

Operational risk [☆]

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Received 25 January 2007; accepted 19 June 2007
Available online 14 September 2007

Abstract

This paper provides an economic and mathematical characterization of operational risk useful for clarifying the issues related to estimation and the determination of economic capital. The insights for this characterization originate in the corporate finance literature. Operational risk is subdivided into two types, either: (i) the risk of a loss due to the firm's operating technology, or (ii) the risk of a loss due to agency costs. These two types of operational risks generate loss processes with different economic characteristics. We argue that the current methodology for the determination of economic capital for operational risk is overstated. It is biased high because the computation omits the bank's net present value (NPV) generating process. We also show that although it is conceptually possible to estimate the operational risk processes' parameters using only market prices, the non-observability of the firm's value makes this an unlikely possibility, except in rare cases. Instead, we argue that data internal to the firm, in conjunction with standard hazard rate estimation procedures, provides a more fruitful alternative.

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JEL classification: G21; G28; G13

Keywords: Operational risk; Net present value; Basel II; Agency costs

1. Introduction

Risk management concerns the investigation of four significant risks of a loss to a firm or portfolio: market risk, credit risk, liquidity risk, and operational risk (see [Jarrow and Turnbull, 2000](#), p. 587). Market risk includes the risk of a loss due to unanticipated price movements in financial securities or asset values, and it includes price fluctuations due to either equities, interest rates, commodities, or foreign currencies. Credit risk is the risk of a loss due to default, and liquidity risk is the risk of a loss due to the inability to liquidate an asset or financial position at a reasonable price in a reasonable time period. And, according

to the revised Basel Committee revised report ([Basel Committee on Banking Supervision, 2005](#)) "operational risk is defined as the risk of loss resulting from the inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk". Furthermore, "legal risk includes, but is not limited to, exposure to fines, penalties, or punitive damages resulting from supervisory actions, as well as private settlements".

The existing literature on operational risk almost exclusively focuses on two issues: one, the estimation of operational risk loss processes using either extreme value theory or Cox processes, (see [Chavez-Demoulin et al., 2006](#); [Coleman, 2003](#); [de Fontnouvelle et al., 2004](#); [de Fontnouvelle et al., 2005](#); [Ebnother et al., 2001](#); [Embrechts and Puccetti, forthcoming](#); [Jang, 2004](#); [Moscadelli, 2004](#); [Lindskog and McNeil, 2003](#); [Chavez-Demoulin et al., 2006](#)) and two, the application of these estimates to the determination of economic capital, (see [de Fontnouvelle et al., 2004](#); [de Fontnouvelle et al., 2005](#); [Moscadelli,](#)

[☆] This paper was reviewed and accepted while Prof. Giorgio Szego was the Managing Editor of *The Journal of Banking and Finance* and by the past Editorial Board.

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2004). In the estimation of economic capital for operational risk, the estimates appear to be quite large, in fact, at least as large as that necessary to cover market risk. The magnitude of the necessary capital for operational risk is a surprising result.

As evidenced by these references, the modeling and estimation of operational risk is treated identically to market and credit risk, i.e., a loss process is modeled and estimated. However, this is where the similarity ends. Unlike market and credit risk, which are external to the firm in their origin, operational risk is internal to the firm. Although this asymmetry between external and internal risk generation is well known, the implications of this asymmetry for either: (i) the pricing of financial securities within the firm, or (ii) the determination of economic capital, is not. The purpose of this paper is study these implications.

We argue that the current methodology for the determination of economic capital for operational risk is overstated. It is biased high because the computation omits the bank's net present value (NPV) generating process. In fact, based on standard economic reasoning, we argue that the NPV process itself provides sufficient capital to at least cover the *expected* operational risk losses. Thus, additional economic capital is only needed to cover *unexpected* operational risk losses. The magnitude of the unexpected operational risk losses are potentially significantly less.

To make these arguments, we must step back and revisit the notion of operational risk from a more holistic perspective. In this regard, we generate an economic and mathematical characterization of operational risk, useful for clarifying the issues related to estimation and the determination of economic capital. Our economic characterization is based on insights from the corporate finance literature. The mathematical characterization, as in the existing literature, is analogous to that employed in the credit risk literature. Estimation of the model's parameters is discussed, but its implementation is left for subsequent research.

Our economic characterization partitions operational risk into one of two fundamental types, either: (i) the risk of a loss due to the firm's operating technology/system, including failed internal processes and transactions, or (ii) the risk of a loss due to agency costs, including fraud and mismanagement.¹ These two types of operational risks are generated by different economic considerations. One is based on the production/trading process/system generating revenues, the other is based on managerial incentives. As such, they will have different economic characteristics.

Our mathematical characterization for both of these operational risks is similar to the modeling of default risk

in the reduced form credit risk literature. This mathematical characterization leads to the generation of simple valuation formulas for pricing (and hedging) financial securities. These valuation formulas are firm specific, akin to standard net present value calculations often discussed in the selection of investment projects in capital budgeting.

This mathematical characterization also provides insights into the estimation of operational risk losses. We show that although it is conceptually possible to estimate the operational risk processes' parameters using only market prices, the non-observability of the firm's value makes this an unlikely possibility, except in rare cases. Instead, we argue that given data internal to the firm and databases of collections of internal data across many firms, standard hazard rate estimation procedures provide a more fruitful alternative. Only the agency cost component can possibly be estimated using data external to the firm's operating system.

An outline of this paper is as follows: Section 2 provides the economic based definition. Section 3 provides a simple, yet robust mathematical characterization of the operational event risk processes. Section 4 discusses estimation, and Section 5 concludes.

2. The definition

This section provides our economic and mathematical characterization of operational risk. Based on the standard definition, we divide operational risk into two types. Type one corresponds to the risk of a loss due to the firm's operating *system*, i.e., a failure in a transaction or investment, either due to an error in the back office (or production) process or due to legal considerations. And, type two corresponds to the risk of a loss due to *incentives*, including both fraud and mismanagement.² The second type of operational risk represents an agency cost, due to the separation of a firm's ownership and management. Agency costs are recognized as a significant force in economics, and they have received significant study in the corporate finance literature as key determinants of the firm's capital structure and dividend policy (see Brealey and Myers, 2004). Both types of operational risk losses occur with repeated regularity, and they can be small or catastrophic. Spectacular catastrophic examples include Orange County, the Barings bank failure, or the bankers trust and Procter and Gamble fiasco (see Risk Books, 2003). Of course, both the system and agency type operational risks can be further subdivided into event type and business line categories as detailed in the revised Basel II report (Basel Committee on Banking Supervision, 2005) and discussed in Section 4. For the moment, however, to keep the logic simple we will confine our discussion to this coarser partitioning.

¹ Of course, each of these two types of operational risk can be divided into subcategories, for example, system risk can be divided into business lines (corporate finance, sales and trading, retail banking, commercial banking, payments and settlement, agency services, asset management, retail brokerage) and agency risk can be divided into fraud and production related factors (see Section 4).

² There is some ambiguity with respect to the classification of human error. If the human error is due to misaligned incentives, then it should be included in the agency operational risk category. Otherwise, it is system related risk.

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