Building blocks for a mortality index in an international context

Tiziana Torri*

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Life expectancy has been increasing in all industrialized countries for many decades. The risk associated with mortality improvements is financially material for pension funds and annuity providers. Caused by reduced financial returns, the increased capital impact of the longevity risk induced to search for innovative solutions to hedge the risk. The need is emphasized by the inability of reinsurance markets to diversify the risk. With this regard, securitization is a promising solution for transferring the longevity risk. From 2004, when the first transaction on longevity risk took place with the EIB/BNP bond, progresses have been made in developing a market in mortality-linked securities and derivatives. The scarce success of the EIB/BNP bond led to outline desirable requirements of mortality-linked securities for the successive issues. Consequently, transparent and reliable set of mortality indexes has been proposed. Biffis and Blake (2009) reviewed mortality indexes used for evaluating liability-based longevity risk. These indexes are also used as basis for financial instruments. The Longevity Index proposed in 2005 by Credit Suisse and the Xpect-Indices launched by the Deutsche Börse in 2008 are both based on life expectancy.

In order to obtain reliable assessments of future values for the mentioned mortality indexes is necessary to forecast life expectancy using suitable statistical tools. Specifically, we initially apply the univariate autoregressive integrated moving average (ARIMA) model to the time series of life expectancy, for each country separately. A generalization of the ARIMA model that captures both the short-run and the intergroup dynamics of mortality is also employed. Here, I propose a joint modeling and forecasting of life expectancy for a number of countries, by sex. This approach provide stochastic future values of life expectancy, at different ages and for different countries, as the starting points for creating more sophisticated mortality index. National mortality trends are thus analyzed in an international context. In particular, a cointegration analysis is used to test for the presence of a trend common to more than one country. The existence of a common trend forces the series to move together in the long run. If two or more series are cointegrated, an error correction model exists and it is used to forecast the series (Engle and Granger, 1987). The error correction model is simply a vector autoregressive (VAR) model in first-differences with lagged error correction terms included in each equation of the model. A VAR model consists in regressing each current variable in the model on all the variables in the model lagged a certain number of times.

Comparison between the univariate and multivariate case will be carried out. Preliminary results on Italian, French, and US data show better performance of the multivariate model. Cross-validation, i.e. testing the model over a period where data are known, has been used to assess the performance of the two models. Moreover, an extension of the approach to a larger number of countries is enviable and an attempt to include the parameter uncertainty in the forecasts will also be made.

KEYWORDS: cointegration analysis, forecasting, life expectancy, mortality index.

*Max Planck Institute for Demographic Research, Konrad-Zuse-Strasse 1, 18057 Rostock, Germany; Tel. +49(0)381 2081 150, Fax. +49(0)381 2081 450; email: torri@demogr.mpg.de