

Analysis on mortality cohort effect of birth year in view of differential geometry and its application

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Abstract

This paper analyzes mortality cohort effect of birth year. We have promoted an approach to identify and measure cohort effects in mortality data set based on differential geometry. And we also improve its results to avoid small volatilities in series of cohort effect. The approach leads to an explicit result which can describe how strong the cohort effect is in any generation. The peaks on the series of cohort effect mean the existence of cohort effects and the height of the peaks tells us the strength of the corresponding effects. All the resulting series show the desired strength of cohort effects in different generations. This quantitative measurement provides a possibility to compare cohort effects among different countries or groups. And so we got all the series of cohort effect of 31 countries, which showed the distinct 'demographic map'. And we also analyze the impacts and their dependence. In the paper, we introduced the aggregating index of cohort effect (AICE) which is a general description of cohort effect for the whole population of a country or group. And a concept called global curvature from the differential geometry was used to achieve this target.

There are two potential ways to use the series of cohort effect in capital market or insurance market. One way is to use dependence of series of different countries to construct stable longevity bond. The other way is to hedge among different generation by utilizing series of cohort effect.

As a detailed result we got, our model gives the cohort effect series of U.K. The left figure in Figure 2 gives the cohort effect series of U.K. which just comes up to our expectations. And the right figure in Figure 2 which comes from Willets¹ uses a three-dimensional block graph to show cohort effect of U.K. intuitively. The two graphs above both give the conclusion that the generations (of both sexes) who born approximately between 1925 and 1945 have experienced more rapid mortality changing. Moreover, more detailed information about cohort effect could be seen intuitively in our result.

Keywords: Mortality, mortality Cohort Effect, Cohort Effect Measurement, Normal Vector, Normal Curvature

¹R.C. Willets, The cohort effect: insights and explanations, 2004, Page 2

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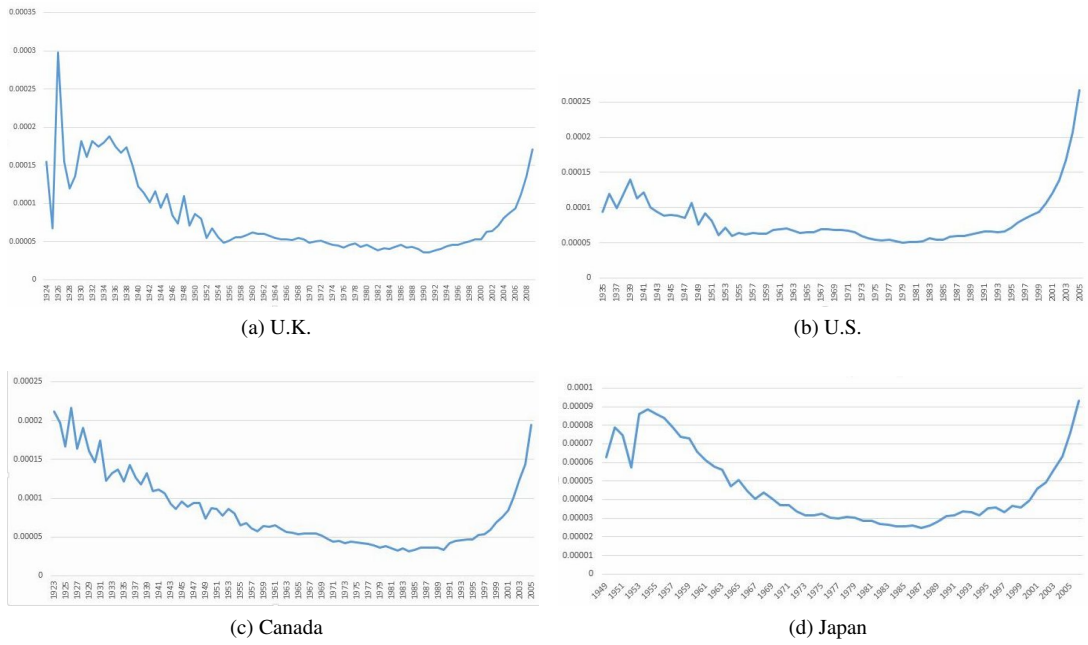


Figure 1: Curves of cohort effect

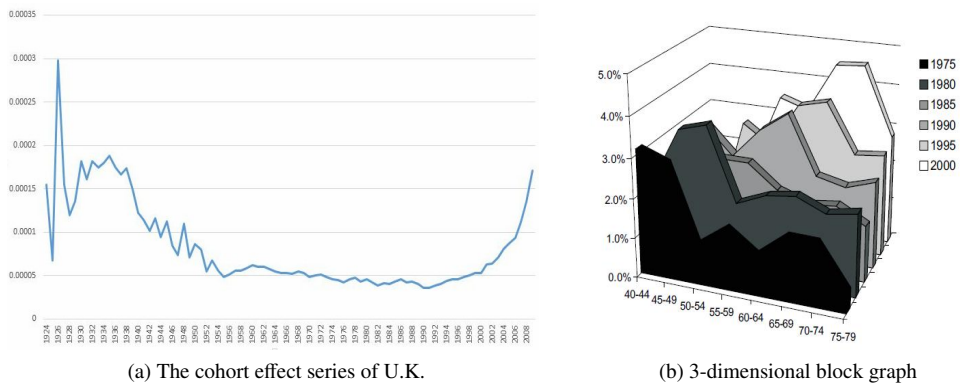


Figure 2: The cohort effect of U.K.