Longevity Risk and Economic Growth

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March 15, 2012

Abstract

In response to the increasing role of longevity risk and the demand for more accurate projections of future mortality rates, a vast literature on stochastic mortality modeling has been produced during the recent decade. On the one hand, most of the models focus on the extrapolation of past mortality trends and summarizes the trends by a number of latent factors. In general, each latent factor summarizes a trend in mortality rates along some dimension (for example, time, cohort). However, how these trends will behave in the future is hard to determine, as long as it is not fully understood what kind of forces are behind them. On the other hand, it is still difficult to explain mortality dynamics by identifying and measuring all revelent so-called risk factors. By direct comparisons between the latent factor in the well-known Lee-Carter model and a potential related observable factor, namely economic growth, this paper serves as an intermediate step between the extrapolation and explanation methods. Furthermore, we propose and investigate an extended version of the Lee-Carter model that incorporates both extrapolation and explanation elements.

Using U.S. data, the first part of this paper compares the latent factor of the Lee-Carter model with real GDP. We separately fit the historical log central death rates at each age by a latent factor and the observed GDP series, for both males and

females. The results indicate that the two variables explain a similar amount of variations in mortality for most ages. We further apply a cointegration analysis to investigate possible long-run relationships between mortality rates, the latent factor and real GDP, the results of which are mixed. However, for the latent factor and observable factor, we still cannot distinguish one from the other in terms of their cointegration test results on historical mortality rates.

Secondly, we propose a stochastic mortality model that includes both latent and observable factors in the Lee-Carter framework, which aims at better interpreting and predicting the mortality dynamics. We estimate our model using U.S data and make projections of life expectancies. The standard Lee-Carter model is also estimated and forecasted as a comparison. We find hat our model has a better performance, evidenced by information criteria and residual plots. Moreover, although our model and the Lee-Carter approach have very similar forecast means, the former allows for more interpretable scenario analysis. Finally, by means of a nonparametric analysis, we show that the linear trend in the latent factor is mostly captured by real GDP, although some non-random variations remaines, possibly caused by nonlinear relationship.

The findings in this paper can generate new insights in the prevailing extrapolative mortality forecast models, stimulating further developments of methods with more interpretable components.

Keywords: longevity risk, economic growth, Lee-Carter model

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