



# Basel III leverage ratio requirement and the probability of bank runs



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## ABSTRACT

A new argument for the Basel III *leverage ratio* requirement is proposed: the need to limit the risk of a bank run when there is imperfect information on the value of a bank's assets. In addition to screening and monitoring borrowers, banks provide liquidity insurance with the supply of short-term deposits withdrawable on demand. The maturity mismatch creates the risk of a disorderly bank run which can be exacerbated by imperfect information about the value of bank assets. It is shown in a stylized Basel III framework that capital regulation should incorporate a liquidity risk component. Credit risk diversification and/or a reduced probability of loan default which lead to a reduction of Basel III regulatory capital will increase the probability of a bank run. The *leverage ratio* rule puts a floor on the Basel III risk-weighted capital ratio, allowing the limitation of such a risk.

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## 1. Introduction

The bank capital regulation set by the Basel Committee on Banking Supervision has attempted to measure the riskiness of a bank's on- and off-balance sheet exposure and to fix the amount of capital needed to limit the probability of default to a desired level of confidence. In 2014, the Basel Committee announced the introduction of a complementary *leverage ratio* which is not anymore risk-weighted. This paper provides an argument for its *raison d'être*: the need to limit the probability of a bank run when there is imperfect information on the value of bank assets.

Under the 1988-Basel I bank capital regulation, the capital required to fund a loan portfolio is a minimum 8% of assets, whatever the riskiness of bank loans or the degree of credit risk diversification. The Basel II risk-based capital regulation, adopted in June 2004, applies a formula that captures better credit risk (Basel Committee, 2004). The framework includes three pillars: capital regulation, bank supervisors' oversight and information disclosure. Pillar 1 capital regulation requires bank capital to cover annual credit losses with a 99.9% confidence level. The degree of credit risk diversification is assessed under Pillar 2 by bank supervisors who can adjust the capital adequacy requirement. Although the Basel II capital regulation also covers market and operational risks, the focus of this paper is on credit risk, the main source of bank failures around the world. The essence of Basel II internal-rating based

(IRB) approach was retained in the revised Basel III capital regulation. The asset risk-weighting is based on the Basel II framework and higher capital ratios with a much larger emphasis on common equity Tier 1 are imposed to create a more resilient banking system (Basel Committee, 2010).

Besides credit risk, a second source of risk was prevalent during the global financial crisis: liquidity risk. Constraints on liquid assets and maturity mismatch are imposed in the Basel III rules. A liquidity coverage ratio (LCR) ensures that a portfolio of contingent liquid assets can fund a cash outflow lasting 30 days in a stress scenario (Basel Committee, 2013). And consultations about a net stable funding ratio are taking place. Its objective is to ensure that permanent assets are funded with stable funds (Basel Committee, 2014a).

The Pillar 1 risk-weighted Basel II/III capital ratio has been criticized for several reasons: insufficient capital in a recession, complexity, open to gaming, lack of robustness, and fear of excess leverage in the economy. Opponents recommend the application of a complementary simple *leverage ratio*, equity divided by unweighted balance sheet assets. Preparation for a mandatory leverage ratio is taking place (Basel Committee, 2014b). Public disclosure on the leverage ratio will start on January 1, 2015. Calibration of the ratio will follow with the objective of migrating the leverage ratio into a mandatory Pillar 1 capital requirement by January 1, 2018.

In this paper, we focus on the Pillar 1 risk-weighted capital regulation and the unweighted *leverage ratio*, providing an

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additional argument for its *raison d'être*: the need to limit the risk of a bank run when there is imperfect information about the value of bank assets. We show that diversification of credit risk or a reduced probability of loan default, which under Basel III internal ratings-based approach is accompanied by a capital relief, will increase the probability of a bank run. The effect is caused by imperfect information on loan losses and the shape of the aggregate loan loss probability distribution. It is shown that the reduction of Pillar 1 Basel III capital moves the 'bank run locus', the set of loan losses which can trigger a bank run, to a higher probability zone. A unweighted *leverage ratio* regulation, a floor on the equity-to-asset ratio, limits the risk of a bank run.

In essence, Basel II models a bank as if one-year maturity assets are funded with one-year maturity debt. Capital requirement is set to reduce to a desired confidence level the risk of bank default over a one-year horizon. The one-year horizon was chosen partly because the Basel Committee wanted to follow market practice in measuring credit risk, but also to reflect banks' inability to raise equity on a continuous basis. The implicit assumption of perfect matching of maturities and orderly repayment of deposits at maturity does not recognize that banks offer a second type of service. In addition to screening and monitoring borrowers, banks provide liquidity insurance (Diamond and Dybvig, 1983), and long-term assets are funded partly with short-term deposits that are withdrawable on demand. The maturity mismatch creates a second type of risk, a bank run by uninsured depositors. Recent examples of bank runs include the investment banks Bear Stearns and Lehman Brothers during the subprime crisis or the American money market funds stopping the U.S. Dollar funding of French banks during the *euro* crisis in 2011. Run by smaller insured retail depositors have also taken place in specific circumstances of incomplete insurance coverage, delay/hassle in insurance payment, or when the solvency of the country providing deposit insurance was in doubt. Cases include Northern Rock<sup>1</sup> in the United Kingdom in fall 2007 and banks in Cyprus in March 2013 and Bulgaria in July 2014. Ideally, bank regulations should be based on models that incorporate both sources of risk: credit and liquidity risks.

The Basel III liquidity coverage ratio and the net stable funding ratio are not modeled in the paper. It will be argued that these regulations do not alter the conclusion of the paper regarding the need for a floor on leverage unless maturity mismatch, an essential function of banks, is banned. "One of the most important roles performed by banks is the creation of liquid claims on illiquid assets" (Goldstein and Puzner, 2005).

In general discussion on financial stability by central bankers, it is assumed implicitly that the Basel capital regulation that measures risk with a 99.9% confidence level also contributes to reducing the risk of bank runs. "Regulators must not start piling new ratios on the existing ones, adding further requirements (leverage ratios, special ratios on large systematically important institutions, anti-cyclical capital buffers) to the normal – and revamped – Basel 2 risk-based system" (de Larosière, 2009). But not everybody agrees that the higher risk-weighted capital ratio of Basel III provides all the answers. Sheila Bair, former Chairman of the FDIC, justifies the need for an effective floor on leverage by the concern that risk-weighted capital designed in periods of prosperity could lead to insufficient capital when the credit cycle deteriorates.<sup>2</sup> Haldane (2012) argues that it is too complex and open to gaming with an 'optimization of risk-weighted assets'. He proposes a simple and transparent *leverage*

*ratio*, equity over unweighted assets. Jarrow (2012) argues that the *leverage ratio* is more robust to estimation errors. Another concern was the build-up of leverage in the economy. This led the Financial Stability Forum (2009, p. 15) to also recommend a simple, non-risk based measure to complement the risk-based approach of Basel II. These five concerns with the risk-weighted capital ratios – insufficient capital in a recession, complexity, open to gaming, lack of robustness and fear of excess leverage in the economy – led to the revised Basel III capital regulation and the introduction of a complementary *leverage ratio* (Basel Committee, 2010, 2014b).<sup>3</sup> An additional argument is presented in this paper: the need to limit the risk of a disorderly bank run, risk which is amplified by imperfect information on the value of bank assets.

Finally, the paper provides a new rationale for the empirical observations that bank capital often exceeds the Basel regulatory level (Flannery and Rangan, 2002). This rationale is complementary to those advanced in the literature, according to which banks hold excess capital either to avoid falling below the supervisory ratio or, under private market pressure, to reduce the risk of bank default when the volatility of asset return increases. In this paper, the quest for excess capital is motivated by the desire to reduce the probability of a bank run.

The paper is structured as follows. The literature on bank runs is reviewed in Section 2. The asset side of the bank and portfolio credit risk are introduced in Section 3. Funding of illiquid loans with short-term deposits and equity is introduced in Section 4. The probability of a bank run is discussed in Section 5. The impact of default correlation and probability of loan default on the probability of a bank run for the case of a homogeneous loans portfolio is discussed in Section 6. The model is generalized to a portfolio with heterogeneous loans in Section 7, and a discussion of the Basel III capital and liquidity regulations follows in Section 8.

## 2. Literature review

One can distinguish three streams in the economics of banking literature: fundamental economics of banking, structural models of the banking firm funded with equity and debt of different tenor, and models of the banking firm subject to Basel II/III capital regulations. This paper is related to the third stream. Although several 'shadow banking' structures such as the asset-backed commercial paper programs (ABCP) have a financial structure similar to that of banks (Covitz et al., 2013), we focus on bank runs because the Basel III regulations are specific to banking.

Banks engage in maturity transformation by financing long-term opaque loans with short-term deposits. This creates the risk of a bank run. The theoretical economic literature has identified two main motivations for the offering of short-term deposits. Bryant (1980), Diamond–Dybvig (1983), Jacklin and Bhattacharya (1988) and Goldstein and Puzner (2005) focus on liquidity insurance when investors do not know if they will be early or late consumers. This literature distinguishes two types of bank runs: *Sunspot* bank runs driven by pure panic and *fundamental* runs linked to information on the business cycle and a loss of value of banks' assets (Allen and Gale, 2007). An alternative explanation for the supply of bank deposits is that, in the presence of asymmetric information on asset quality, a short-term deposit is an information-insensitive security, a characteristic which is quite useful for investors searching for liquid easily tradable assets (Gorton and Pennachi, 1990; Dang et al., 2013). These papers are

<sup>1</sup> In the case of the bank run on the British Northern Rock in September 2007, depositors had a 100% coverage for the first £ 2000, and a 90% coverage for the next £ 33,000 with a payout time estimated at 6 months.

<sup>2</sup> In "A Special Report on International Banking", The Economist, 19 May, 2007. The FDIC imposes a second capital ratio, the *leverage ratio*, defined as the ratio of Tier 1 over unweighted balance sheet assets.

<sup>3</sup> In December 2008, Switzerland imposed a *leverage ratio* on its two largest banks, Credit Suisse and UBS. On July 2, 2013, the US Federal Reserve Board approved the Basel III rules which include a leverage ratio. The EU will require banks to publish their individual leverage ratios from 2015 and decide by 2018 whether region-wide standards need to be set.

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