The Actuarial Profession
making financial sense of the future

Emerging Trends in Mortality and Longevity Symposium 2011
Michael Murphy, London School of Economics

Mortality trends in recent decades in Eastern and Western Europe: contrasts, correlates and consequences

13 - 14 September 2011, University of Warwick

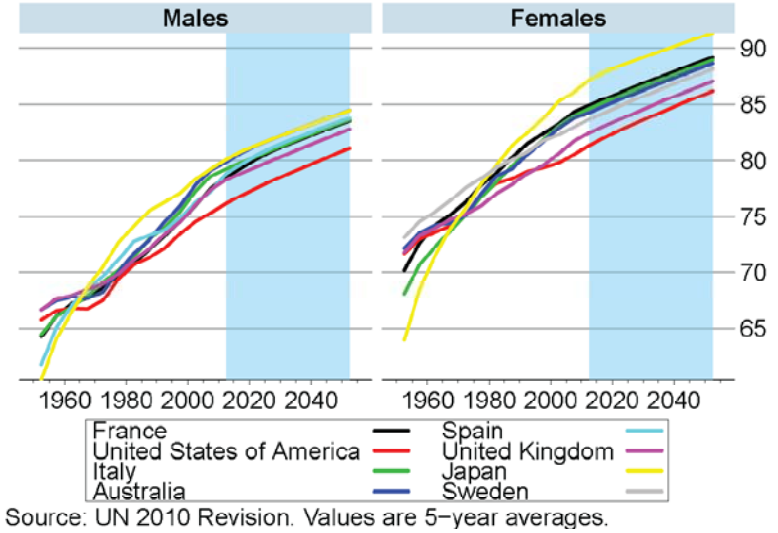
An overview …

- International context
- Main cross-national trends
- Some macro-level correlates
- Sex differentials in mortality
- Changes by age
- Some speculations about the future

Data sources

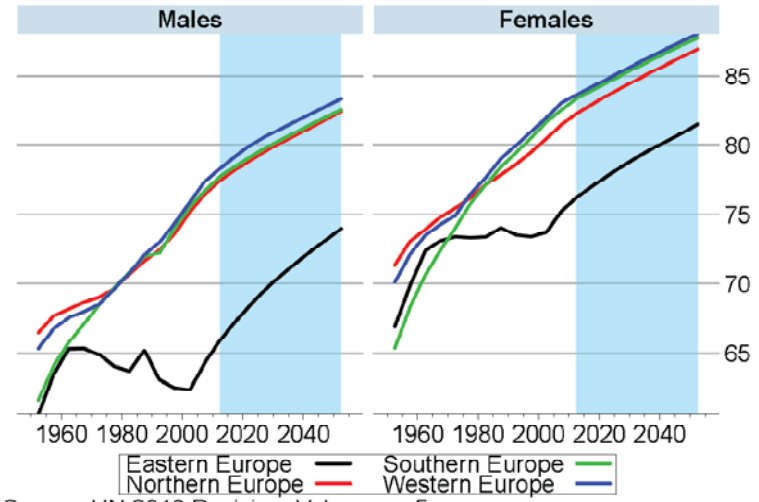
- UN World Population Prospects 2010 (WPP2010) (http://esa.un.org/unpd/wpp/unpp/panel_indicators.htm)
- Human Mortality Database (HMD) (http://www.mortality.org/)
- WHO Europe Health for All Database (WHO-HFA_DB) (http://www.euro.who.int/en/what-we-do/data-and-evidence/databases/european-health-for-all-database-hfa-db2)

Life expectancy at birth 1950-2050 international comparison countries



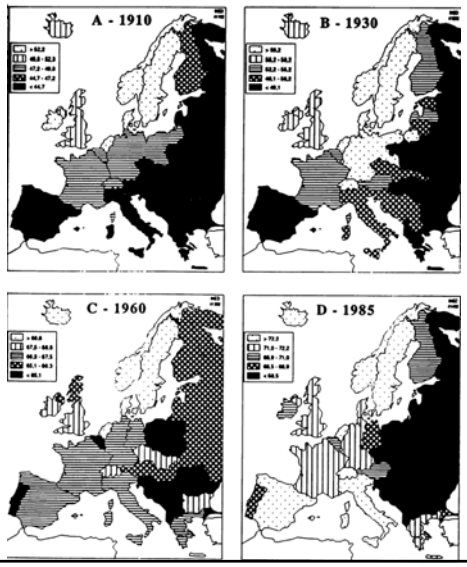
Source: UN 2010 Revision. Values are 5−year averages.

Life expectancy at birth by major area, 1950−2050 (years)



Source: UN 2010 Revision. Values are 5−year averages.

Geographic trends in Mortality, Males 1910-85



A. Scandinavia good, S & E Europe bad

B. Central improves

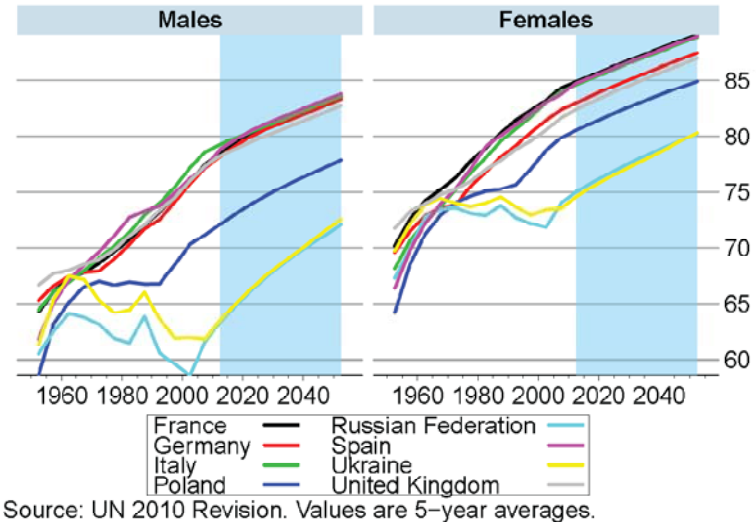
C. East improves

D. More recently

- Mediterranean improves
- Eastern Europe deteriorates

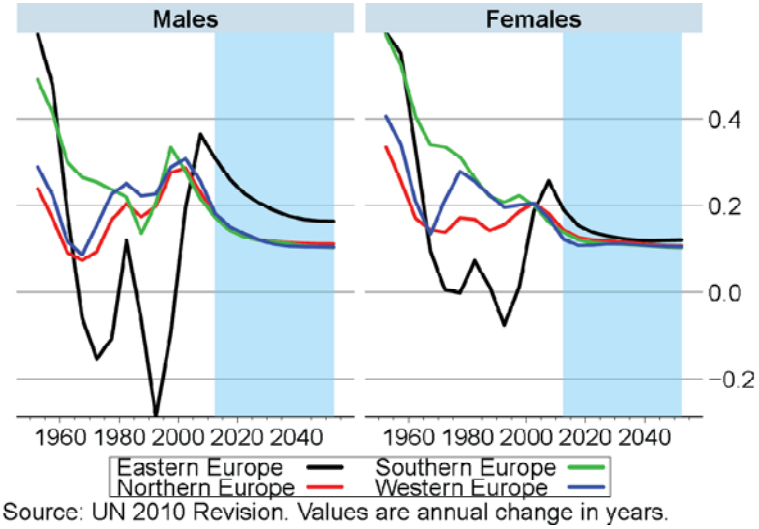
Source: Caselli, G., 1994. Long-term Trends in European Mortality. Studies on Medical and Population Subjects, No. 56. OPCS

Life expectancy at birth 1950-2050 "Big 8" countries



Source: UN 2010 Revision. Values are 5-year averages.

Change in life expectancy (in years) at birth 1950-2050 major European regions



Source: UN 2010 Revision. Values are annual change in years.

Macro-level relationships …

- Does what matters at individual/national-level also matter cross-nationally?

"Social Determinants of Health" (Marmot)

- Social gradient
- Stress
- Early life influences
- Social exclusion
- Unemployment and job insecurity
- Social support
- Addictions
- Inappropriate food
- Transport

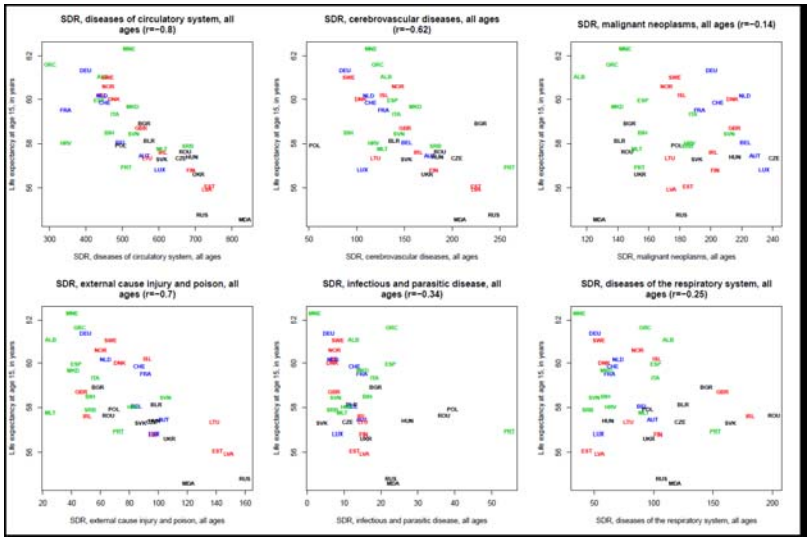
Medical/Public health "risk factors"

- Occupation
- High blood cholesterol
- Hypertension
- Lack of fruit & vegetables
- Overweight and obesity
- Physical inactivity
- Abuse alcohol & illicit drugs
- Tobacco
- Unsafe sex

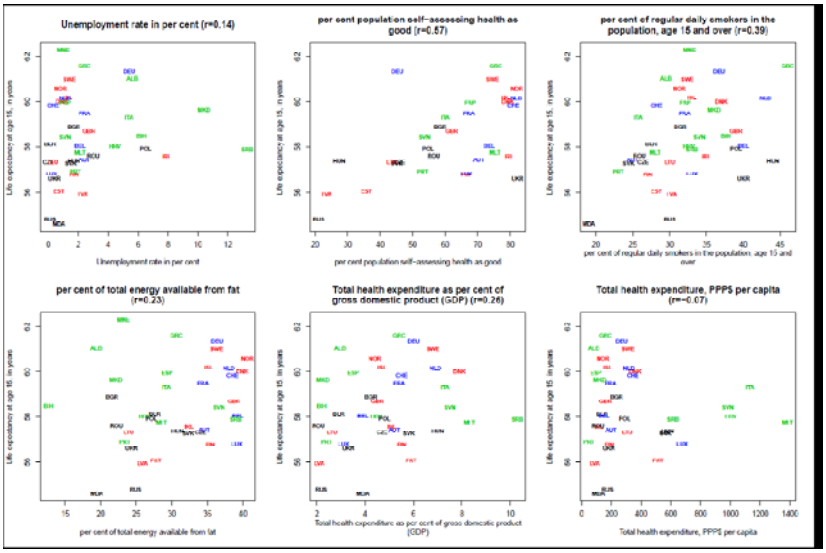
B**ASMRG (2008)**

- **Age**
- **Gender**
- **Medical history**
- **Genetics**
- **Smoking**
- **Diet**
- **Obesity**
- **Occupation/socio-economic class**
- Alcohol consumption
- Regular exercise
- Exposure to stress
- Wealth
- Marital status
- Education

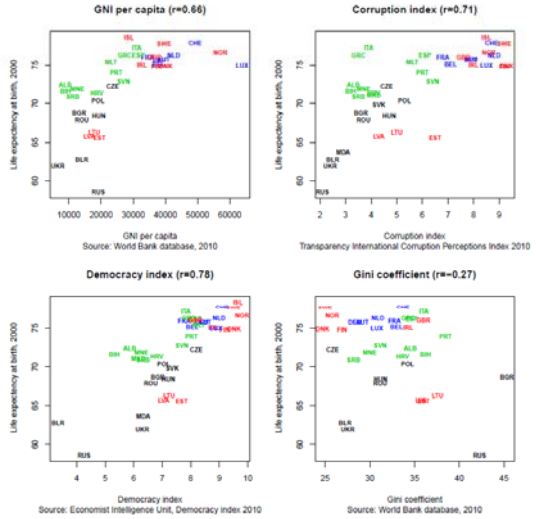
Life expectancy at 15 and macro-level mortality-related indicators, Europe (Source: HFA-DB)



Life expectancy at 15 and macro-level health-related indicators, Europe (Source: HFA-DB)



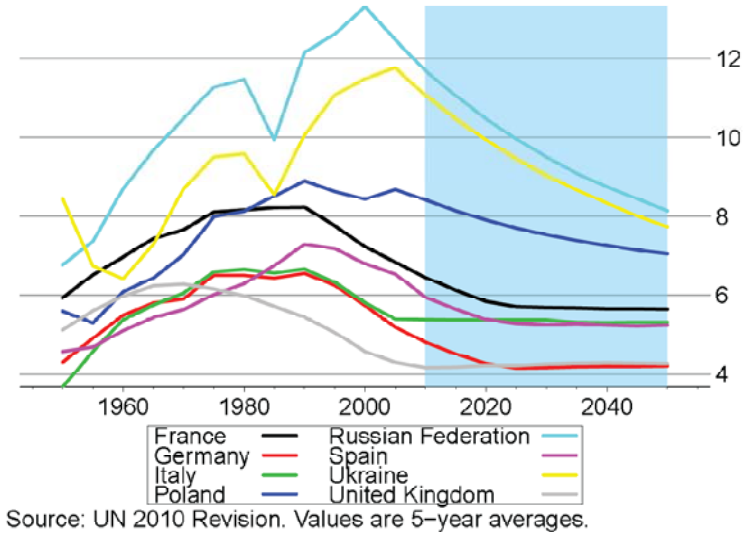
Life expectancy and macro-level socio-political indicators, Europe



Sex differentials in mortality

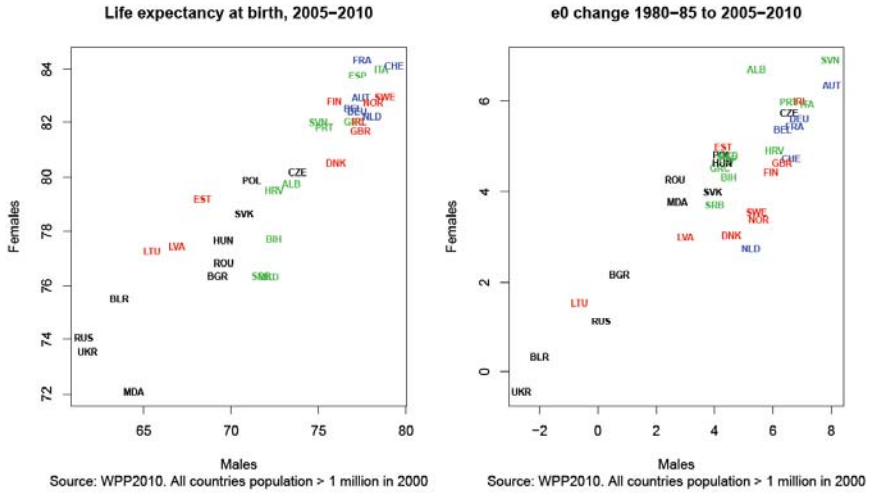
- Trends & differentials

Change in sex differential in life expectancy (in years) at birth 1950-2050 “Big 8” countries



Source: UN 2010 Revision. Values are 5–year averages.

Male-female relationship in:



Source: WPP2010. All countries population > 1 million in 2000

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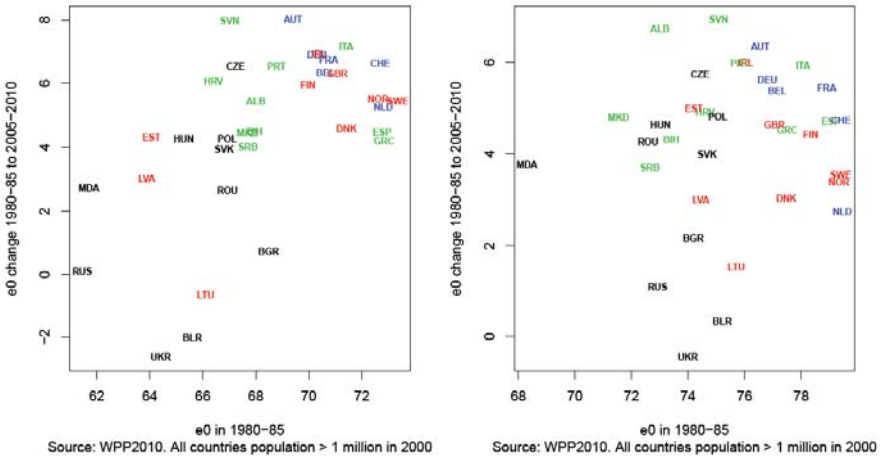
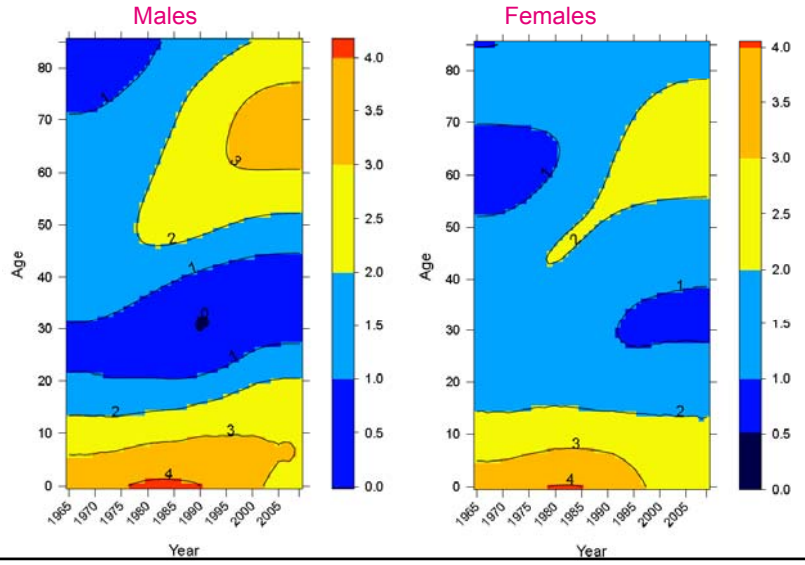
e_0 in 1980-5 & change 1980-5 to 2005-10,
(a) males (b) females



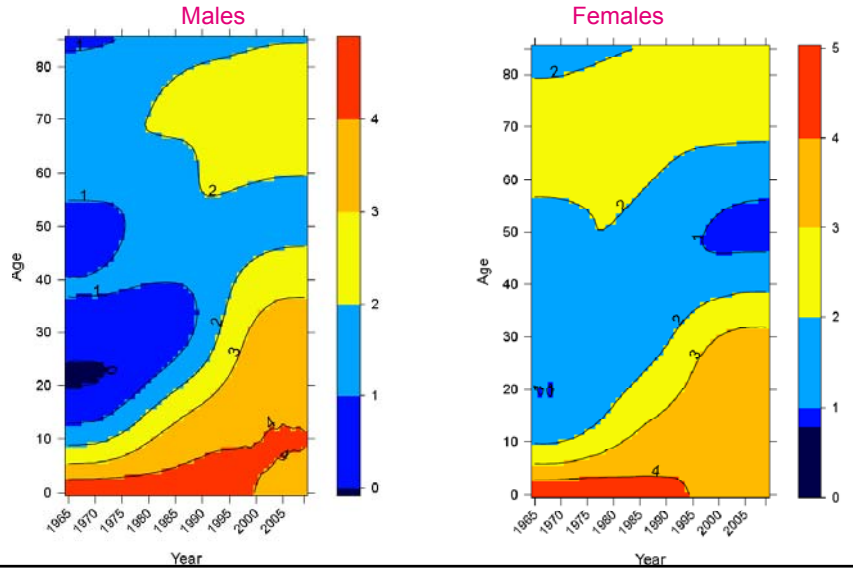
Changes by age …

- Who wins?
- Cohort patterns?
- Derivative-based smoothed mortality surface
- Decomposition of changes in e_0

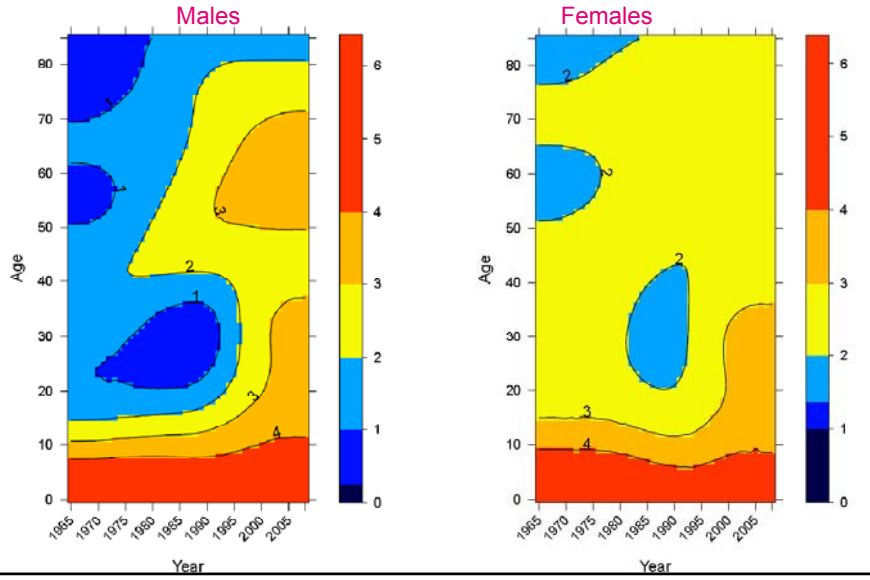
Annual age-specific percentage rate mortality improvement, England and Wales, 1965-2009



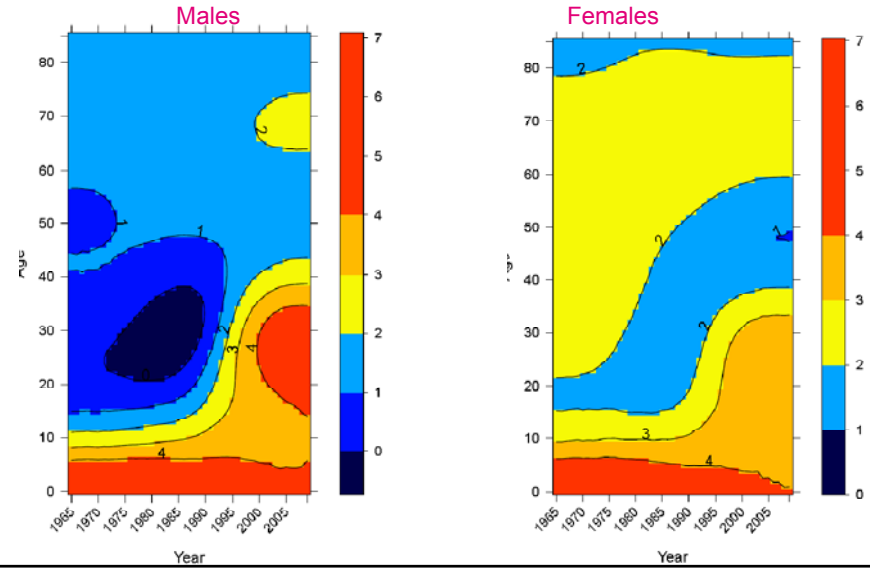
Annual age-specific percentage rate mortality improvement, France, 1965-2009



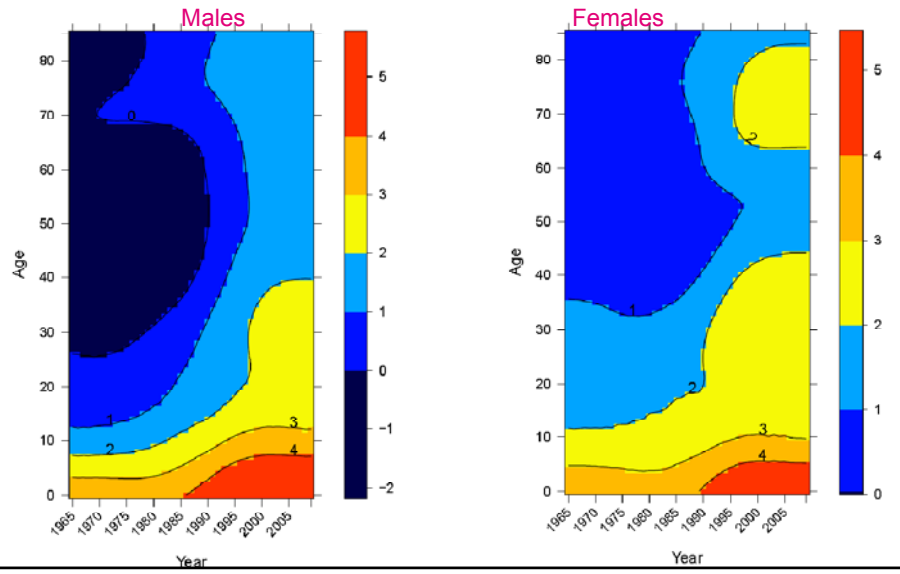
Annual age-specific percentage rate mortality improvement, Italy, 1965-2009



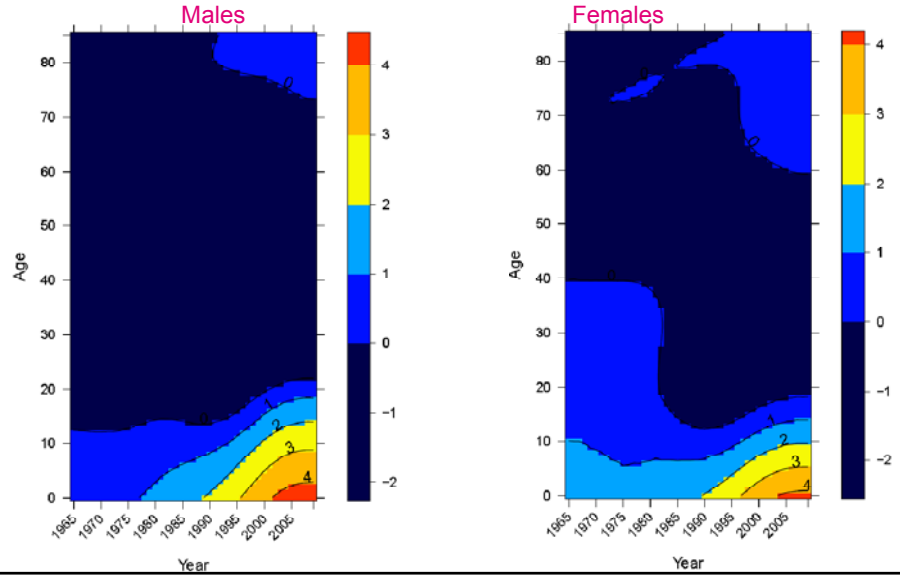
Annual age-specific percentage rate mortality improvement, Spain, 1965-2009



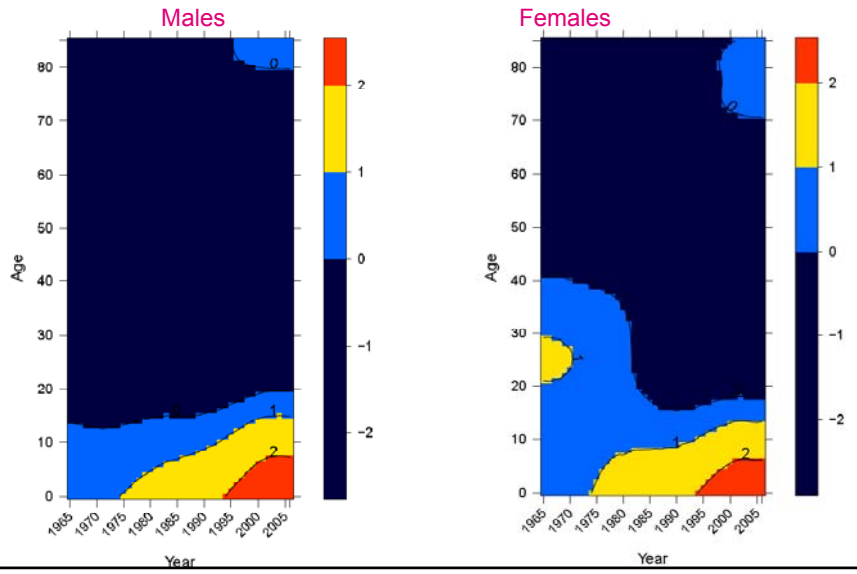
Annual age-specific percentage rate mortality improvement, Poland, 1965-2009



Annual age-specific percentage rate mortality improvement, Russia, 1965-2009



Annual age-specific percentage rate mortality improvement, Ukraine, 1965-2006

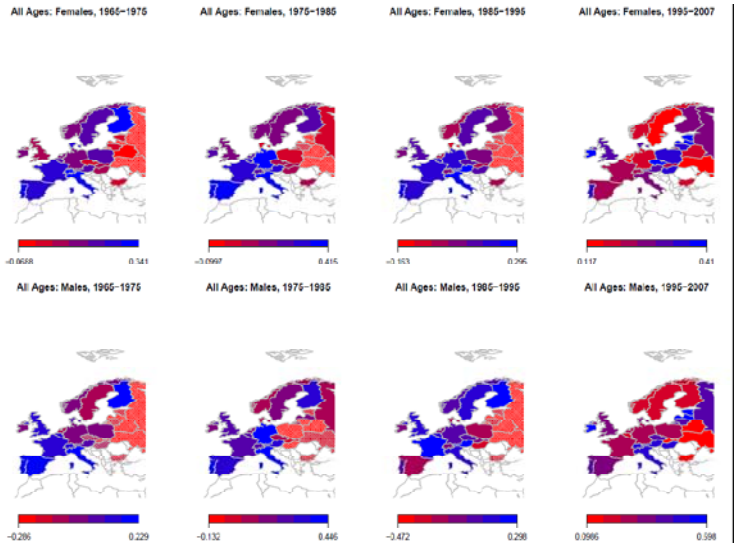


Arriaga (1984) decomposition

- Arriaga's formula decomposes the differences in the expectation of life at birth (e_0^b- e_0^a) for populations *a* and *b* due to differences in age-specific death rates
- The total effect of age interval (x , x + n) consists of a direct effect and an indirect effect
- The direct effect of age interval (x , x + n) is
- $${}_nDE_x = l_x^a\left(\frac{{}_nL_x^b}{l_x^b} - \frac{{}_nL_x^a}{l_x^a}\right)$$
- And the indirect effect is

$${}_nIE_x = \left(l_x^a\frac{l_{x-n}^b}{l_x^b} - l_{x-n}^a\right)e_{x-n}^b$$

Components of period life expectancy change by decade (HMD-based)



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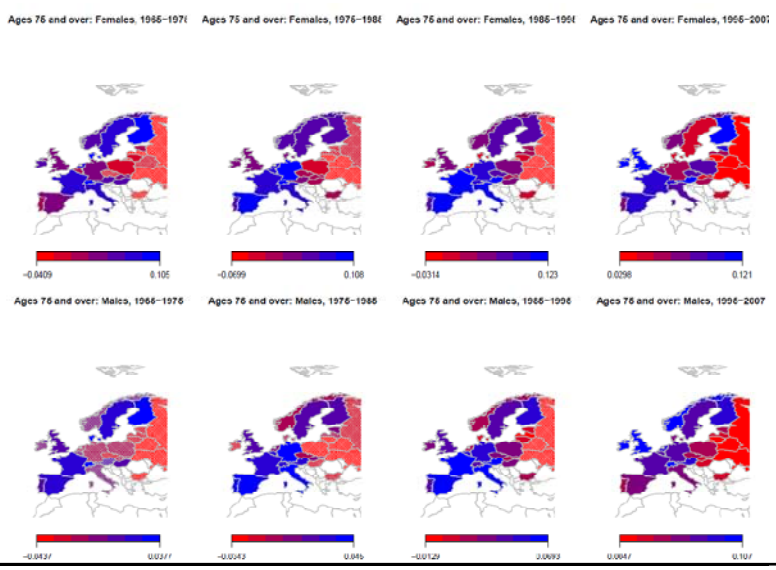

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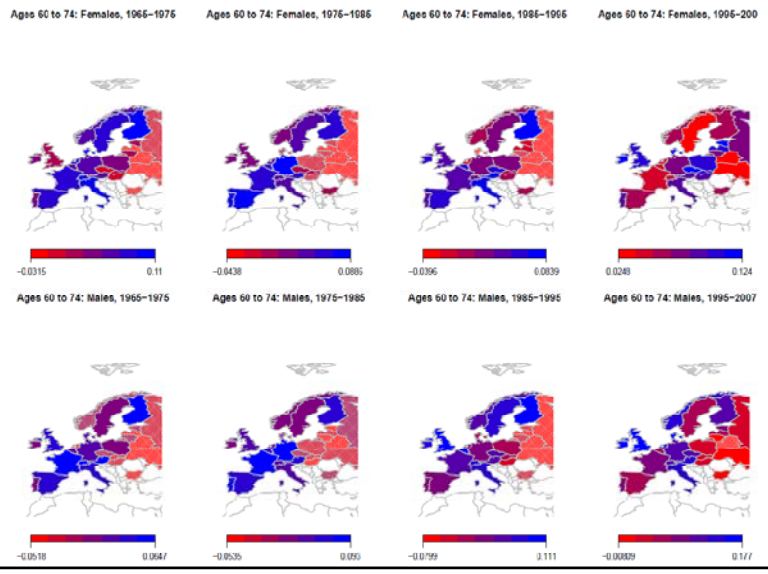
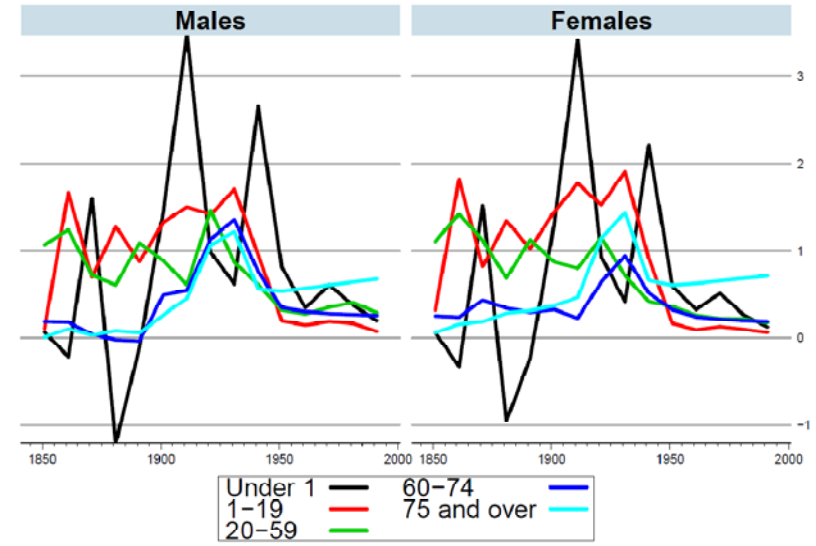


Some speculations about the future …

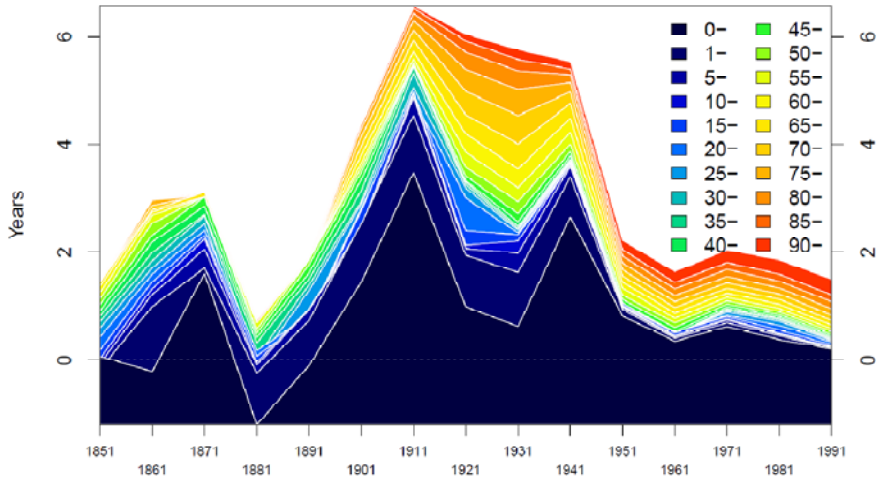
- Britain (uniquely good data)
- Impact on different age groups

Decadal change in cohort life expectancy (in years) by age group, England and Wales



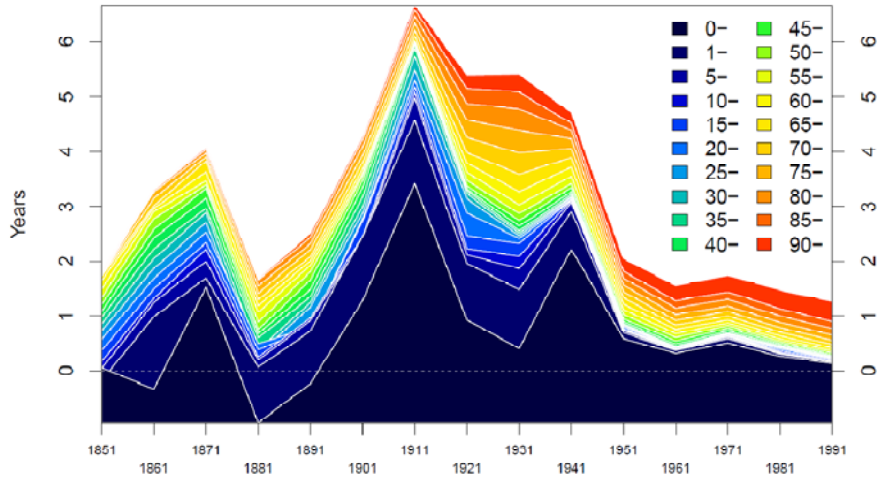
Source: Calculated from E&W 2008−based Official projections

Years of life expectancy gained in cohorts by age in decade: Males, England and Wales



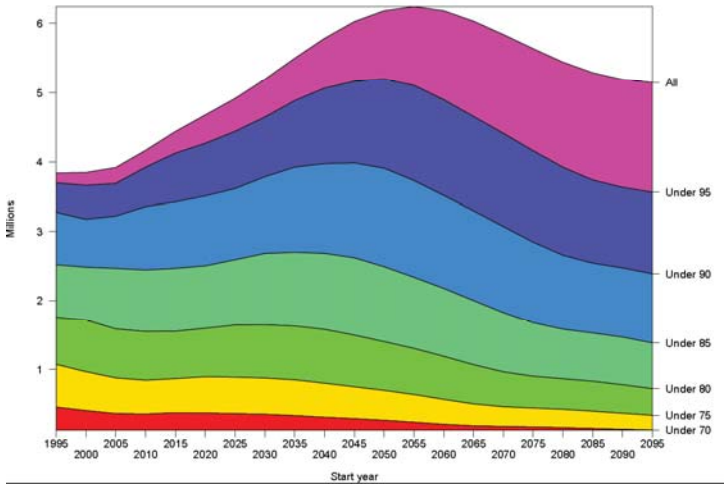
Using 2008−based official projections

Years of life expectancy gained in cohorts by age in decade: Females, England and Wales



Using 2008−based official projections

Annual cumulative number of deaths from age 65 in following 5 years, EU



Values are 5−year averages. Source: UN 2010 Revision

Thank you - Questions or comments?