

Health Expectancy of the Chinese Elderly: Current Trends and Future Projections

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Life Expectancy in China

Substantial and More Rapidly Increase in Life Expectancy in China:

- In China:
 - about 35 Years in the beginning of the 1950s
 - about 71 years by 2000
 - an increase of 8.6 months per year
- In the US:
 - 68 years in 1949
 - 75 years in 1990
 - an increase of only 2.17 months per year
- In best “performing” countries:
 - an increase of 2.9 months per year

Quality of Life

- **But, “increased longevity without quality of life is an empty prize”(WHO, 1997)**

- **Improvement in mortality accompanied with health deterioration is possible, for example:**
 - The US (Crimmins et al., 1997; Ycas, 1987)
 - Canada (Wilkins and Adams, 1983)
 - Japan (Riley, 1990)
 - Australia (Mathers, 1990)

Three Competing Theories

- *Compression of morbidity* (Fries, 1980 and 1989)
 - Delayed onset of chronic diseases & constant life span
 - Increase in both absolute and relative time in health state


- *Expansion of morbidity* (Olshansky et al., 1991; Gruenberg, 1997)
 - Increasing prevalence of morbidity and disability
 - Increased proportion of life in poor health

- *Dynamic equilibrium* (Manton, 1992)
 - Interdependence between mortality and morbidity

Health Expectancy

- **Each theory has its own explanation power**
- **So, estimating the trends in mortality and morbidity becomes an empirical issue (Imai and Soneji, 2007)**
- **The concept of health expectancy (Sanders, 1964)**
 - Takes into account both mortality and morbidity
 - Reflects the multidimensionality of health
 - Extensively used for measuring population health

What is Missing?

- Most research addresses this topic in developed countries
- Differentials in measures of health status
 - Incomparision across countries
 - Inconsistent within nations
- Methodology issue 
 - Sullivan's method
 - Without allowing for stationary assumptions
- Without projections into the future

Purposes & Contributions

- Estimating the health expectancy of the Chinese elderly
 - Why choose China?
 - The Chinese Longitudinal Healthy Longevity Survey (CLHLS)
- Sullivan's method combined with the cohort life table
- Projections of health expectancy

Data & Health Measures

- Mortality Data
- Health Data
- Definitions and Measures of Health

Mortality Data

- **Raw mortality data: age 0-89 in year 1994-2009**
- **Two Challenges with raw data**
 - **Inconsistent statistical methods**
 - **Unavailability of mortality data at advanced ages**
- **Solutions**
 - **Smoothing raw data using B cubic-splines**
 - **Extrapolating mortality rates at advanced ages by the Kannisto model**

$$m_{x,t} = \frac{\alpha_t \cdot \exp(\beta_t x)}{1 + \alpha_t \cdot \exp(\beta_t x)},$$

Which Age Range We Use?

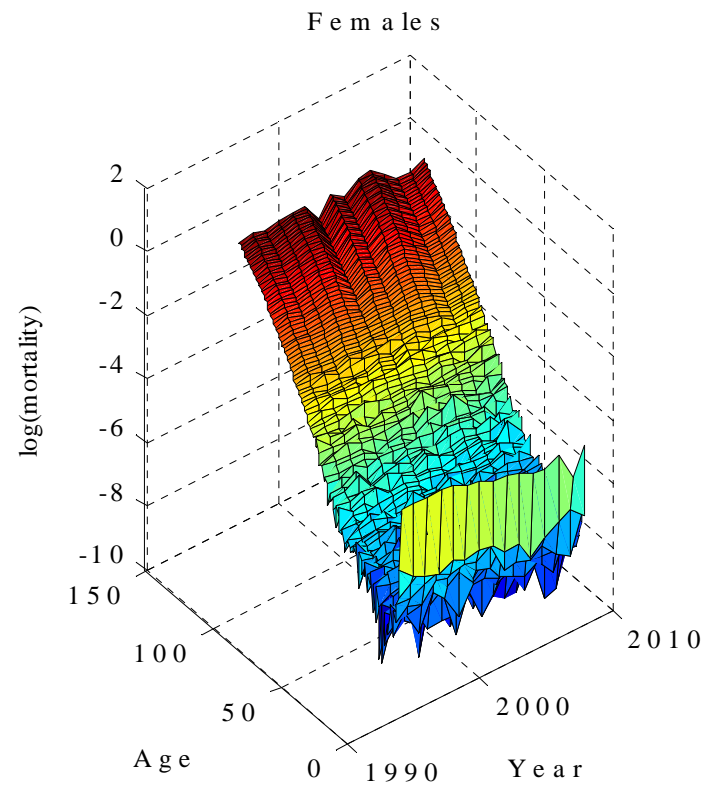
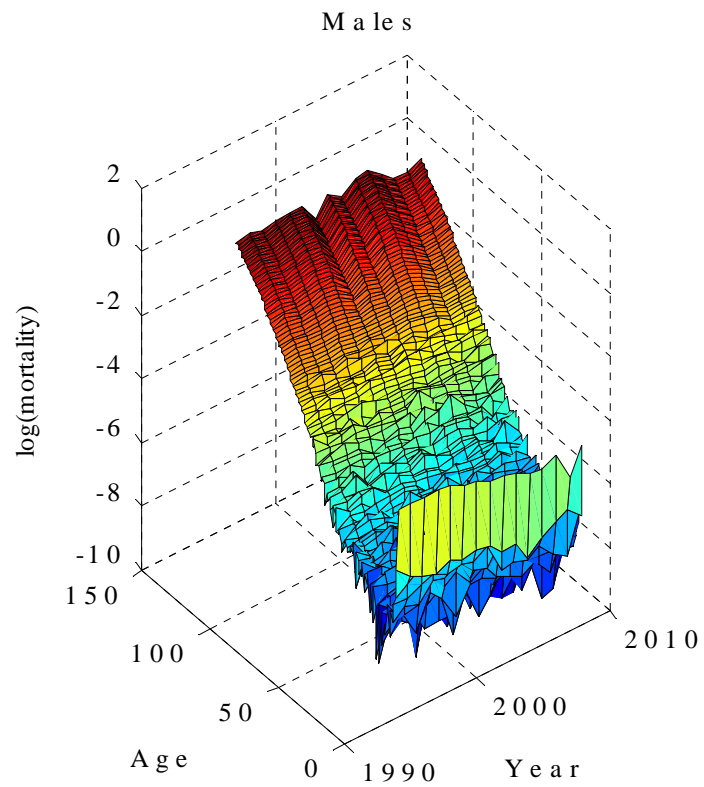
- Determining the lower limit of age range by the *life table ageing rate* (Horiuchi and Cole, 1990)

$$k_{x,t} = \frac{\ln(m_{x,x+5,t}) - \ln(m_{x-5,x,t})}{5},$$

- The lower age limit of our fitting range should be the one at which *life table aging rate* falls off
- So, we fit the realized mortality data from the age of 70 to the maximum age available



Mortality Data: 0-120 & 1994-2009



Health Data: CLHLS

- **The Chinese Longitudinal Healthy Longevity Survey (CLHLS)**
 - First nationally representative and longitudinal survey
 - Covering 22 of China's 31 provinces
 - Accounting for about 85% of the total population
 - Four waves, namely 1998, 2000, 2002, and 2005

Detailed Health Information

- **Self-rate Health Status: Subjective Indicator**
 - *“How do you rate your health at present?”*
 - Answer coded on a 1-6 scale: *“very good”, “good”, “so-so”, “poor”, “very poor”, and “not able to answer”*

- **Activities of Daily Living (ADLs): Objective Indicator**
 - Bathing
 - Dressing
 - Toilet
 - Transfer
 - Continence
 - Feeding

Health Measures: HLE

- **Healthy Life Expectancy based on Self-rated Health**
- **Subjective Measure of Health Expectancy**
- **Expected Life Expectancy in a Self-rated healthy State**
- **Two Definitions:**
 - Wider One: “*very good*”, “*good*”, and “*so-so*”
 - Narrow One: “*very good*”, and “*good*”

Health Measures: DFLE

- **Disability Free Life Expectancy based on Limitations of ADLs**
- **Objective Measure of Health Expectancy**
- **Expected Life Expectancy without Performing the ADLs**
- **Three Definitions:**
 - Severe Disability: three or more limitations
 - Mild Disability: one or two limitations
 - ADLs Active: no limitations

Estimation and Results

- Sullivan's Method
- Cohort Life Table: Lee-Carter Model
- Estimation Results

Sullivan's Method

- **One of the mostly used methods for health expectancy**
- **Based on the combination of the period life table and disability prevalence**
- **Sullivan's estimators proved to be unbiased and consistent of the health expectancy under stationary assumptions**
- **However, are stationary assumptions appropriate in reality?**

An Alternative Sullivan's Method

- Sullivan's method based on a *cohort life table* rather than a *period life table* (Imai and Soneji, 2007)
- No need to take into account stationary assumptions
- Suitable for the consecutive cross-sectional survey

Cohort Life Table

- **Future mortality data are needed**
- **Using the Lee-Carter model (1992) to project future Chinese mortality (see, Melenberg and Zheng, 2010)**
- **Then, derive the cohort life table based on both realized and projected mortality rates**

Estimations Results: Improvement in Health

- **Improvement in Life Expectancy**

- an 80 year-old male: 7.77 years in 1998 to 13.83 years in 2005
- an 80 year-old female: 9.38 years in 1998 to 15.83 years in 2005

- **Also improvement in both the HLE and DFLE**

- For example: an 80 year-old (fe)male

	Male	Female
HLE (n)	4.67 → 6.63	5.15 → 6.74
DFLE (a)	6.22 → 10.85	6.91 → 11.17

Estimations Results: Health Ratio

- **Health Ratio: the Ratio of Health Expectancy to Life Expectancy**
- **With Advancing Age, Health Ratio Decreases**
- **Declining Trends in Health Ratio: Deterioration in Health**

Estimations Results: Sex Differentials

- **In General, Females Enjoy Better Health in Terms of Life Expectancy and Health Expectancy**
- **However, Females Live Smaller of Their Remaining Life in Good Health**
-

Projections on Health Expectancy

- Health index model

$$\text{logit}(I_{x,t}) = \ln\left(\frac{I_{x,t}}{1-I_{x,t}}\right) = \alpha_x + \beta_x K_t^I + \varepsilon_{x,t},$$

$$K_t^I = K_{t-1}^I + C^I + \zeta_t^I$$

Projection Results

- **Again, a positive trend in life expectancy for both gender group**

- **Mixed results of the health expectancy**
 - A declining trend in the HLE and corresponding health ratio
 - A positive trend in the DFLE and corresponding health ratio

- **Sex differentials**
 - Females enjoying a longer HLE and DFLE

Limitations and Further Work

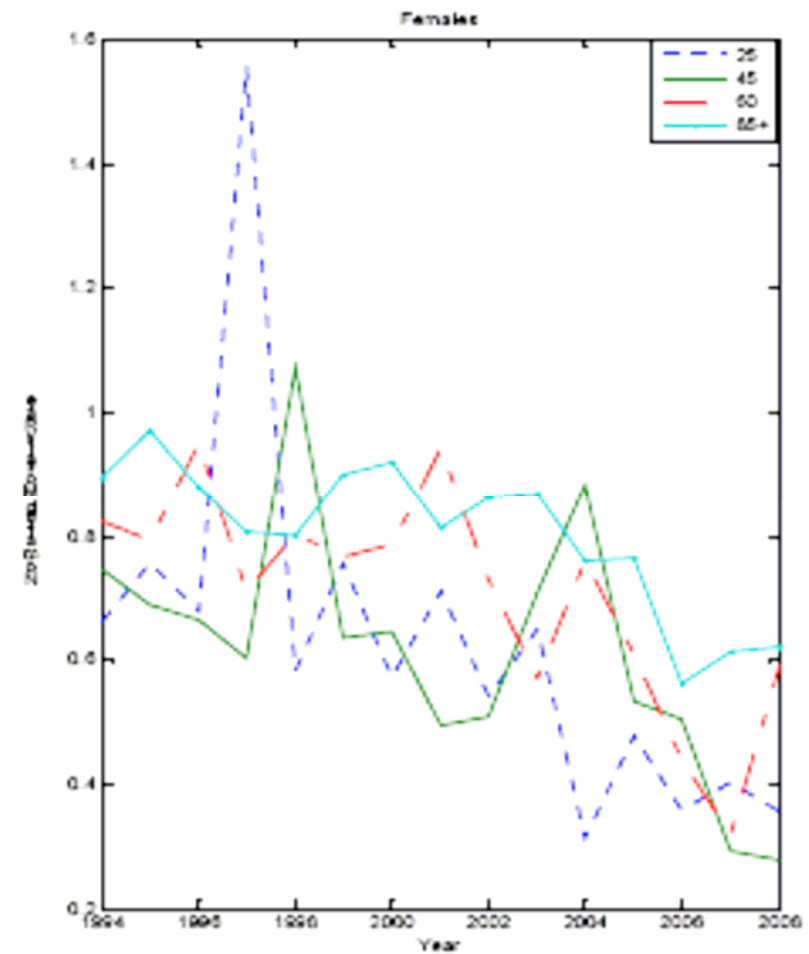
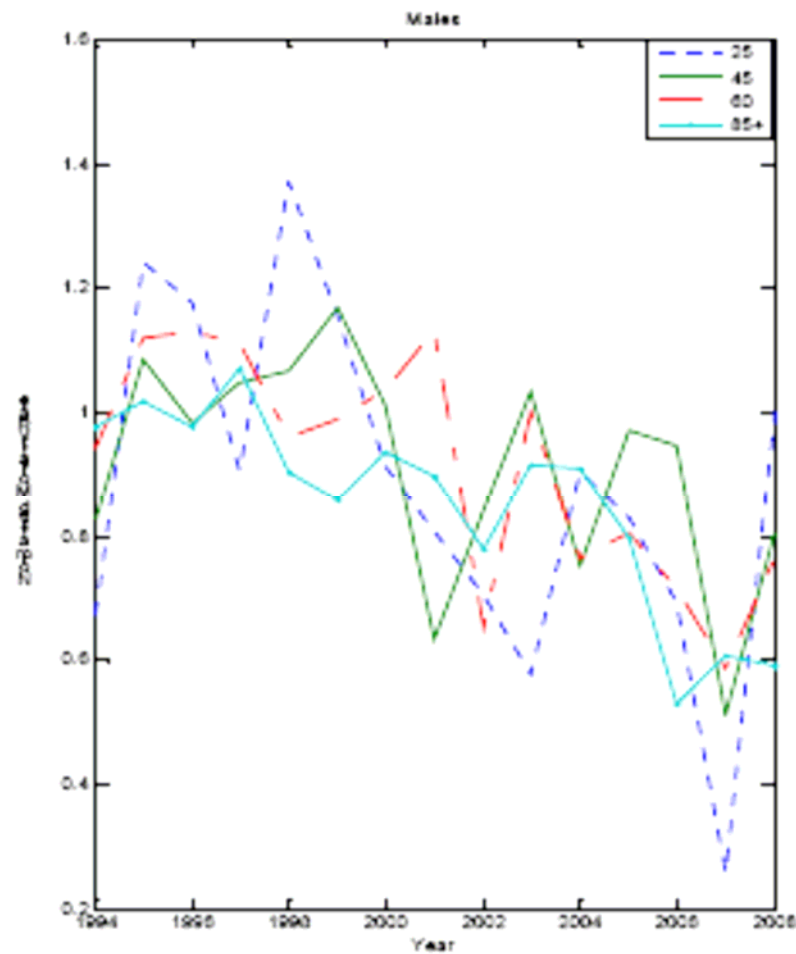
- **This paper is still not perfect so far:**
 - Robust Check
 - Consistent Measure of Health
 - Regional Disparity

- **Next, ???**
 - Policy Making: Retirement Policy, Pension, Medical Insurance etc.
 - Linkage with Macroeconomics: National Saving Rate, Asset Price etc.

Conclusions

- **Improvement in absolute health expectancy over the sample period; but deterioration in terms of relative level**
- **A positive trend in health expectancy in terms of functional capacity in the future; but a declining trend in terms of self-reported health**
- **Possible explanations for these disparities**
 - Social and economic transition
 - Change in family size and structure

Normalized Mortality Rates



Which Age Range?(males)



Panel A: Males															
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
K ₆₀	0.127 (0.089, 0.165)	0.106 (0.097, 0.115)	0.082 (0.053, 0.111)	0.127 (0.098, 0.156)	0.106 (0.074, 0.138)	0.136 (0.104, 0.168)	0.106 (0.105, 0.107)	0.134 (0.101, 0.167)	0.101 (0.071, 0.131)	0.095 (0.063, 0.126)	0.078 (0.048, 0.108)	0.096 (0.087, 0.104)	0.095 (0.062, 0.128)	0.091 (0.057, 0.126)	0.089 (0.057, 0.120)
K ₆₅	0.074 (0.042, 0.106)	0.095 (0.087, 0.103)	0.097 (0.071, 0.122)	0.061 (0.036, 0.085)	0.121 (0.096, 0.147)	0.083 (0.057, 0.109)	0.1 (0.099, 0.101)	0.094 (0.068, 0.121)	0.075 (0.050, 0.101)	0.080 (0.052, 0.107)	0.078 (0.051, 0.106)	0.101 (0.094, 0.109)	0.101 (0.072, 0.131)	0.143 (0.113, 0.173)	0.107 (0.078, 0.136)
K ₇₀	0.108 (0.077, 0.138)	0.098 (0.091, 0.106)	0.106 (0.083, 0.129)	0.099 (0.075, 0.123)	0.093 (0.070, 0.115)	0.096 (0.072, 0.120)	0.109 (0.108, 0.110)	0.095 (0.071, 0.118)	0.126 (0.103, 0.148)	0.126 (0.102, 0.149)	0.114 (0.090, 0.139)	0.101 (0.094, 0.107)	0.103 (0.077, 0.129)	0.094 (0.069, 0.119)	0.088 (0.062, 0.133)
K ₇₅	0.086 (0.055, 0.118)	0.085 (0.077, 0.093)	0.085 (0.061, 0.108)	0.083 (0.059, 0.108)	0.095 (0.072, 0.118)	0.098 (0.074, 0.122)	0.09 (0.089, 0.090)	0.090 (0.066, 0.114)	0.071 (0.049, 0.093)	0.102 (0.079, 0.124)	0.086 (0.063, 0.109)	0.095 (0.089, 0.101)	0.094 (0.070, 0.118)	0.090 (0.067, 0.113)	0.092 (0.069, 0.116)
K ₈₀	0.082 (0.045, 0.118)	0.094 (0.086, 0.103)	0.081 (0.054, 0.108)	0.113 (0.085, 0.141)	0.105 (0.079, 0.131)	0.105 (0.078, 0.132)	0.102 (0.102, 0.103)	0.086 (0.059, 0.114)	0.090 (0.064, 0.115)	0.090 (0.064, 0.115)	0.107 (0.082, 0.133)	0.093 (0.087, 0.100)	0.075 (0.049, 0.102)	0.072 (0.046, 0.098)	0.084 (0.058, 0.109)
K ₈₅	0.083 (0.032, 0.133)	0.075 (0.062, 0.087)	–	0.091 (0.053, 0.129)	0.050 (0.013, 0.088)	0.056 (0.020, 0.093)	0.07 (0.068, 0.071)	0.104 (0.067, 0.140)	0.070 (0.035, 0.106)	0.083 (0.050, 0.117)	0.096 (0.062, 0.129)	0.087 (0.078, 0.096)	0.052 (0.015, 0.089)	0.075 (0.041, 0.108)	0.073 (0.040, 0.106)

Which Age Range? (females)



Panel B: Females															
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
K_{60}	0.085 (0.036, 0.134)	0.093 (0.081, 0.106)	0.106 (0.068, 0.144)	0.128 (0.088, 0.168)	0.114 (0.074, 0.154)	0.083 (0.043, 0.123)	0.109 (0.108, 0.110)	0.178 (0.134, 0.222)	0.145 (0.105, 0.186)	0.075 (0.032, 0.118)	0.099 (0.059, 0.139)	0.109 (0.097, 0.120)	0.119 (0.074, 0.165)	0.083 (0.040, 0.125)	0.136 (0.046, 0.178)
K_{65}	0.089 (0.047, 0.132)	0.110 (0.099, 0.120)	0.094 (0.063, 0.126)	0.114 (0.083, 0.146)	0.088 (0.055, 0.121)	0.117 (0.084, 0.150)	0.102 (0.101, 0.103)	0.084 (0.051, 0.117)	0.102 (0.070, 0.133)	0.159 (0.123, 0.195)	0.089 (0.054, 0.124)	0.105 (0.095, 0.115)	0.119 (0.080, 0.158)	0.135 (0.097, 0.173)	0.102 (0.070, 0.139)
K_{70}	0.140 (0.103, 0.177)	0.116 (0.107, 0.125)	0.1 (0.071, 0.128)	0.1 (0.072, 0.128)	0.111 (0.082, 0.140)	0.096 (0.067, 0.124)	0.116 (0.115, 0.117)	0.111 (0.082, 0.140)	0.081 (0.053, 0.108)	0.101 (0.073, 0.128)	0.118 (0.088, 0.147)	0.109 (0.101, 0.117)	0.104 (0.072, 0.136)	0.107 (0.076, 0.138)	0.127 (0.057, 0.158)
K_{75}	0.087	0.092	0.115	0.087	0.104	0.079	0.098	0.084	0.115	0.096	0.108	0.111	0.093	0.107	0.086
K_{80}	0.118 (0.084, 0.151)	0.105 (0.096, 0.113)	0.082 (0.056, 0.108)	0.111 (0.084, 0.138)	0.093 (0.066, 0.120)	0.133 (0.105, 0.161)	0.112 (0.111, 0.113)	0.092 (0.064, 0.121)	0.087 (0.061, 0.133)	0.127 (0.101, 0.153)	0.096 (0.069, 0.122)	0.103 (0.096, 0.110)	0.106 (0.078, 0.135)	0.081 (0.054, 0.109)	0.100 (0.057, 0.127)
K_{85}	0.057 (0.016, 0.098)	0.080 (0.069, 0.090)	-	0.037 (0.003, 0.072)	0.069 (0.035, 0.102)	0.084 (0.052, 0.116)	0.08 (0.079, 0.081)	0.09 (0.057, 0.123)	0.103 (0.072, 0.134)	0.047 (0.016, 0.078)	0.085 (0.054, 0.116)	0.089 (0.081, 0.097)	0.068 (0.035, 0.101)	0.081 (0.050, 0.113)	0.080 (0.042, 0.111)