ABSTRACT OF PROPOSED PAPER FOR PAA, 2004

"Forecasting Best-Practice Life Expectancy to Forecast National Life Expectancy"

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Historical trends in mortality in a country are often studied based on data for that country alone and for the two sexes separately. Similarly, death rates are generally projected into the future for males and females separately and for a country without reference to other countries. This can be useful, but it is clear that death rates in different countries are correlated with each other and that male and female death rates are also correlated. Biomedical advances, public health practices, environmental and safety regulations, economic growth, educational achievement, behavioral changes, social alterations, etc., spread quickly from country to country and affect both males and females. To understand historical patterns of mortality reduction and to forecast future patterns, much can be learned by studying the patterns in aggregate, international context, albeit with emphasis on the countries at or not too far from the leading edge of the frontier of survival.

A major advance in mortality forecasting over the past decade or so has been the development of methods of stochastic forecasting. The next major advance is likely to be the development of methods to base forecasts for a particular country (and sex) on trends in other countries (and the other sex). In any case, our major purpose in writing and presenting the proposed paper is to develop methods for putting life expectancy forecasting in international context, so that correlations among countries (and between males and females) can be analyzed and taken into account.

Life expectancy for females and males in various developed countries equals or lags behind the best-practice level: the gaps grow and shrink over time. Hence, one strategy for studying life expectancy change is to analyze the pattern of changing gaps. This is what we propose to do. It is complicated to study the correlations among many countries (and the two sexes) in life expectancy over time. Having a

standard—in this case, the best-practice (female) level—facilitates analysis. An alternative kind of standard would be life expectancy in some aggregate population. We decided to focus instead on the record, for three reasons.

- Record life expectancy follows a very linear trend since 1840, whereas the average among the countries we propose to study follows a linear trend only since 1955. Before that year, some countries (especially Japan but also the United States and other countries) rapidly caught up with the best-practice levels of life expectancy. This rapid catch up created nonlinearities in the average for the aggregate of countries. Furthermore, because we intend to make forecasts out to 2100, a time series that only stretches back to 1955 may be inadequate and inappropriate.
- Record life expectancy can be considered to be a measure of how well a population could do under current conditions and knowledge, i.e., at the current stage in Fogel and Costa's (1997) "technophysio evolution". Countries lagging behind the record will tend to move toward it as national conditions improve and knowledge spreads.
- In this proposed paper we want to strive for clear, uncluttered research that emphasizes careful analysis of a selected topic. If other kinds of forecasting research make sense, then this research can be done by others or by us later. The Oeppen-Vaupel (2002) article opened up a new perspective. We have decided to pursue this new perspective.

Specifically, the proposed paper will focus on forecasting best-practice female life expectancy at birth. This task requires fairly sophisticated but now standard and well-understood time series methods. Because the historical trend in record female life expectancy from 1840 to 2000 is so linear, we will be able to forecast the future trend using a simple ARIMA model, with the most appropriate fit probably provided by an ARIMA(1,1,0) model, perhaps an ARIMA(2,1,0) and very probably not anything more complicated. The ARIMA(1,1,0) and ARIMA(2,1,0) models are the models used by Lee, Carter, Tuljapurkar and colleagues for their mortality forecasts, so the general method we propose to use is very similar to theirs. The main difference is that we will forecast female life expectancy whereas they forecast a measure of the general level of female mortality. The linear rise in life expectancy is even more regular than the linear decline in their measure of the level of mortality, so

the degree of uncertainty in our stochastic forecasts will be less than in their forecasts.

In addition, we will base rough forecasts on cruder methods for males and females in the four countries that we propose to consider--the United States, Japan and Germany, the three biggest rich countries, and Sweden, with its long-time series of reliable data and sustained performance as a life-expectancy leader. The general approach we will adopt is illustrated by the following remark in Oeppen and Vaupel's (2002) article: "Life expectancy can be forecast by considering the gap between national performance and the best-practice level. The U.S. disadvantage varied from a decade in 1900 to less than a year in 1950 and about 5 years in 2000. If the trend in record life expectancy continues and if the U.S. disadvantage is between a year and a decade in 2070, then female life expectancy would be between 92.5 and 101.5, considerably higher than the Social Security Administration's forecast of 83.9 years…." That is, for this task we will make some judgements about the likely range of the gap in the future, given the historic record of the gap in the past. Similarly, we will make some judgements about whether the male-female differential will narrow or widen in the four countries. We fully realize that this is unsatisfactory and only an interim stratagem. We intend to try to develop more sophisticated stochastic forecasting methods for the four countries and if we succeed in doing so before the PAA meeting, we will include the results in our presentation.