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When disadvantaged cohorts impact a period's mortality deterioration: Czechia versus France

Jitka Rychtaříková, Charles University, Prague
Jindra Reissigová, Czech Academy of Sciences

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Introduction

- Since the beginning of the 20th century, mortality patterns in developed countries showed a long-term, continuous decrease.

- However, mortality in former Eastern Europe, including the population of the current Czechia begun to deviate from the overall downward trend as of the mid 1960's. Men's life expectancy at birth shortened. This trend resulted in a deepening of the gap in life expectancy between Eastern and Western Europe, in this case represented by Czechia and France.

- The reversal trend, a renewal of a mortality decline (with different timing and speed), started again in Central and Eastern Europe in the 1990's.

Long-term trends of male mortality : Czechia and France (1920-2014)

Life expectancy at birth and temporary life expectancy between ages 30-95

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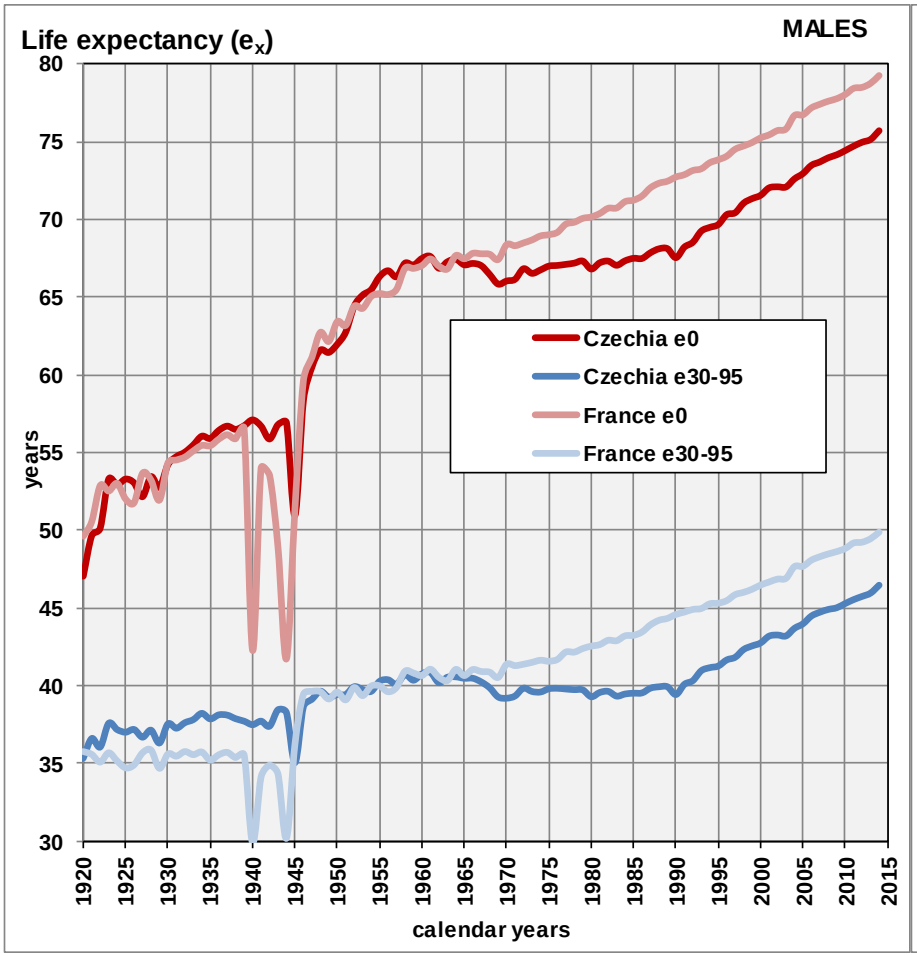
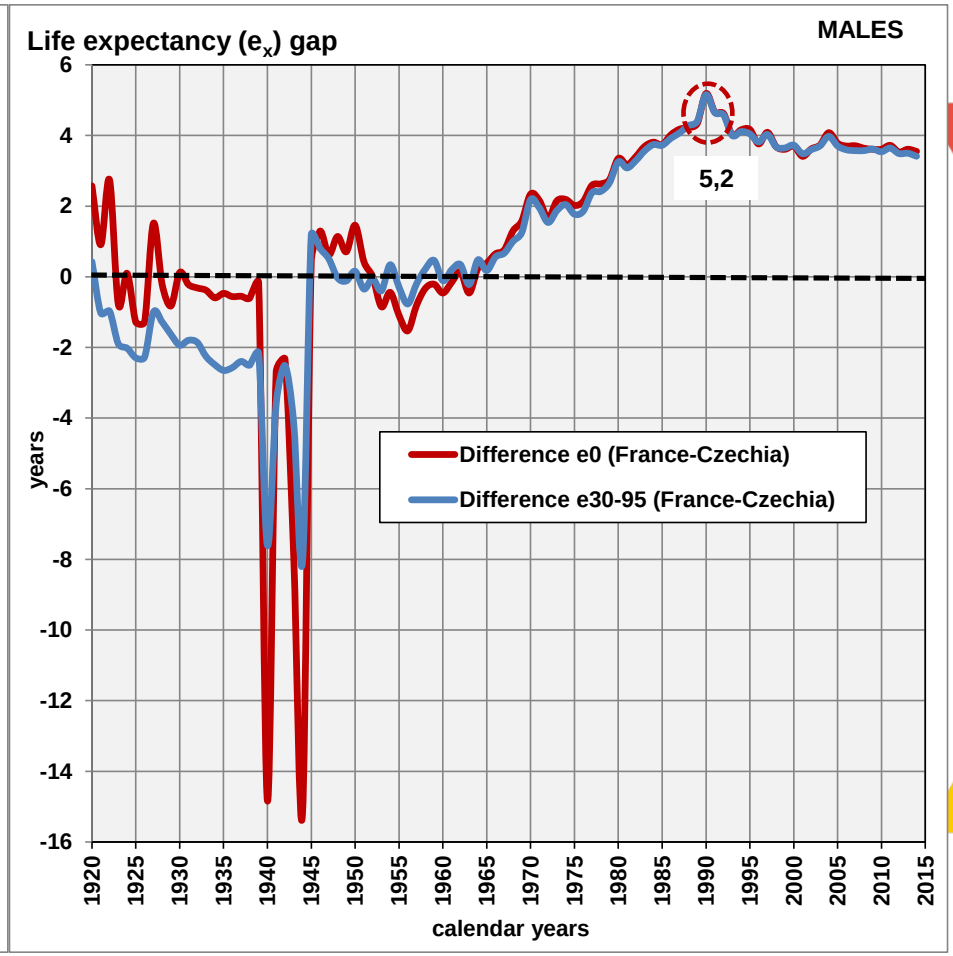
Source: Human Mortality Database; Czech Statistical Office





The gap at the expense of the Czech males started at the beginning of the 1960's and reached its peak in 1990. French males suffered higher mortality during WWII.
In the interwar period, Czech adult males enjoyed longer life than their French counterparts.

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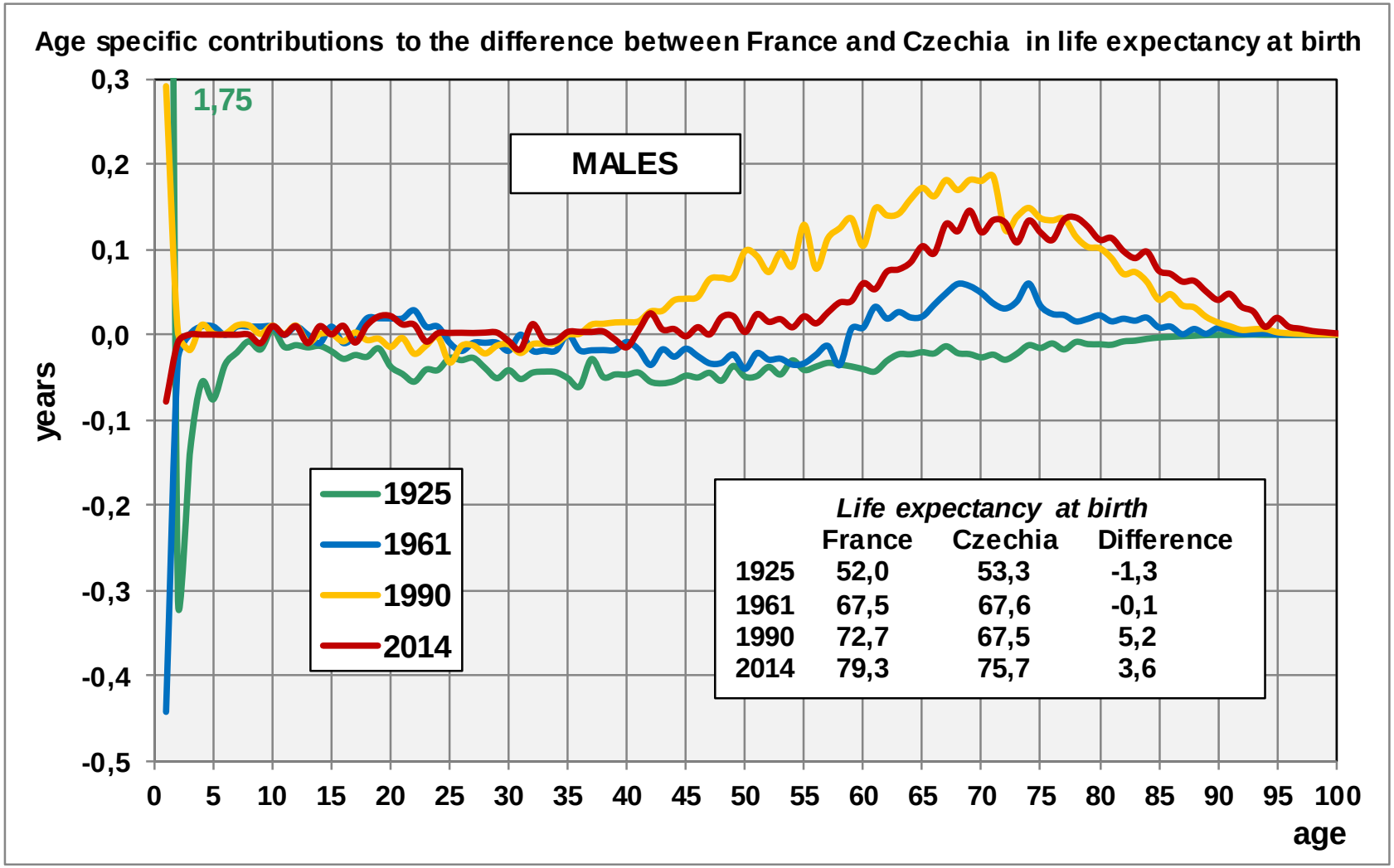
Decomposition of the differential in male life expectancy at birth between Czechia and France in years 1925, 1961, 1990, and 2014



Old and adult age mortality started increasing in Czechia compared to France in the post-war period due to higher mortality risks after the age of 50!

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Outline

Descriptive section

- Long term trends in male mortality (${}_5q_x$) by five year age groups from cross-sectional (1920-2014) and cohort (1830-1979) perspectives for ages 30-95 in Czechia and France are displayed. Contour maps (cross-sectional and cohort) by units of age show the shifts over time in male mortality patterns in both countries.

Analytical section

- Age-Period, Age-Cohort, and Age-Period-Cohort modelling based on data (D_x and P_x) for units of age (30-95) in the period 1920-2014 is presented for Czechia and France.
  - How did low and high mortality cohorts contribute to the currently observed mortality patterns?
  - Is the mortality deterioration, reported between 1965 and 1990 in Czechia, impacted by the participation of high or low mortality cohorts?
  - What are the cohort effects of the two World Wars when Czechia is compared to France?

- Conclusions

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Cross-sectional perspective 1920-2014

- French males were more affected by the events of the WWII.
- Due to the transition from „western mortality pattern“ into the „eastern one“ after WWII, Czechia experienced profound absolute but more particularly relative aggravation of mortality conditions.
- Mortality risk differences (when comparing France and Czechia) culminated somewhere around 1990 to the detriment of Czechia.
- Currently, older Czech males consistently lag behind their French counterparts.
- The contour map shows persisting shift by one interval in mortality aggravation in case of Czech males. The higher the age, the higher the difference between Czechia and France, to the Czech disadvantage.

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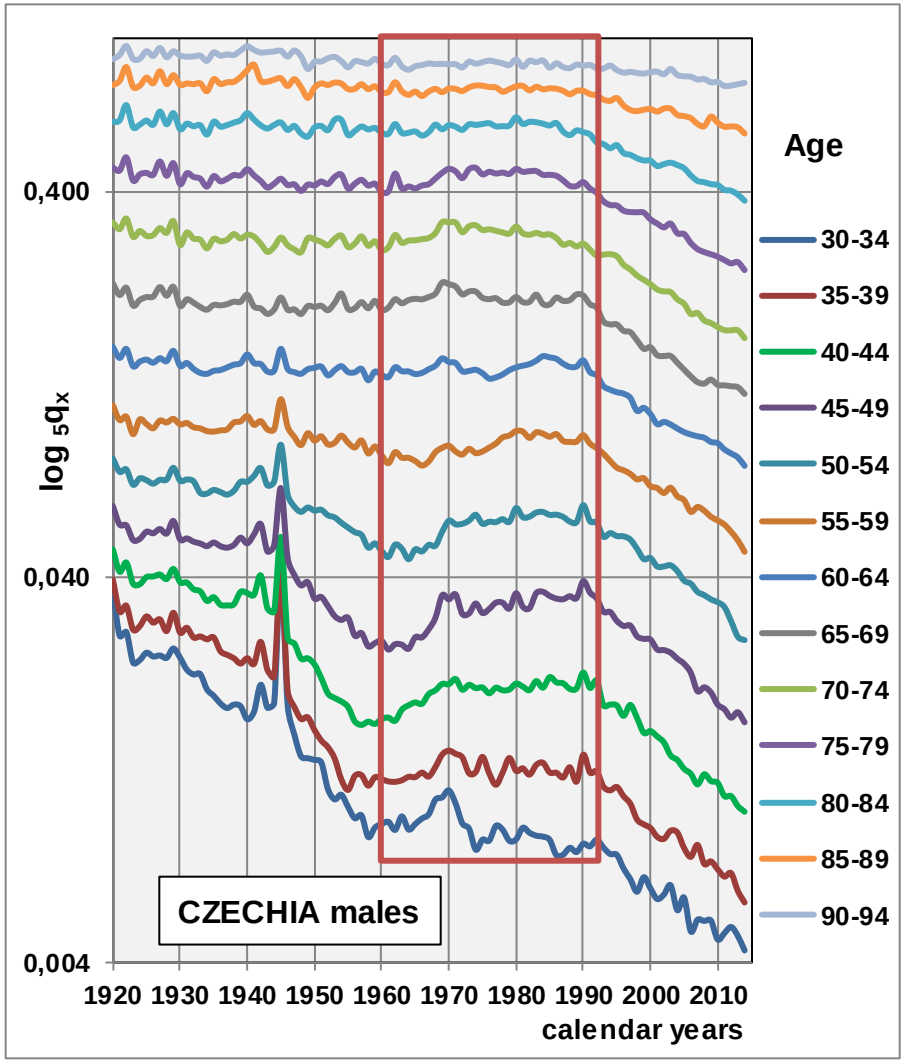
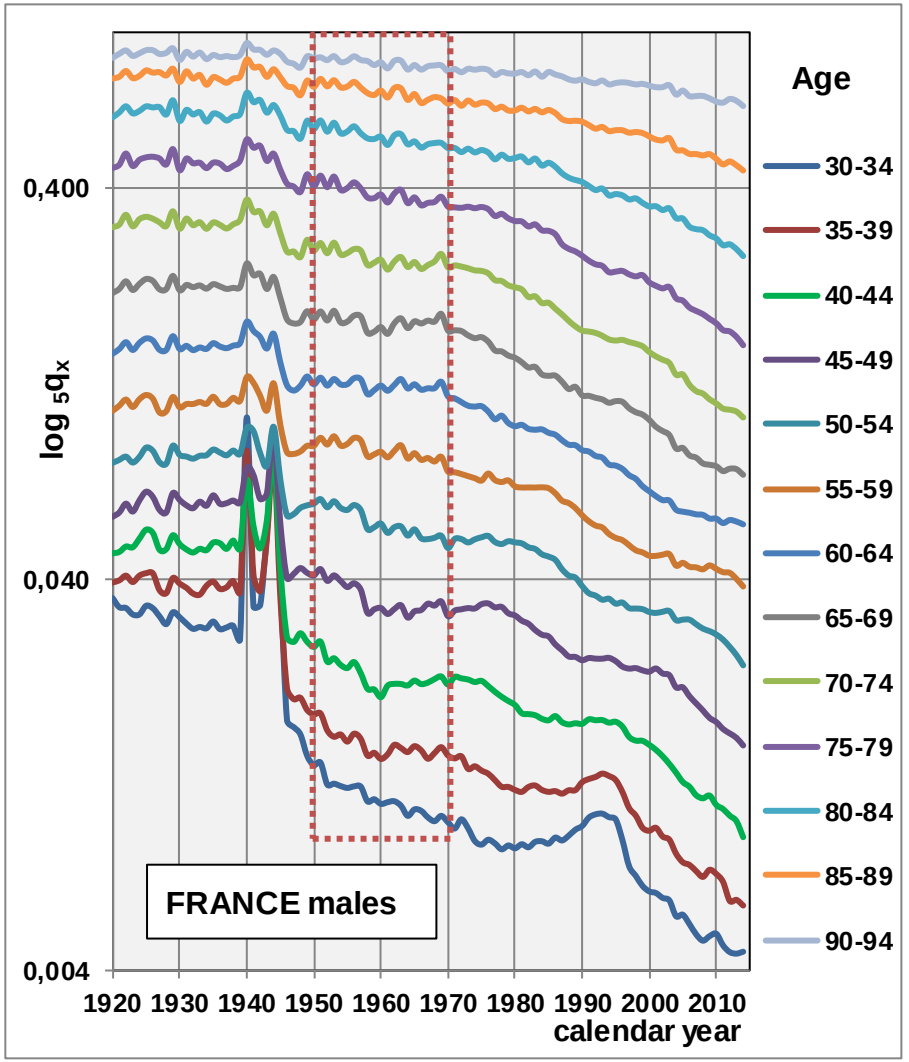
Cross-sectional view on male mortality: Czechia and France 1920-2014





Male mortality shows a moderate decline in France during 1950-1970, while a deterioration is observed in Czechia in 1960-1990.

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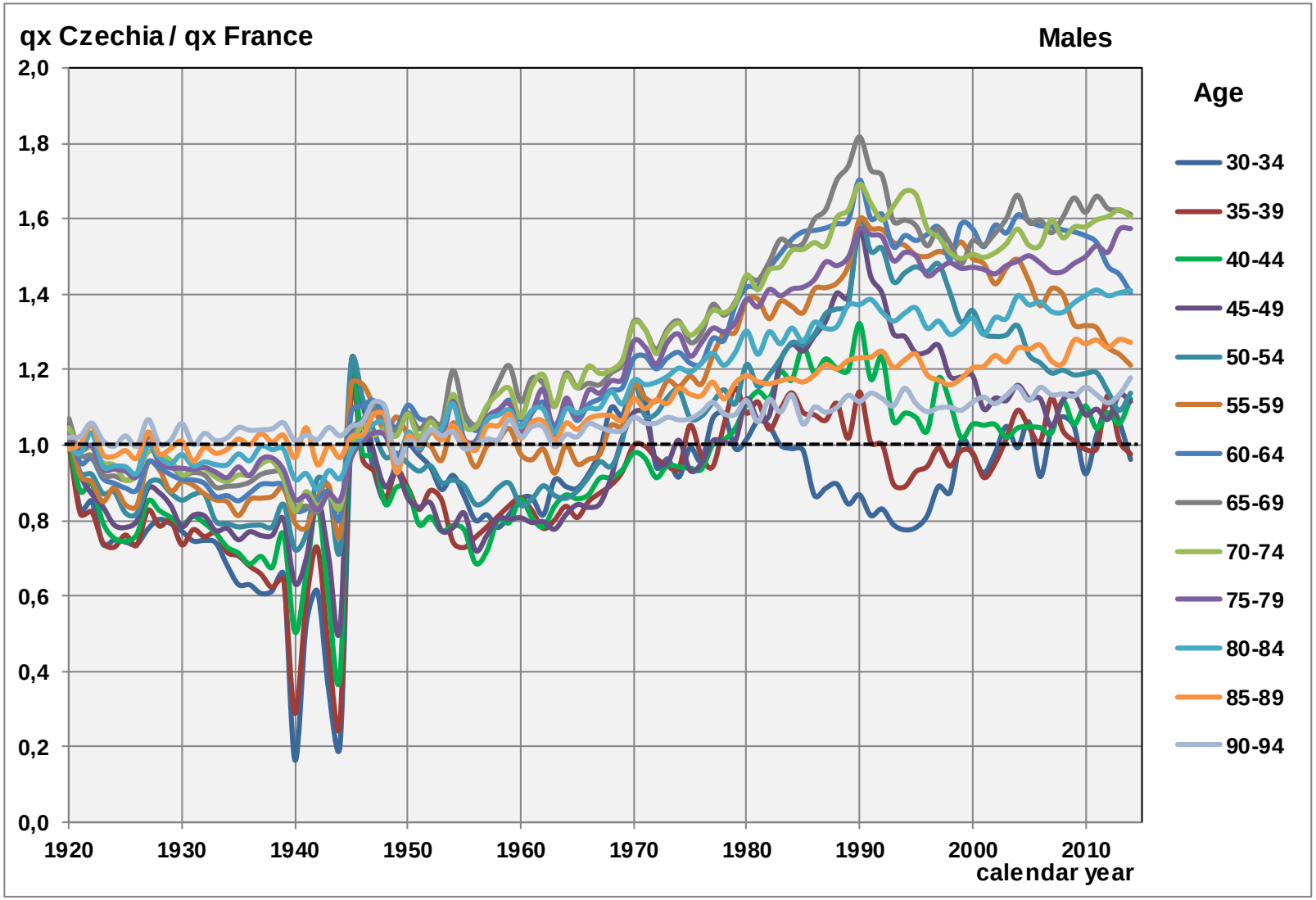
Czechia versus France (cross-sectional):
Before WWII Czechia showed lower adult mortality, but worse mortality primarily at old ages in 1970-1990



After the age of 55 and since 1970, Czech males experienced a permanently higher risk of dying in spite of changing health conditions.

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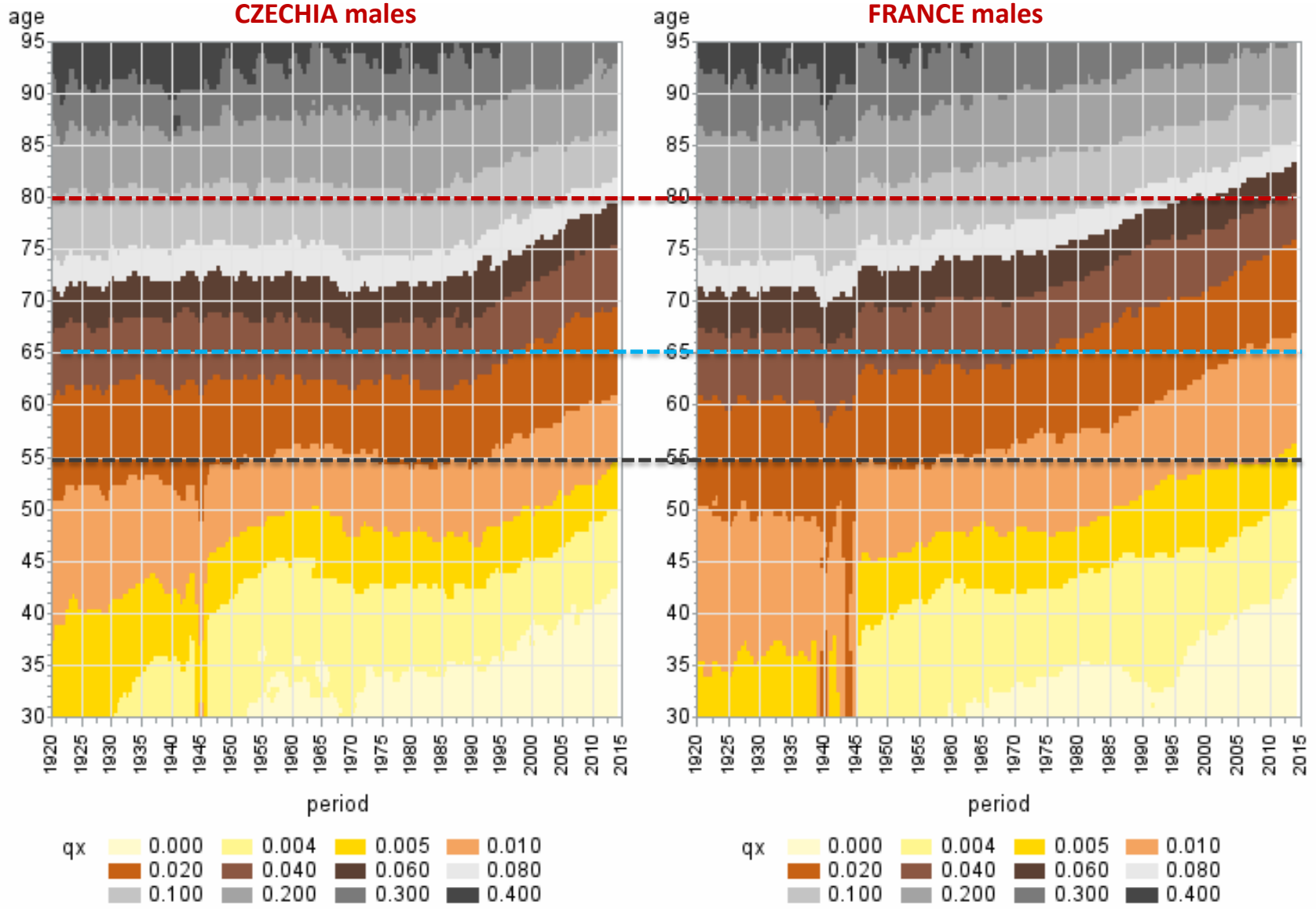

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Cohort perspective 1830-1980

- Low mortality cohorts are visible in Czechia for males born during the First World War. They are then followed by high mortality cohorts. In France, this pattern is less evident or could be overshadowed by intense mortality decrease (in which all ages participated) after World War II.

- The most variability in mortality risks can be seen for Czech male birth cohorts 1920-1940; i.e. lower mortality risks at younger ages with increased risk at older age.

- The contour map shows the evidence of perhaps a selection effect, for males born during WWI experiencing later lower mortality levels.

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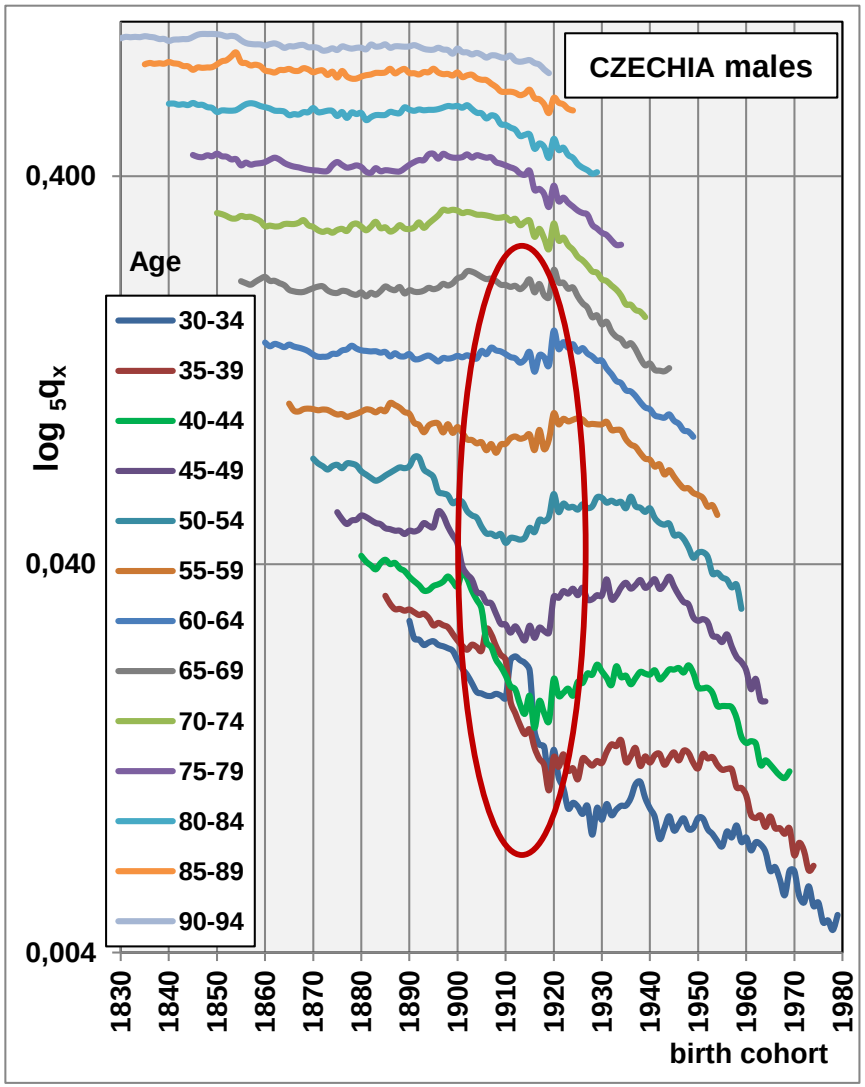
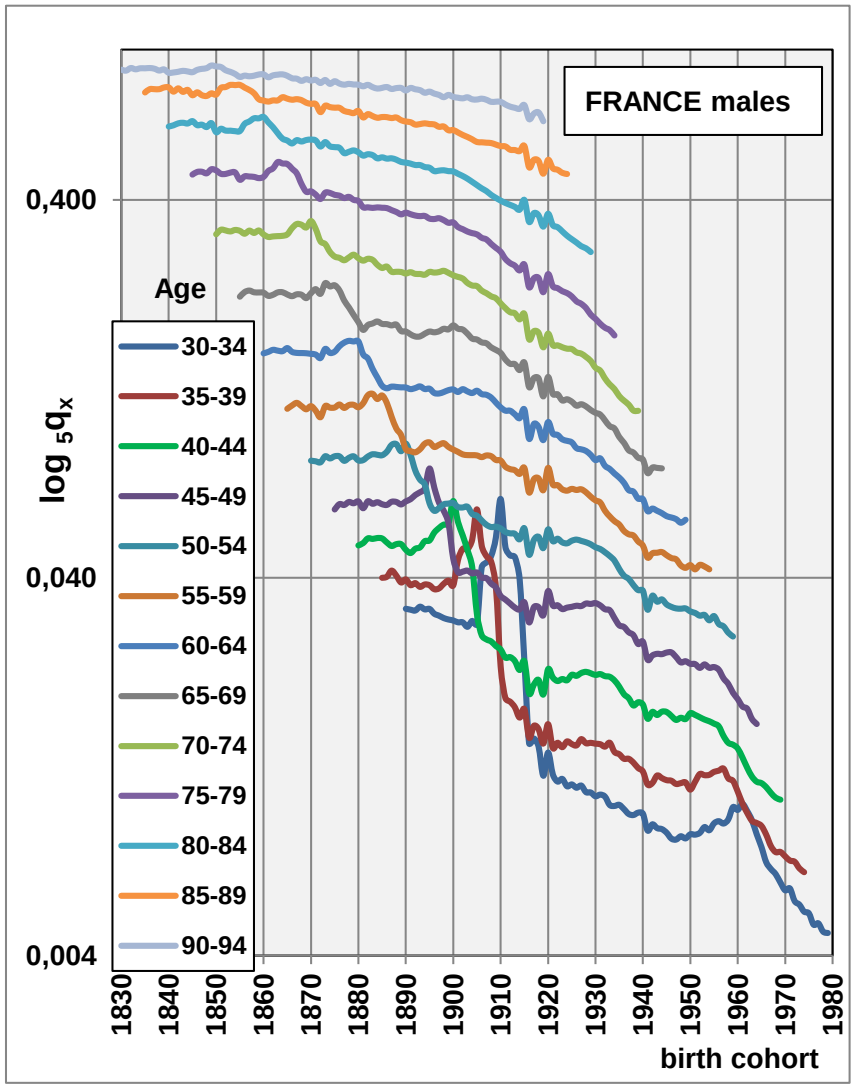
In Czechia, a promising downward trend in mortality of WWI birth cohorts was reversed, in France, males born from 1900 onwards, showed a continuous declining trend, primarily starting at older age.





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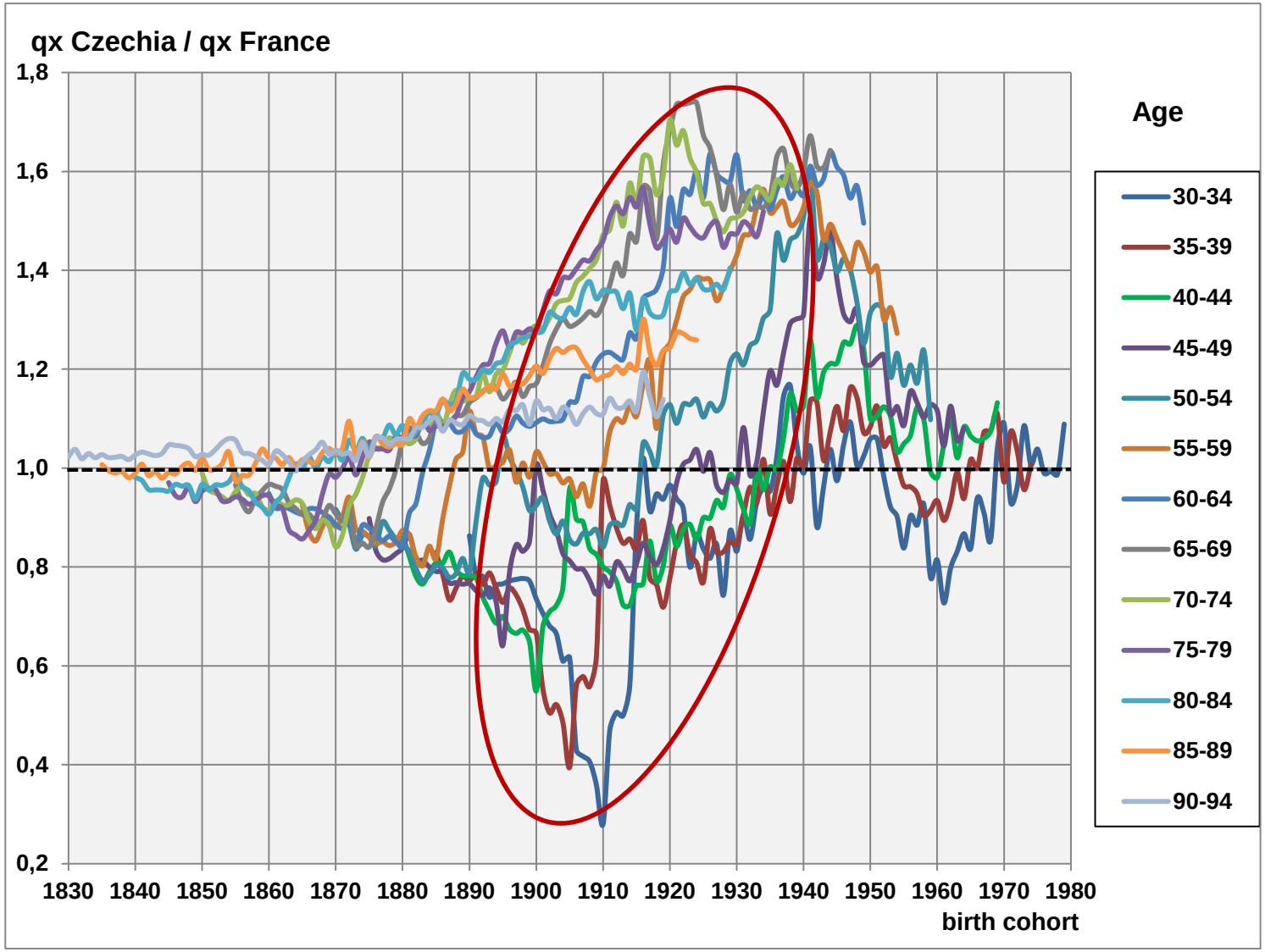
Czechia versus France (cohort view):

19th century birth cohorts: similarity at older age, lower risk at younger age in Czechia.

The interwar birth cohorts of Czech males experienced opposite risks by age: lower at younger age and higher at older age.



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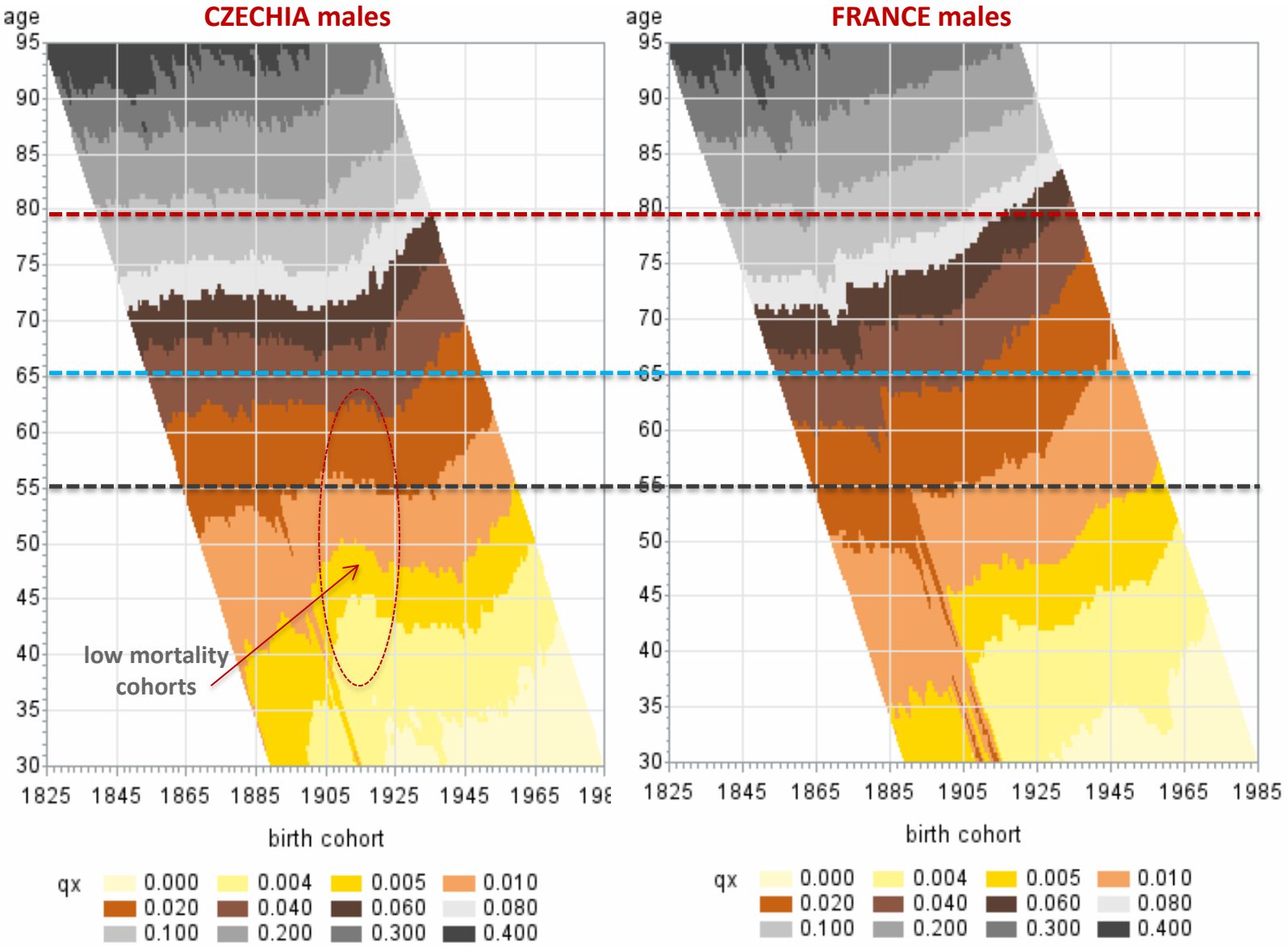
The effect of belonging into a low mortality cohort disappears with advancing age in Czechia and is overlaid in France due to a substantial mortality decline after WWII.



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Analytical section: Age Period Cohort modelling

- Individuals live their lives in particular birth cohorts that are structured by unique opportunities, constraints, and normative contexts.

- Childhood socioeconomic circumstances are predominantly associated with later-life mortality risks. Relatively privileged childhood conditions are predictive of survival up through age 85.

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Should we expect Czech and French male mortality trends to be driven by period-based changes, cohort-based changes, or both?

Individuals live their lives in particular birth cohorts that are structured by unique opportunities, constraints, and normative contexts.

Childhood socioeconomic circumstances are "highly" associated with later-life mortality risks. Relatively privileged childhood conditions are predictive of survival up through age 85.

1) **Age Period and Age Cohort models are presented.**

2) **Age Period Cohort model is elaborated.**

Data:
Deaths by units of age and exposure **population**; period **1920-2014** for Czechia and France; Human Mortality Database and Czech Statistical Office
Software **SAS 9.4**; **proc GLIMMIXED**

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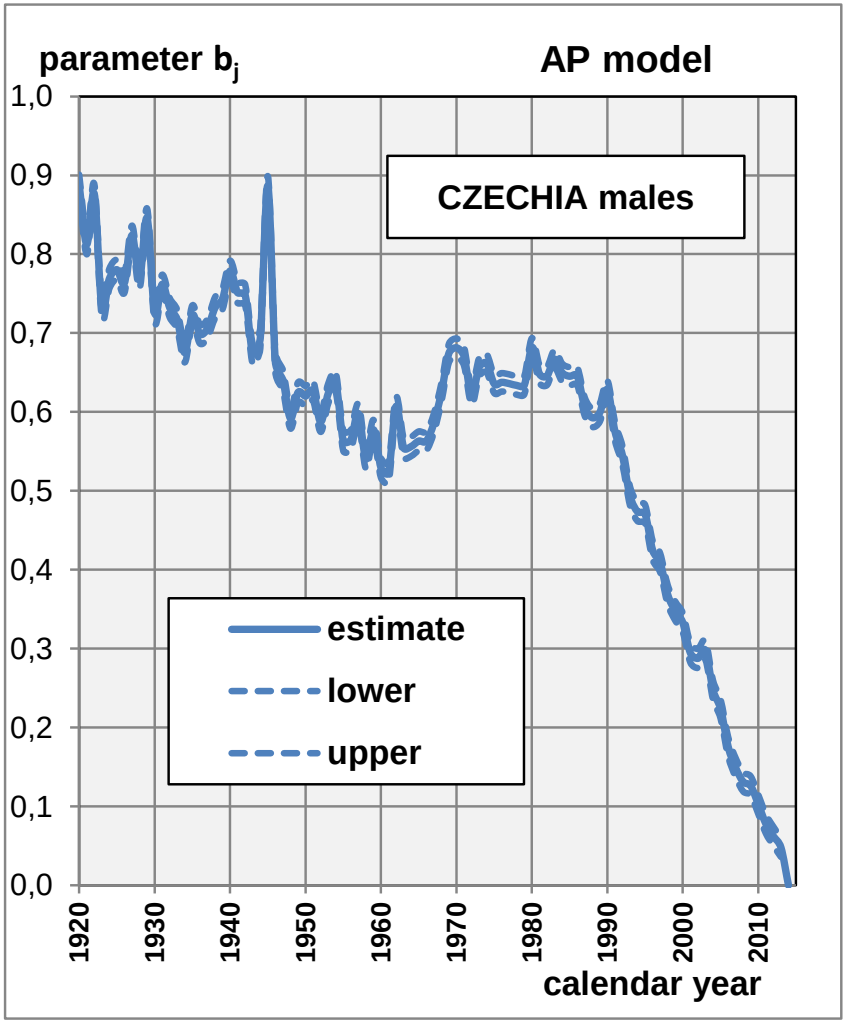
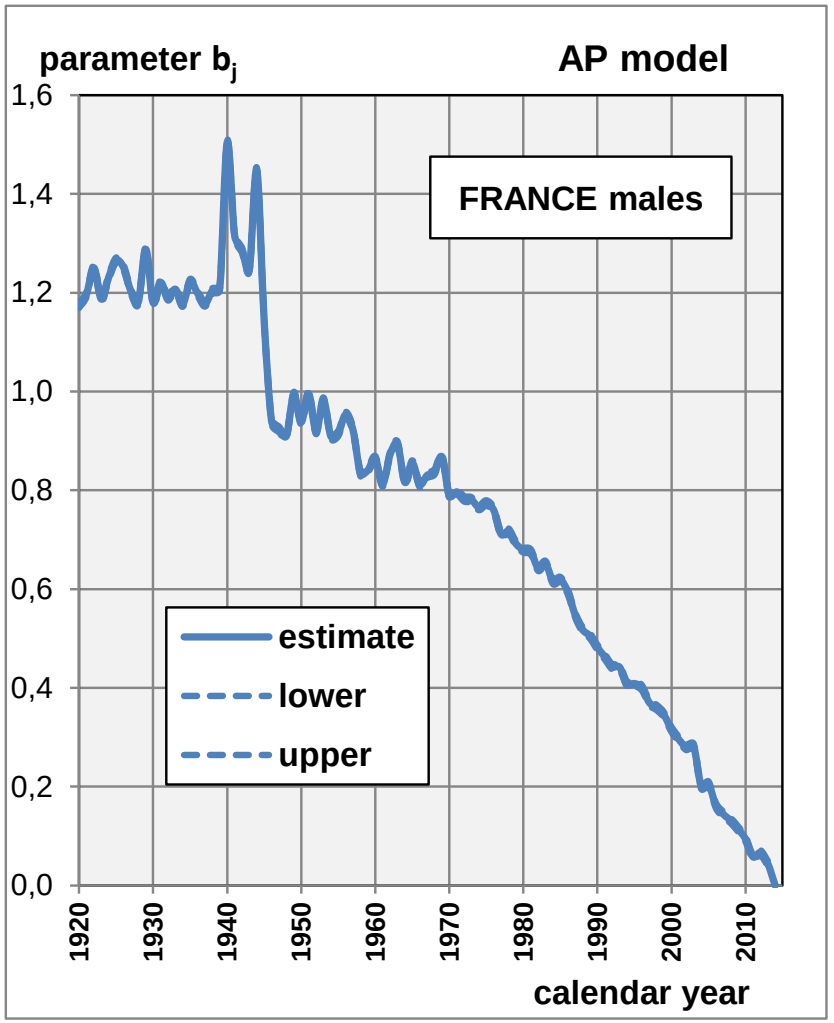
Age-Period (AP) model





- Period effects adjusted for age are similar as those shown with temporary life expectancy.
- The divergence pattern between Czechia and France in 1960-1990 is confirmed.
- However, cohort effects adjusted for age show substantial similarity of Czechia and France.
- It seems that low mortality cohorts are represented by males born during WWI, followed by higher mortality cohorts, and again low mortality cohorts 1930-1944.
- Unexpected increase (higher mortality cohorts) appears for males born during the immediate post-war baby-boom.

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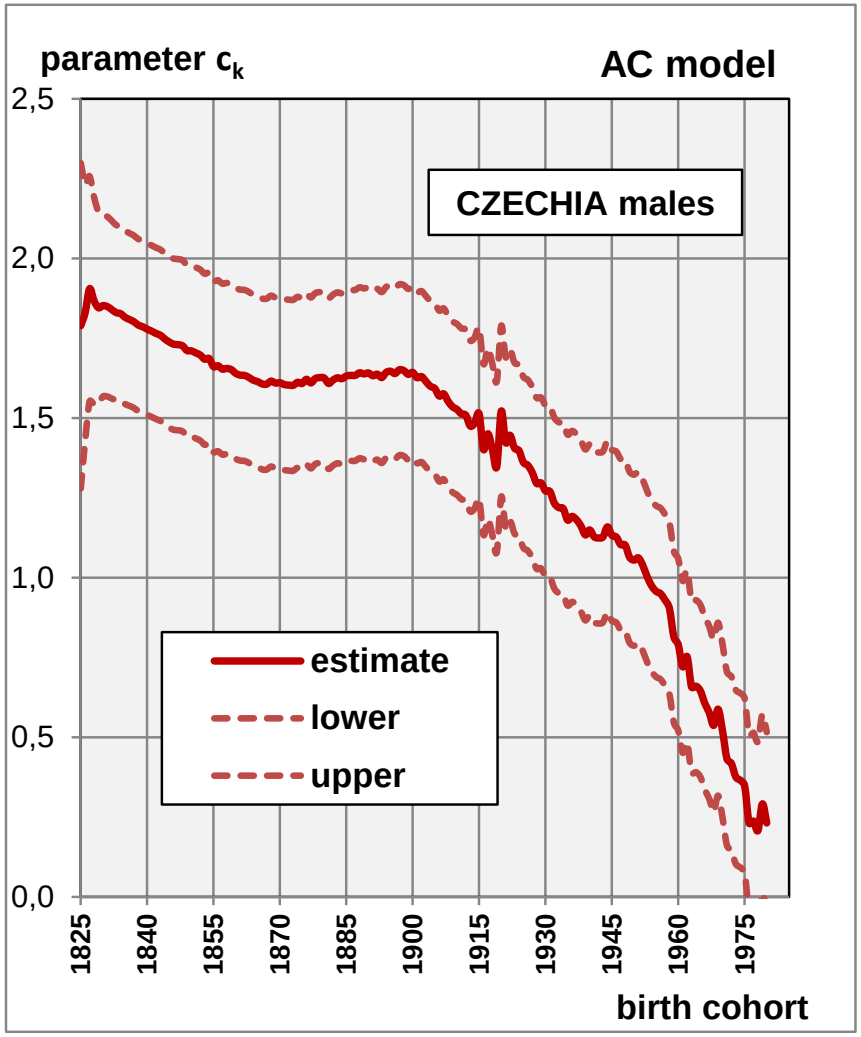
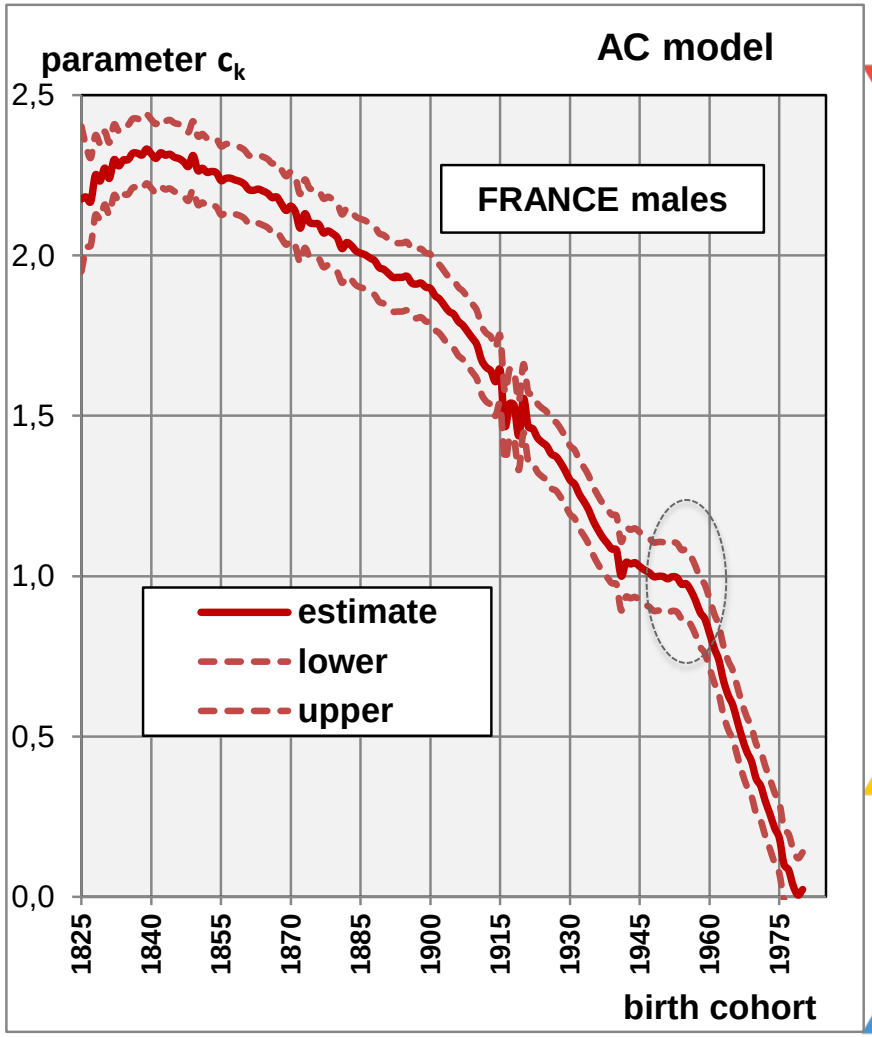
Age-Cohort (AC) model





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Hierarchical age-period-cohort (HAPC) model

Conventional APC models fall into the class of generalized linear models. The model can take a log-linear regression form via a log link as:

$$\ln(D_{ij}) = \ln(P_{ij}) + m + a_i + b_j + c_k$$

where D_{ij} denotes the expected number of deaths (i=age, j=period, k=cohort) that is assumed to be distributed as a Poisson variate, and $\ln(P_{ij})$ is the logarithm of the exposure P_{ij} and is called the "offset" or adjustment for the log-linear contingency table model.

However, the identification problem occurs due to the exact linear dependency between the three variables: cohort =period – age.

HAPC model overcomes the identification problem because the three effects are not assumed to be linear and additive at the same level of analysis. With the use of APC multilevel modelling, the age represents a fixed effect while period and cohort are specified as random contextual effects.

Proc GLIMMIXED (SAS 9.4) was used in order to separate period and cohort effects. The mortality *data of men in Czechia (1920-2014) and France (1920-2014)* were processed.

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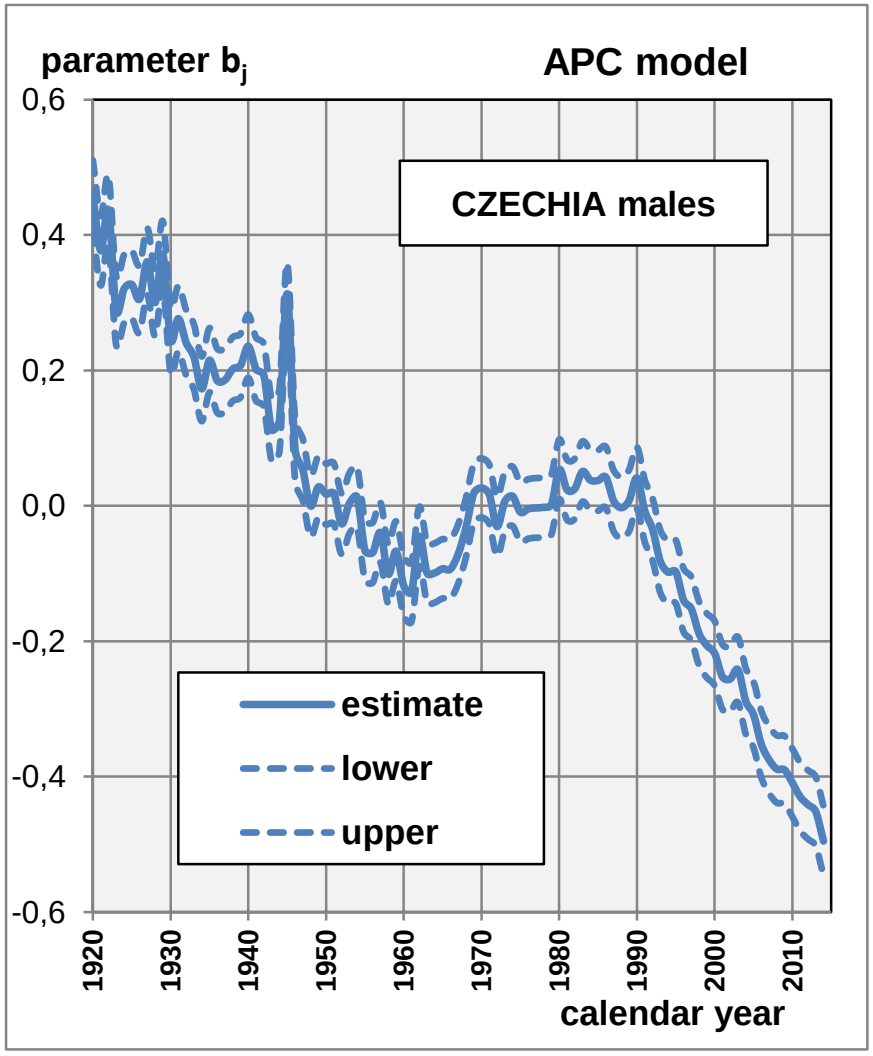
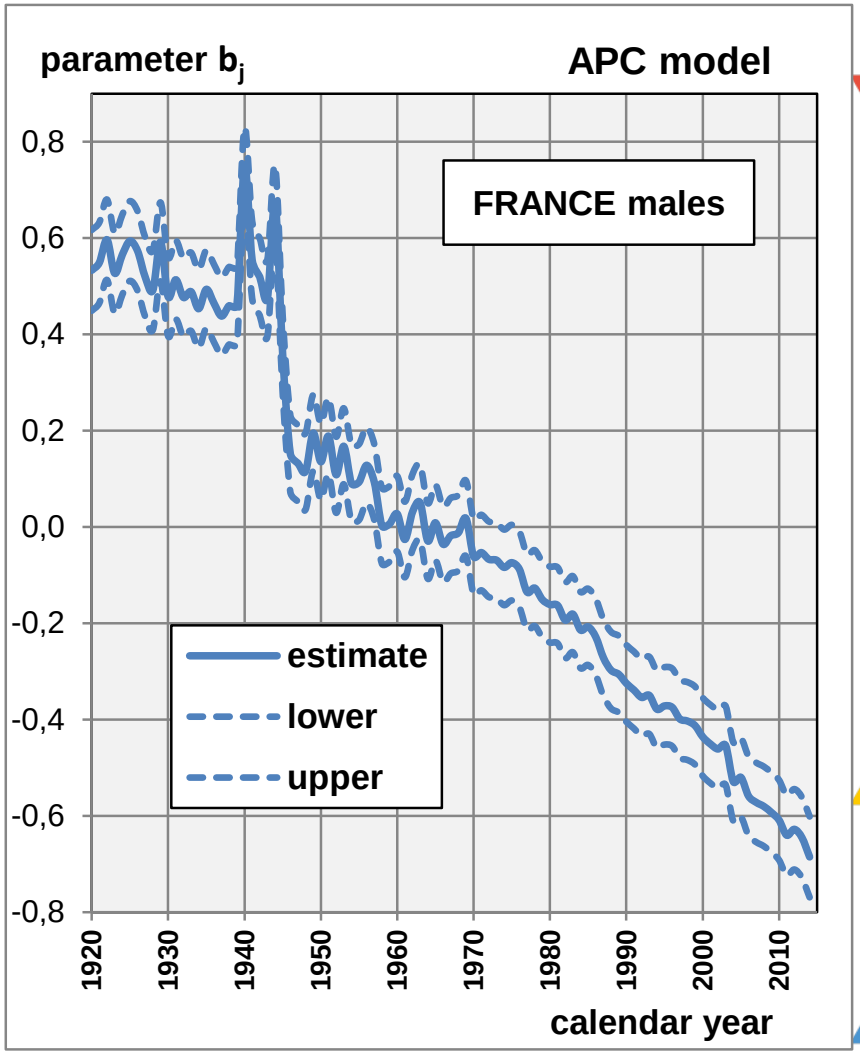
Age-Period-Cohort (APC) model
Period effects





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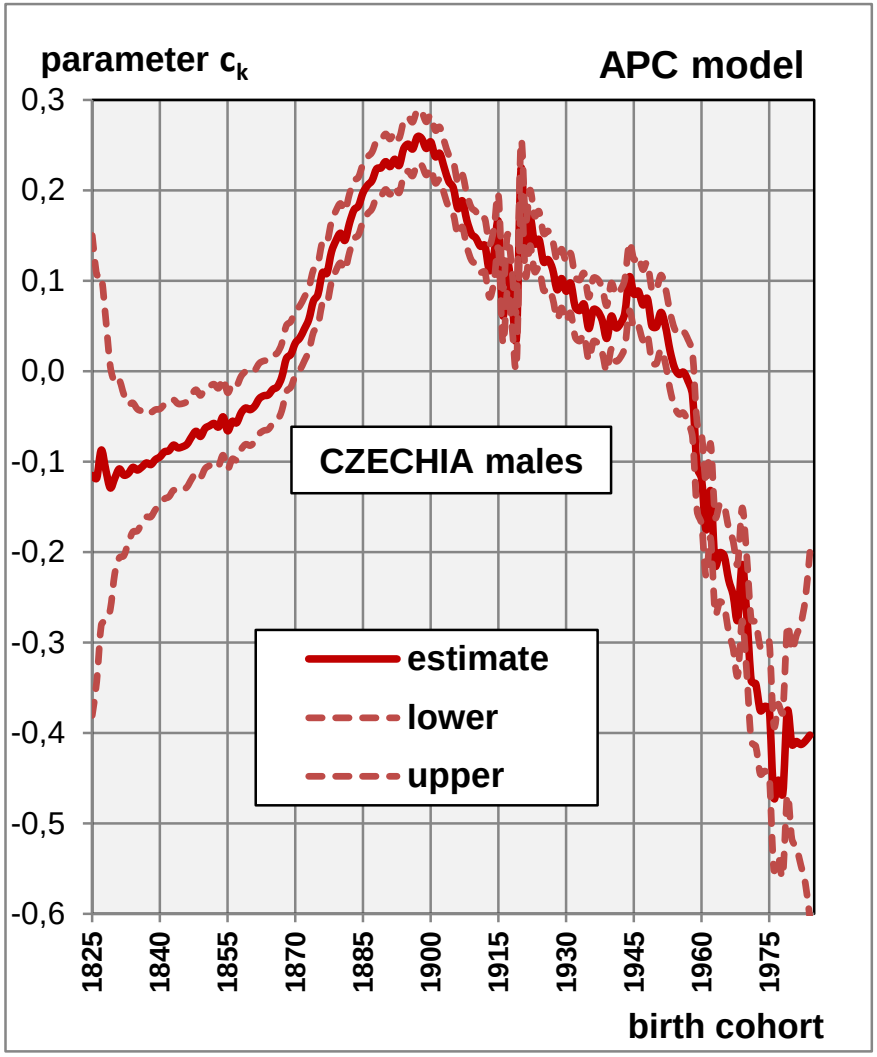
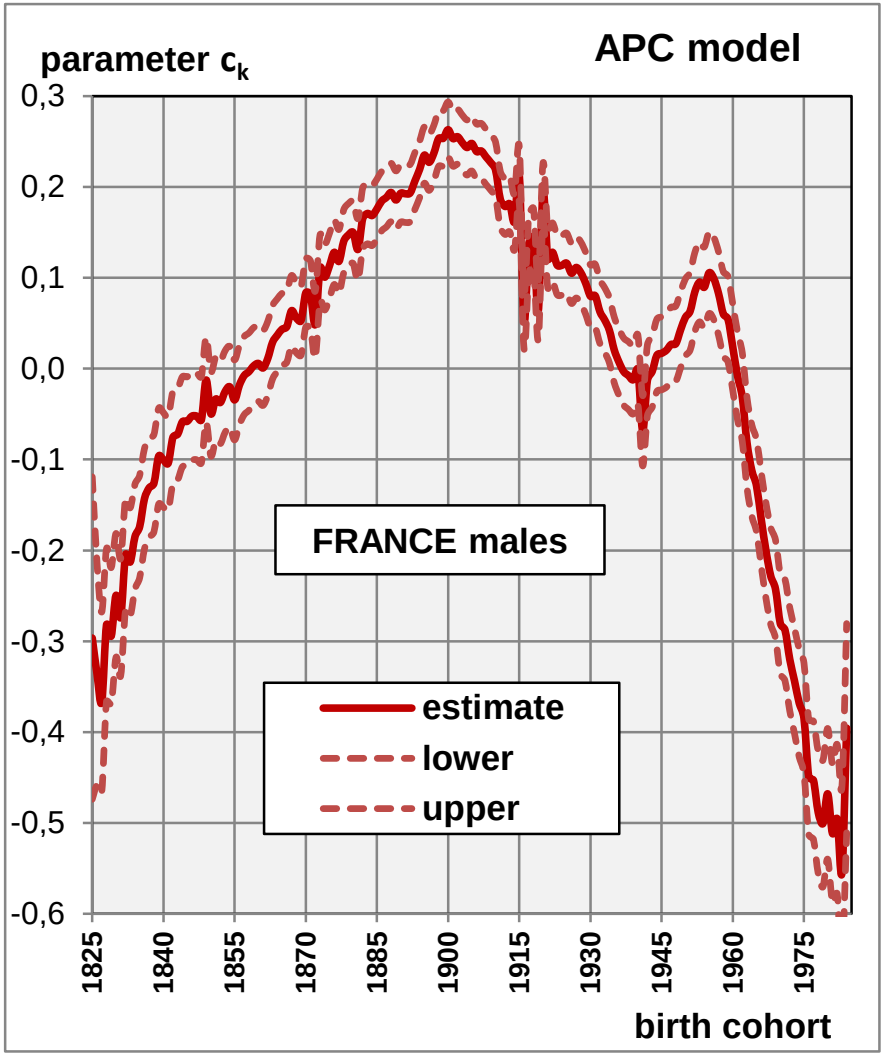
Age-Period-Cohort (APC) model
Cohort effects





- When looking at period patterns as results from APC modelling, we conclude that even after adjustment for age and cohort, main „period“ features remain as it was already shown with „unadjusted“ indicators. Hence, in terms of time trends, the differences between both countries are confirmed.

- However, when exploring cohort net effects, a striking similarity is observed for both countries. Does it mean that the inner life conditions/culture are shared, are the same? Consequently, is the length of a human life in Europe impacted strictly by external conditions?

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Conclusions

- In spite of the recent increase in survival, Czechia still lags behind „western“ developed countries (France) in mortality figures.
- However, long-term trends (1920-2014) have shown that mortality levels are sensitive to external conditions and may be not only changed but also reversed.
- Age-period-cohort modelling indicates a common mortality pattern (net cohort effect) and the only deviations we observe are fully (completely) dependent on the current situation.

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Thank you for your attention