Possible Convergence of Female and Male Mortality. Part I

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June 2016

MoPAct
Mobilising the Potential of Active Ageing in Europe

1This research was supported by the European Commission’s Seventh Framework Programme FP7-SSH-2012-1/No 320333, project MoPACT.
1. Motivation
   1.1 Changing Household Structure
   1.2 Life Expectancies at 65 Generally Increase
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1.1 Changing Household Structure

**Stylized facts:**

* more one-person households, so more consumer equivalents even if population does not increase

* more young women living alone in the cities

* more young males living alone in rural areas

* more elderly females living alone

Could convergence of male and female mortality alleviate the situation?
1.2. Life Expectancies at 65 Generally Increase

Figure 1: Average Life Expectancies at 65 for Females and Males, in 1959-2009, in European Regions.
2. Mortality Data from 23 Countries of Europe

1. Nordic Countries
Denmark (1835-2012), Finland (1878-2014), Norway (1846-2009), Sweden (1751-2012)

2. Atlantic Countries
Belgium (1841-2009), Ireland (1950-2010), the Netherlands (1850-2010), United Kingdom (1841-2011)

3. Mediterranean Countries
France (1816-2010), Italy (1872-2010), Portugal (1940-2010), Spain (1908-2010)

4. Central Europe
Austria (1947-2010), East and West Germany (1956-2012), Switzerland (1876-2012)

5. Baltic Countries

6. Eastern Europe
Czech Republic (1950-2012), Slovakia (1950-2010), Hungary (1950-2010)
3. Decomposing Expected Years in Ages 65+

$p_F(x)$ and $p_M(x)$ are survival probabilities to age $x \geq 0$ for females and males, computed from period data.

$\kappa = 1.05$ is the sex-ratio at birth.

Define,

$$Q = \kappa \frac{\int_{65}^{+\infty} p_M(x) dx}{\int_{65}^{+\infty} p_F(x) dx}. \quad (1)$$

Then,

$$Q = \kappa \times r(0, 65) \times \int_{65}^{+\infty} r(65, x) g(x) dx, \quad (2)$$

where e.g. $r(0, 65) =$ ratio of survival probabilities from 0 to 65, and

$$g(x) = \frac{p_F(65, x)}{\int_{65}^{+\infty} p_F(65, x) dx}, \quad x \geq 65. \quad (3)$$
3.1 Survival from Birth to Age 65

3.1.1 Nordic

![Graph showing the ratio of male survival probability to female survival probability from birth to age 65 in Nordic countries over the years 1750 to 2000.]

Figure 2: Ratio of Male Survival Probability to Female Survival Probability, from Birth to Age 65, in Nordic Countries.
3.1 Survival from Birth to Age 65

3.1.2 Atlantic

![Graph showing the ratio of male survival probability to female survival probability, from birth to age 65, in Atlantic countries.](image)

**Figure 3**: Ratio of Male Survival Probability to Female Survival Probability, from Birth to Age 65, in Atlantic Countries.
Figure 4: Ratio of Male Survival Probability to Female Survival Probability, from Birth to Age 65, in Mediterranean Countries.
Figure 5: Ratio of Male Survival Probability to Female Survival Probability, from Birth to Age 65, in Central Europe.
3.1 Survival from Birth to Age 65

3.1.5 Baltic

![Graph showing the ratio of male survival probability to female survival probability from birth to age 65 in Baltic countries.](image)

**Figure 6:** Ratio of Male Survival Probability to Female Survival Probability, from Birth to Age 65, in Baltic Countries.
Figure 7: Ratio of Male Survival Probability to Female Survival Probability, from Birth to Age 65, in Eastern Europe.
3.2 Expected Years in Ages 65-99

3.2.1 Nordic

Figure 8: Ratio of Expected Years of Life in Ages 65-99, Given Survival to Age 65, in Nordic Countries.
3.2 Expected Years in Ages 65-99

3.2.2 Atlantic

![Figure 9: Ratio of Expected Years of Life in Ages 65-99, Given Survival to Age 65, in Atlantic Countries.](image-url)
3.2 Expected Years in Ages 65-99

3.2.3 Mediterranean

Figure 10: Ratio of Expected Years of Life in Ages 65-99, Given Survival to Age 65, in Mediterranean Countries.
3.2 Expected Years in Ages 65-99

3.2.4 Central

Figure 11: Ratio of Expected Years of Life in Ages 65-99, Given Survival to Age 65, in Central Europe.
3.2 Expected Years in Ages 65-99

3.2.5 Baltic

Figure 12: Ratio of Expected Years of Life in Ages 65-99, Given Survival to Age 65, in Baltic Countries.
3.2 Expected Years in Ages 65-99

3.2.6 Eastern

Figure 13: Ratio of Expected Years of Life in Ages 65-99, Given Survival to Age 65, in Eastern Europe.
3.3 Countries Are Divided

Figure 14: Ratio of Expected Years of Life in Ages 65-99, as a Function of the Ratio of Probabilities of Surviving to 65.
3.4. How the Post-War Divergence and Convergence Came About?

3.4.1 Finland

Figure 15: Mortality in Ages 65-74, 75-84 and 85-99, in Finland.
3.4. How the Post-War Divergence and Convergence Came About?

3.4.1 Denmark

Figure 16: Mortality in Ages 65-74, 75-84 and 85-99, in Denmark.
4. Conclusions

* **Divergence** of female and male mortalities has not occurred for the same reasons or at the same time in European countries studied.

* **Convergence** has been simultaneous in some low mortality countries (DEN, NOR, SWE, NET), but in others (UK, FIN, FRA) the development has been different, and more gradual.

* In forecasting, these findings need to be combined with the earlier observation that **rate of decline in age-specific mortality has not been the same** across time (to be reported).

* **BUT**, even when there is evidence of convergence in period data, any female-male difference that has once occurred, will persist to the end of a cohort’s life.