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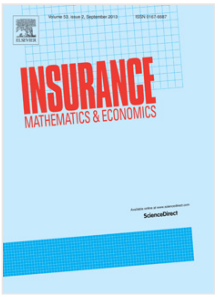

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The Age Pattern of Transitory Mortality Jumps and Its Impact on the Pricing of Catastrophic Mortality Bonds

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Abstract

To value catastrophic mortality bonds, a number of stochastic mortality models with transitory jump effects have been proposed. Rather than modeling the age pattern of jump effects explicitly, most of the existing models assume that the distributions of jump effects and general mortality improvements across ages are identical. Nevertheless, this assumption does not seem to be in line with what we observe from historical data. In this paper, we address this problem by introducing a Lee-Carter variant that captures the age pattern of mortality jumps by a distinct collection of parameters. The model variant is then further generalized to permit the age pattern of jump effects to vary randomly. We illustrate the two proposed models with mortality data from the United States and English and Welsh populations, and use them to value hypothetical mortality bonds with similar specifications to the Atlas IX Capital Class B note that was launched in 2013. It is found that the features we consider have a significant impact on the estimated prices.

Keywords: Risk-neutral valuation; Securitization; The Lee-Carter model

1 Introduction

The dynamics of human mortality over time are subject to short-term jumps. These jumps may be caused by influenza pandemics, most notably the Spanish flu in 1918-20 that is estimated to have infected 50% of the world's population and led to a total mortality of 40-50 million (Crosby 1976). More recently, the Asian flu in 1957-8 is believed to have killed approximately 1 million persons in total (Dauer and Serfling, 1961; Pyle, 1986; Potter, 2001). It is reasonable to assume that similar influenza pandemics will occur in future, because there is an unlimited reservoir of influenza subtypes. Also, for reasons such as interspecies transmission, intraspecies variation and altered virulence, the timings and severities of future pandemics (and hence mortality jumps) are unpredictable (Cox et al., 2003; Webster et al., 1997).

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