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Select Birth Cohorts

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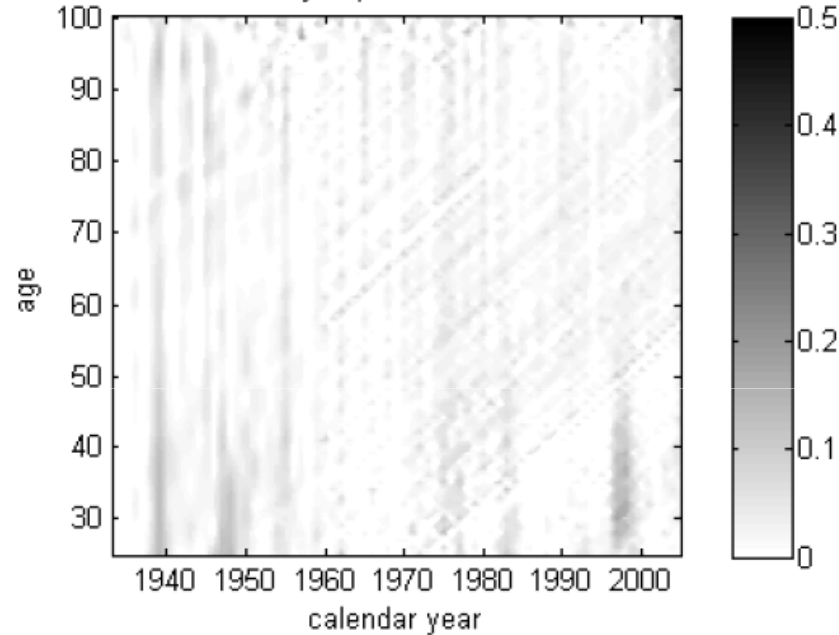
- Introduction: Motivation and Literature Review
- Identifying Select Cohorts
- The Fortunate Generations – Analysis of Historical Data
- Outlook and Summary



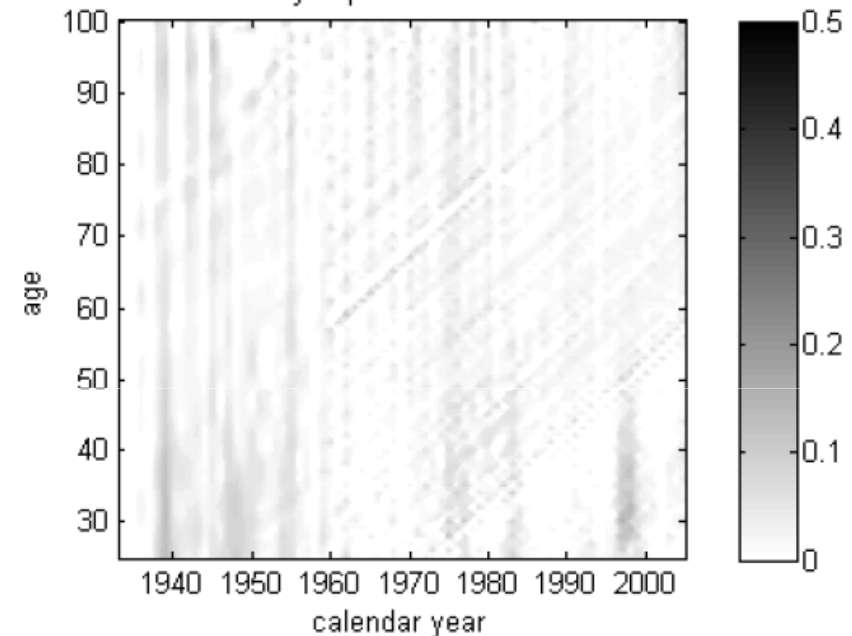
- Common observation for many countries:
 - reduction of death rates (“**mortality improvement**”) (*Wilmoth, 1998*)
 - “**ageing of mortality improvement**” (*Willets et al., 2004*)
- Consequence: increasing life expectancies (“**longevity trend**”) (*Wilmoth, 1998*), i.e. subsequent generations tend to live longer
 - fiscal risk for pension providers; already forced to implement DB → DC transitions, reduced benefits, more conservative pricing
- “Longevity improvements” of particular interest; estimates of cost of pension provision and detection of long-term problems beneficial



Relative rates of mortality improvement - Males - United States



Relative rates of mortality improvement - Females - United States



- Dominance of vertical (“**period effects**”) vs. diagonal patterns (“**cohort effects**”) – not clear which prevail for the US
- A cohort experiencing lower mortality will be quite a shock for a pension system upon retiring – thus of particular interest here



- Straightforward to investigate mortality data in a two-dimensional way – less so which axes to use (age, period, cohort)
- Surprisingly sparse discussion in an insurance context
(*Derrick, 1927; Kermack et al., 1934; Ryder, 1965; Hobcraft et al., 1982*)
 - Tendency for diagonal patterns
 - Cohort perspective more consistent for projections
 - E.g. wars and pandemics have different (persistent) impacts on different ages
- *Richards/Kirkby/Currie (2006)* find that an age-cohort model better explains UK mortality over the past 40 years than age-period models



- *Willets (1999)* identifies stronger mortality improvements in the UK for 1925-1945 generations than adjacent generations
- Reasons for cohort effect include participation in WW hostilities, availability of vaccinations, varying nutrition quality, etc.; driving factor: smoking prevalence (*Willets, 2004*)



- Previous attempt to identify “select” birth cohorts by *Willetts (2004)*
 - **Smoothed** mortality improvement rates tabularized
 - Only “strong” values shown, i.e. if in excess of threshold – determined by comparing different cohorts at **different** ages
- Results fragile to changes in smoothing band (± 2 or ± 1 years vs. ± 4 years), choice of threshold based on comparison of **same** ages
 - Abstain from smoothing procedures
- Suitable to assess impact on public pension systems at one point in time, ill-suited to identify single birth cohorts as “select”
 - Conduct cohort-by-cohort investigation
- Establishing a **formal** criterion almost entirely neglected so far, rather focusing on **graphical** representations
- Several criteria proposed and further analyzed in previous work (*MacMinn et al., 2004*); no criterion could integrate observations



- Define relative mortality improvement rate at age x for cohort z as

$${}^z i_x = 1 - \left(\frac{{}^z m_x - {}^{z-1} m_x}{{}^{z-1} m_x} \right) = 1 - \frac{{}^z m_x}{{}^{z-1} m_x}$$

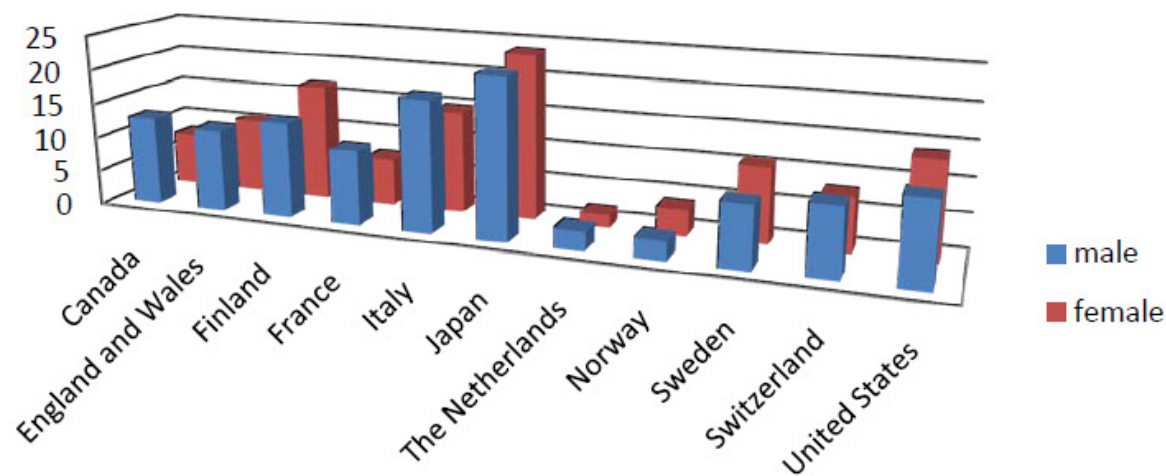
where ${}^z m_x$ central death rate at age x for the cohort born in z

- Cohorts exhibiting **stronger** mortality improvements than adjacent cohorts – **for numerous ages** – are of special interest
- Generation born in year z is a **select cohort** if for k [percent] of ages x mortality improvement rates exceed those of the adjacent cohorts, i.e.

$$\frac{\#\{x \mid {}^z i_x > \max\{{}^{z-1} i_x, {}^{z+1} i_x\}\}}{\#\{x\}} > k$$



- Mortality data taken from HMD (Human Mortality Database)
- Only largest data sets considered due to required age span (25-100 years); only 11 countries suitable – with varying data coverage
- Threshold parameter $k=0.50$ requires significant strength, but number of select cohorts varies greatly – also in their strength





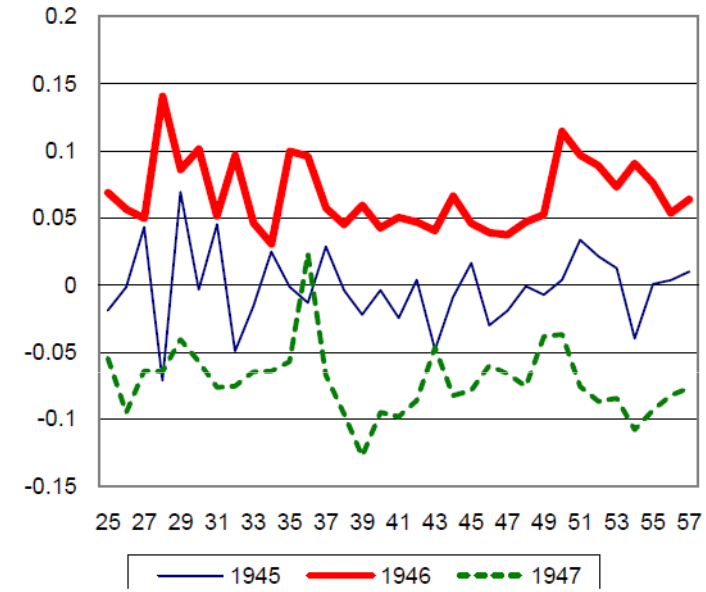
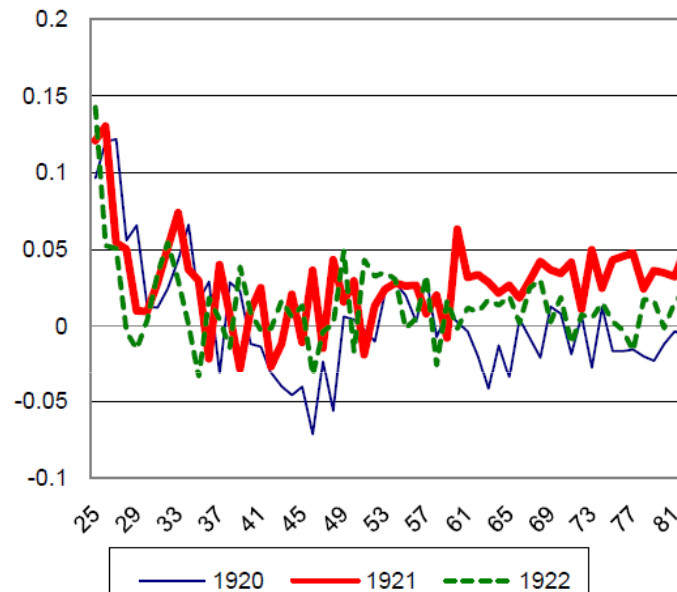
Canada			United States		
M	F	B	M	F	B
1831	1829	1835	1871	1899	1887
1835	1869	1869	1902	1902	1899
1837	1902	1879	1909	1909	1902
1849	1912	1881	1919	1912	1909
1869	1934	1889	1921	1919	1912
1887	1944	1891	1929	1921	1919
1891	1954	1899	1934	1929	1921
1902	1979	1902	1942	1931	1929
1919		1909	1944	1934	1931
1929		1919	1946	1944	1934
1948		1934	1948	1946	1942
1979		1948	1987	1948	1944
1981		1977		1970	1946
		1979		1974	1948
		1981			

Shaded select cohorts determined based on only 11-20 years of age – i.e. tentative select cohort.

- Select birth cohorts do not seem to be correlated across countries nor follow a cyclical pattern.



Relative Rates of Mortality Improvement for U.S. Males

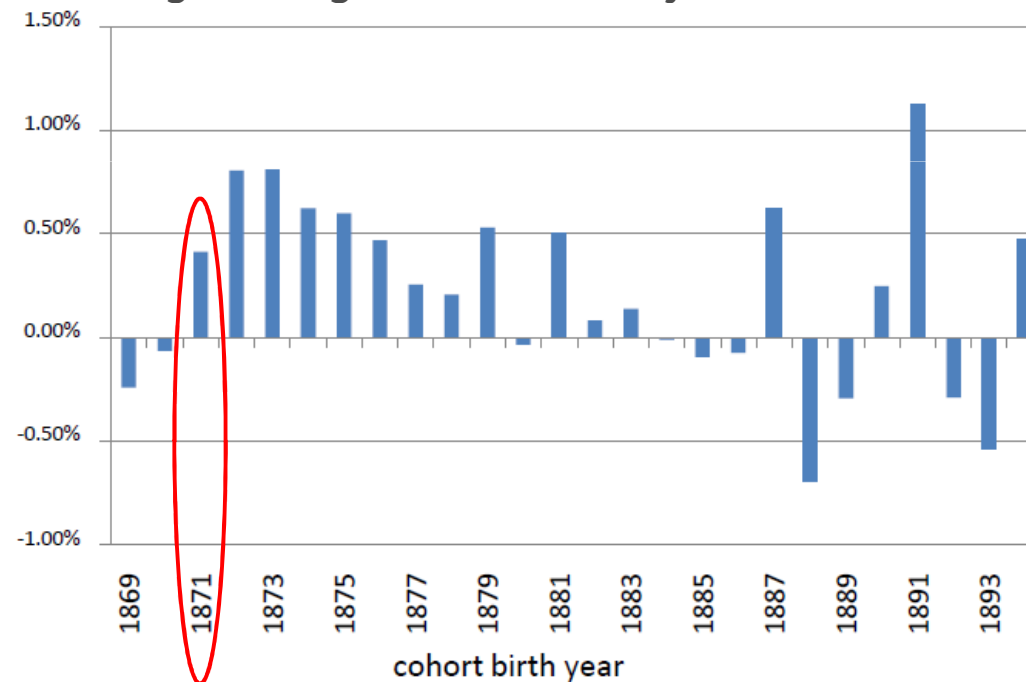


- **Left:** greatest improvements at younger ages, 1921 cohort distinguished by further improvements at higher ages (60+)
- **Right:** 1946 cohort: on average 7% excess improvement (“super” select cohort)



- Predicting extraordinary long lives of special interest for pension providers – preferably long before entering retirement

Percentage Change in Life Annuity Value for U.S. Males





- Dominance of **period/cohort effects varies** across countries
- “Select” birth cohorts **exist** in several countries; **not so common**
- **No** evidence of **correlation** across countries; no **cyclical pattern**
- While measure of **mortality improvement** consistent in the literature, further discussion of **formal select cohort criteria** necessary
- Analysis and **early diagnosis** of (super) select cohorts prudent and possibly value-enhancing for providers as **risk management** option
 - possibly combined with projection of mortality



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