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# Tackling the over-dispersion of operational risk: Implications on capital adequacy requirements

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ABSTRACT

Having proved Basel II to be ineffective to prevent the global financial crisis, Basel III seeks to enhance the resilience of individual financial institutions by strengthening their capital buffer and by building counterbalancing capacity to absorb liquidity shocks. Under this new regulatory framework the increase of capital adequacy ratios is a matter of utmost importance for promoting the soundness and stability of the financial system. With regard to the operational risk, Basel III suggests a greater convergence in the measurement methodologies as well as a higher supervision. To this extent, the objective of this paper is threefold: (i) to test the over-dispersed nature of operational losses; (ii) to capture the extra-Poison variance into the Loss Distribution Approach (LDA); (iii) to assess its potential impact on the capital adequacy requirements (CARs) for operational risk. Our findings point out a higher capital charge associated to the alternative extra-Poisson distributions; even more significant under heavy-tailed scenarios. In consequence, the over-dispersion phenomenon should be addressed very carefully not only by the financial institutions when designing their internal measurement approaches, but also, by the supervisors when validating such models, both ensuring the appropriate specifications to provide with a more realistic capital charges.



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## 1. Introduction

The impact of the global financial crisis has been more severe in large banks operating in industrial economies – precisely those regulated under Basel II (2006) – than those from emerging countries (Shehzad & De Haan, 2013). As a consequence, the Basel Committee on Banking Supervision (BCBS, 2011a) has revised such regulatory framework by introducing new initiatives – previously discussed by the Financial Stability Board (FSB, 2010) and the G20 leaders[1], in order to promote a more stable financial sector. Unlike Basel II, which was focused on the denominator of the solvency ratio, these-called Basel III (see BCBS, 2011a) proposes the increase of the regulatory capital in terms of quality and quantity as well as enhancing the counterbalancing capacity to absorb liquidity shocks (see BCBS, 2013). In particular, besides strengthening the minimum capital requirements (MCR) it seeks to reinforce the protection against periods of acute economic and financial strain by adding two additional capital layers: the capital conservation buffer and the countercyclical capital buffer (Rossignolo & Duygun, 2012). In that sense, as Gupta, Akuzawa, and Nishiyama (2013) state that Basel III obliges banks to maintain more and higher quality capital which can be directly accessed in times of stress. Whatever the case, asin Basel II, the estimation of MCR takes into account the exposure to the market risk, credit risk and operational risk. Focusing on the latter, operational risk is explicitly defined by the BCBS (2006) as "*the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk, but excludes strategic and reputational risk*". In order to calculate the capital requirements for operational risk, the BCBS describes three main methodologies, which ordered from low to high complexity and risk sensitivity are: Basic Indicator Approach (BIA), Standardized Approach (SA) and Advanced Measurement Approaches (AMA). In particular, the BCBS (2011b) proposes the Loss Distribution Approach (LDA) as the most risk-sensitive methodology for estimating the operational risk capital requirements. The concept of Value at Risk (VaR) (Jorion, 1996) is then applied to the LDA, giving rise to the Operational Value at Risk (henceforth, OpVaR). The VaR is defined as an estimate of the probability and size of the potential loss to be expected over a given period (McAleer, Jiménez-Martín, & Perez-Amaral, 2013) and is considered a standard risk measure (Allen, Singh, & Powell, 2013). The LDA is theoretically described by Aue and Kalkbrener (2006) and Frachot, Moudoulaud, and Roncalli (2006) focus on its empirical implementation to the bank industry. The model requires the previous definition of two variables (Häger & Andersen, 2010): severity and frequency. The severity is defined as a random continuous variable that represents the amount of loss. The frequency is a random discrete variable that symbolizes the number of events occurring during a risk horizon. Traditionally, the Poisson distribution is considered a benchmark model for counting data (see Cameron & Trivedi, 1990). This discrete function assumes equi-dispersion between mean and variance, i.e., $E[Y] = Var[Y]$. However, in the operational risk context, the variance usually exceeds the mean, giving rise to the over-dispersion effect (Dahen & Dionne, 2010; McNeil, Frey, & Embrechts, 2005). If over-dispersion arises, the real variance of the sample can be underestimated, and both supervisors and risk managers should be aware of the potential implications of such phenomenon on the capital adequacy requirements (CARs). Since this topic has received little attention in the financial literature our main contribution is to identify and quantify the potential impact of the so called extra-Poisson variance into the regulatory capital.

Lindsey (1995) proposes the application of the *Variance-to-Mean* ratio as an indicator of the potential extra Poisson variance. It can be defined as follows: $VtM = \sigma^2/\mu$. If equi-dispersion holds, this ratio should be equal to one. Potential deviations from this value would imply that the empirical distribution does not follow the Poisson model; that is, if the ratio is higher than one that implies the existence of over-dispersion – or under-dispersion, on the contrary. Depending on the magnitude of the ratio, the presence or such effects will be more evident. In this sense, Cameron and Trivedi (1998) state that: "*If the sample variance is more than twice the sample mean, then data are likely to remain over-dispersed*". Haisley, Mostafa, and Loewenstein (2008) and Lundborg and Lindgren (2004) reject the use of Poisson,

[1] The Group of 20 Finance Ministers and Central Bank Governors representing the 20 major economies: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, United States and the European Union.