaches its use in the credit risk literature. In fact when we talk about credit risk correlation we do not necessarily refer to a correlation parameter but, in a general way, to the degree in which the credit risk of different firms is related. There are several ways of capturing such relationship in the literature; in this paper, credit risk correlation arises from common risk factors affecting the credit risk of all firms.

Interpreting correlation as the impact of common risk factors on the firms' credit risk, the questions we want to address are: How much credit risk can we explain with those common factors? What do they represent? In other words, Can we get an idea of the source and magnitude of credit risk correlations? The paper shows that any firm's credit risk is, to a very large extent, driven by common risk factors affecting all firms. Using a reduced form model and sequential Kalman filtering estimation we decompose the credit risk of a sample of corporate bonds (14 US firms, 2001-2003) into different unobservable risk factors. A single common factor accounts for more than 50% ofall (but two) of the firms' credit risk levels, with an average of 68% across firms. This factor represents the credit risk levels underlying the US economy and is strongly correlated with main US stock indexes.

Credit risk correlation plays an important role in, at least, three key financial frameworks. First, in

the management of portfolios of defaultable instruments: credit risk correlation determines the diversification of the portfolio. Second, in the pricing of multiname credit derivatives such as Collateralized Debt Obligations (CDOs) and Asset Backed Securities (ABSs). These financial instruments have become extremely popular in recent years and represent one of the fastest growing financial markets nowadays. Their payoffs depend on the credit risk evolution (default vs. no default) of a group of underlying firms and, as a consequence, on the credit risk correlation between them. Third, credit risk correlation plays a central role in determining bank capital charges under Basel II: banks are required to hold a minimum capital level which is an increasing function of the credit risk correlation of the credit instruments in their portfolio.

Clearly, and deservedly as we mentioned in the previous paragraph, credit risk correlation has become one of the hot topics in the credit risk literature, probably the hottest. Academics and practitioners alike have devoted large amounts of time and resources to credit risk correlation modelling and measuring. This paper is about measuring the magnitude of credit risk correlations between firms.

There are many papers dealing with the impact of credit risk correlations on different settings. However, very few of them estimate those correlations; they just analyze what happens if the correlation a given value. In 2003, Amato and Remolona (2003, p. 60), from the Bank of International Settlements (BIS), reckoned that «In practice, default correlation has been difficult to estimate with any precision» Two years went by and in 2005 Amato and Gyntelberg (2005, p. 73) state that «Although progress is being made, quantitative modelling of these correlations is complex and not yet fully developed».

This paper computes the importance and source of firms' credit risk correlation. We decompose the credit risk of each firm into common, sector and idiosyncratic factors and compute their importance in explaining such credit risk. The main finding is that one common factor affecting the credit risk of all firms is enough to explain a significant part of it. Such factor is strongly and negatively correlated with major stock indexes, suggesting that the firms' credit risk correlations, during the sample period we cover, arise from the dependence of the firms' credit risk on the business cycle. We find that sector and idiosyncratic risk factors, as well as liquidity and interest rates, play, on average, a lower role than the previous common factor on the firms' credit risk structure.

Leaving credit risk and getting into banking regulation, the second paper (Chapter 3) is entitled: «From Basel I to Basel II: An Analysis of the Three Pillars». The paper studies the impact of several regulatory and supervisory measures included in Basel II on banks' risk taking incentives.

In real life, banking regulation is ratings-based: supervisors and the market do treat banks differently according to their risk and financial situation, i.e. according to their rating. In fact ratings-based regulations are included in the two most important banking regulatory frameworks around the world: FDICIA and Basel II. FDICIA is the current US regulatory framework and was introduced in 1991. FDICIA is built around the concept of ratings-based regulations: regulators are obliged to treat banks differently according to their rating. In FDICIA, supervisors classify each bank into one of five different rating categories (from well capitalized to critically undercapitalized) and take supervisory actions according to the rating of the banks. Such supervisory actions include restrictions in capital distributions and management fees, capital restoration, close monitoring, restriction on activities, deposit insurance premiums, ...

This paper focuses on Basel II, although the framework it develops to analyze ratings-based regulations can be applied to any ratings-based regulations, in particular to the ones in FDICIA. Basel II is a new framework for banking regulation and supervision designed by the Basel Committee on Banking Supervision (BCBS). The BCBS represents central banks and banking supervisory authorities and its mission is to formulate banking regulation and best practices, which country members are expected to adopt. Basel II substitutes Basel I, which has been in place since 1988. Compared to Basel II, Basel I is a very simple piece of banking regulation, it just consists on a capital requirements rule by which banks are required to hold a minimum capital level relative to assets. Basel I has been massively applied around the world and has

become an international standard for bank capital regulation.

Basel II, published in 2004, will become effective from 2006 onwards. The BCBS expects more than 100 countries will adopt it before 2010. Basel II consists on Three Pillars (capital requirements, supervisory review process and market discipline), all of which will be described and analyzed in the paper. In particular, we will focus on the impact on banks' risk taking incentives of several ratings-based regulations included in those pillars: ratings-based audit frequencies, ratings-based dividend restrictions and a ratings-based market discipline mechanism. We show they reduce banks' risk taking incentives.

While current banking regulation is ratings-based, the banking literature is not. As a consequence, to keep up with banking regulation, we have to develop models to analyze ratings-based regulatory measures, which is what this paper does.

How do we model ratings-based regulations? First and most important, we have to bear in mind that rating levels change over time. Thus, the analysis of ratings-based regulation requires dynamic models. In terms of modelling, we have two options: discrete and continuous time models. Most of discrete time models are static or with a very poor dynamic component (1, 2, 3 periods models). The general problem of using fully dynamic discrete time models is that they involve complex numerical solutions. Continuous time models are dynamic by construction and, in fact, they have been used in the banking literature. There is a line of research, started by Merton (1978), applying continuous time models to banking analysis. However, none of those models analyze ratings-based regulations. This paper builds on the existing continuous time banking literature and provides a framework to analyze ratings-based regulations.

Although the mix of continuous time and ratings-based regulations seems very complicated in terms of solving the model, one of the attractiveness of the paper is that it uses a methodology that yields analytical solutions. Therefore, the first contribution of the paper is to provide a manageable framework to analyze ratings-based regulatory measures. The second contribution is to apply such framework to Basel II and check whether it will reduce or increase banks' risk taking incentives.

The paper presents a dynamic model of banking supervision to analyze the impact of each of Basel II three pillars on banks' risk taking. We extend previous literature providing an analysis of rating-based supervisory policies. In Pillar 2 (supervisory review) the supervisor audits low rated banks more frequently and restricts their dividend payments in order to build capital. In Pillar 3 (market discipline) the supervisor reduces the level of deposit insurance coverage compelling not-fully insured depositors to adjust interest rates contingent on the bank's external rating. We also analyze the risk sensitiveness of Pillar 1 (capital requirements) concluding that all three Pillars reduce banks' risk taking incentives.

The third paper of this dissertation (Chapter 4) is entitled «Economic, Regulatory and Actual Capital in Banking». Sometimes in a research topic a given terminology makes its way without too much noise and ends up in every single conversation. That is what has happened with the terms economic and regulatory capital in the jargon of Basel II. Regulatory capital can be defined as the minimum required by regulation and economic capital as that chosen by shareholders without regulation.

Banking regulators are probably the ones most to blame for making economic and regulatory capital two of the most used words in the Basel II jargon. Some of the reasons put forward for the Basel II crusade had to do with economic and regulatory capital. In particular, many discussions about Basel II have highlighted the objective of bringing regulatory capital closer to economic capital. Just a sample of them:

- Basel II sets «...more risk-sensitive minimum capital requirements, so that regulatory capital is both adequate and closer to economic capital». Jaime Caruana (2005, p. 9), Chairman of the Basel Committee on Banking Supervision.
- «The enhanced risk sensitivity and extended supervisory recognition of credit risk mitigation factors contribute to reducing the gap between the regulatory and economic capital». European Central Bank (2001).

- «The primary objective under Pillar 1 (of Basel II) is better alignment of regulatory capital requirements with 'economic capital' demanded by investors and counterparties.» Gordy and Howells (2004, p. 1).

The first task of this paper is to check whether Basel II will narrow the gap between economic and regulatory capital. Regulatory capital is computed as the capital charges in the Internal Ratings-Based (IRB) approach of Basel II. To compute economic capital we use a dynamic model in which shareholders choose, at the beginning of each period, the level of capital in order to maximize the value of the bank, taking into account the possibility that the bank be closed if the losses during the period exceed the initial level of capital. Thus economic capital trades-off the costs of funding the bank with costly equity against the benefits of reducing the probability of losing its franchise value, which appears as a key endogenous variable in the bank's maximization problem.

Will Basel II close the gap between economic and regulatory capital? Our results: not necessarily. It depends on the values of the variables characterizing the banks' assets and liabilities structure: cost of capital, intermediation margin, loans' default probabilities and losses given default. We show that both regulatory and economic capital depend positively on the loans' probability of default and loss given default for reasonable values of these variables. However, variables that only affect economic capital, such as the intermediation margin and the cost of capital, may significantly move it away from regulatory capital.

That is not all. The idea that Basel II should close the gap between regulatory and economic capital is in our view misguided. The implicit objective behind the desire to make regulatory capital similar to economic capital is to make sure banks hold the capital level they would hold without regulation (!?). That doesn't sound right, does it? If you want banks to hold the capital they would hold without regulation, just don't regulate capital levels. But the point is that capital regulation exists, and that capital regulation affects banks' actual capital levels. It turns out that what we should be worrying about is not economic capital but actual capital (the capital which banks will hold taking into account the existing capital regulation.) The paper also analyzes actual capital.

The analysis of actual capital allows one to check the impact of the considered capital regulations on the (actual) level of banks' capital. We consider two capital regulations: *i)* banks are only allowed to operate if their initial capital is higher than the minimum required by regulation, and *ii)* those banks with capital levels (tangible equity) below 2% at the end of the period will be closed. This second regulation is included in FDICIA, but not explicitly in Basel II (although Pillar 2 gives national supervisors enough discretion to consider it).

The first regulation alone makes actual capital equal to the maximum of economic and regulatory capital, which according to our results coincides almost always with the latter (except for small values of the cost of capital). Therefore, whenever actual capital is higher than regulatory capital this is due to the second regulation. Our results indicate that the threat of closing critically undercapitalized banks significantly increases actual bank capital for reasonable ranges of parameter values. As a consequence, national supervisors applying Basel II can consider a similar closure rule if they want to boost banks' capital levels.