Modelling of Cohort mortality Patterns – New Approaches

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Structure of the presentation

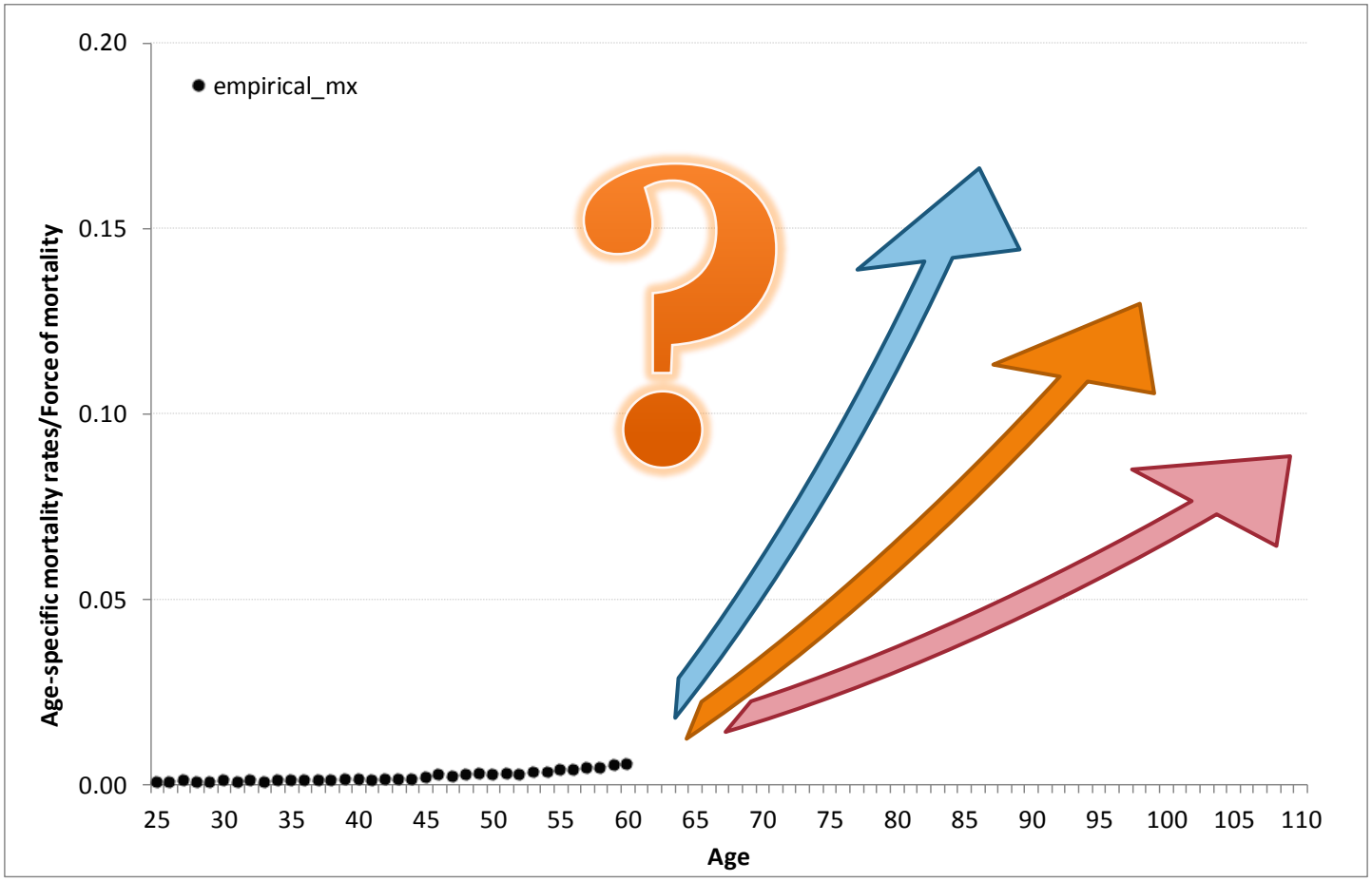
- What?
- Why?
- How?
- Results
- Conclusions

What – the main goal

- Our aim was to estimate the mortality development at higher ages for not yet extinct cohort

- What do we mean…?

Cohort 1940 (SWE, females)



Possible solutions – I.

- We could construct the transversal life tables (for 60 years old from generation 1940 it would be the table for year 2000)
  - Important: transversal tables reflect the current situation – how would mortality develop if the conditions remains the same as in the studied year…

Year	Age	mx	qx	lx	dx	Lx	Tx	ex
2000	60	0.00583	0.00581	93966	546	93692	2286868	24.34

Possible solutions – II.

- Some sophisticated forecast methods
  - Lee-Carter and others based also on cohort perspective
  - Such methods often need more many historical data and could have problems with dealing the sudden changes in the trend
  - Often need special SW or deep knowledge of some staff

Possible solutions – III.

- Fitting some parametric function, where the parameters could be estimated from empirical data in the studied cohort
  - Which function should be used?

HMD (year 2000):
$e_{60} = 24.3$

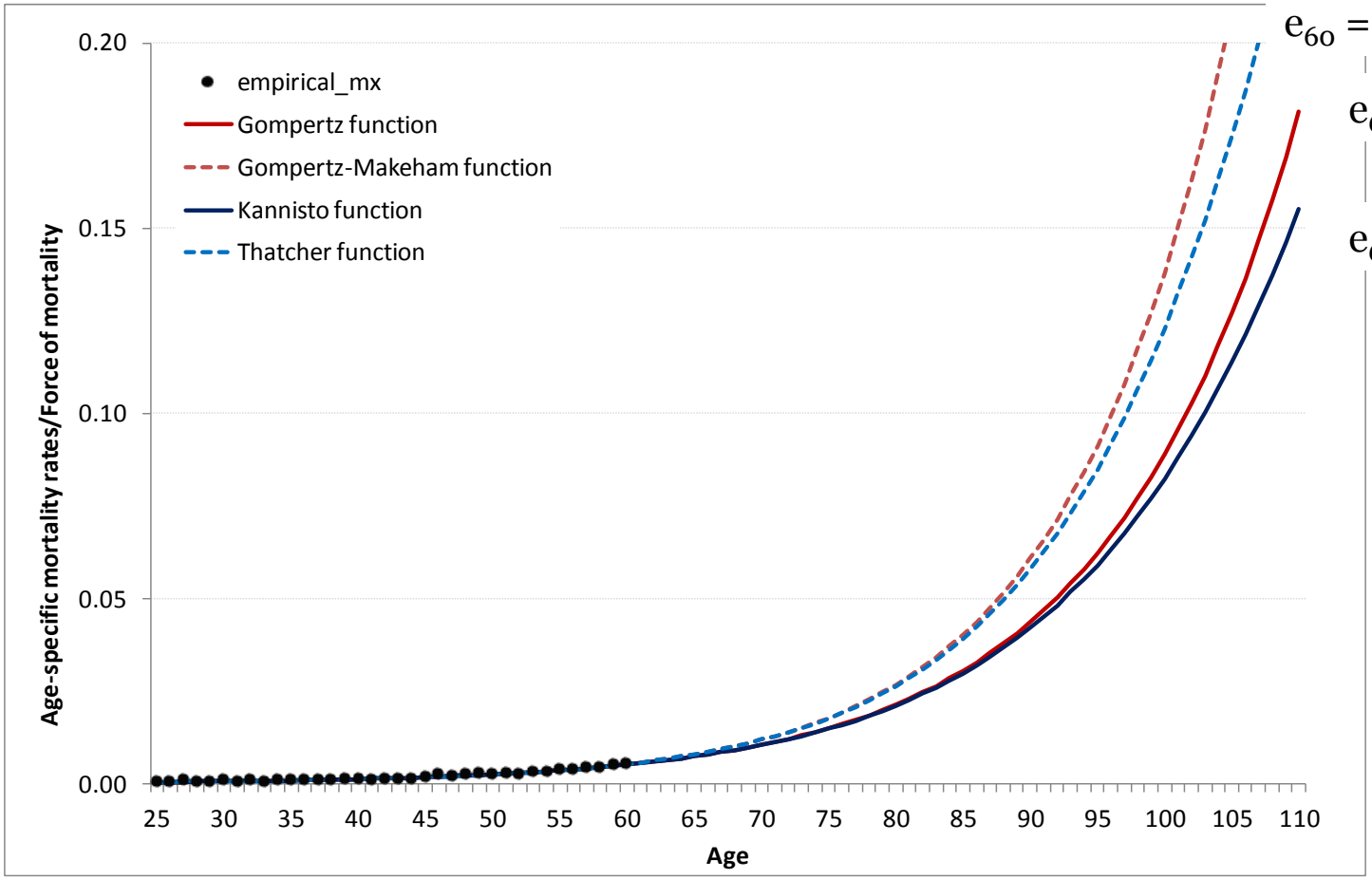
Cohort 1940 (SWE, females)

$e_{60} = 29.6$

$e_{60} = 30.0$

$e_{60} = 32.6$

$e_{60} = 33.0$



Why – motives of our work

- We wanted to work with cohorts
- If we find some general developmental pattern for cohorts in the generally available period data, we can use it for estimation
- The aim was to find as simple method as possible (not using any special SW) – the method should be clear, simple and respecting the general patterns

How – methodology – I.

Basic assumption:

$$m_{x,z} \geq m_{x-1,z}$$

x represents age and z is the year of birth of the considered generation (higher ages)

Hard to model rates due to high volatility and unexpected trend

How – methodology – II.

But we can model ratios of rates

if $\frac{m_{x,z}}{m_{x-1,z}} = r_{x,z}$ then $r_{x,z} > 1$

Basic theory:

$$r_{x,z} = r_{x,z+1}$$

How – methodology – III.

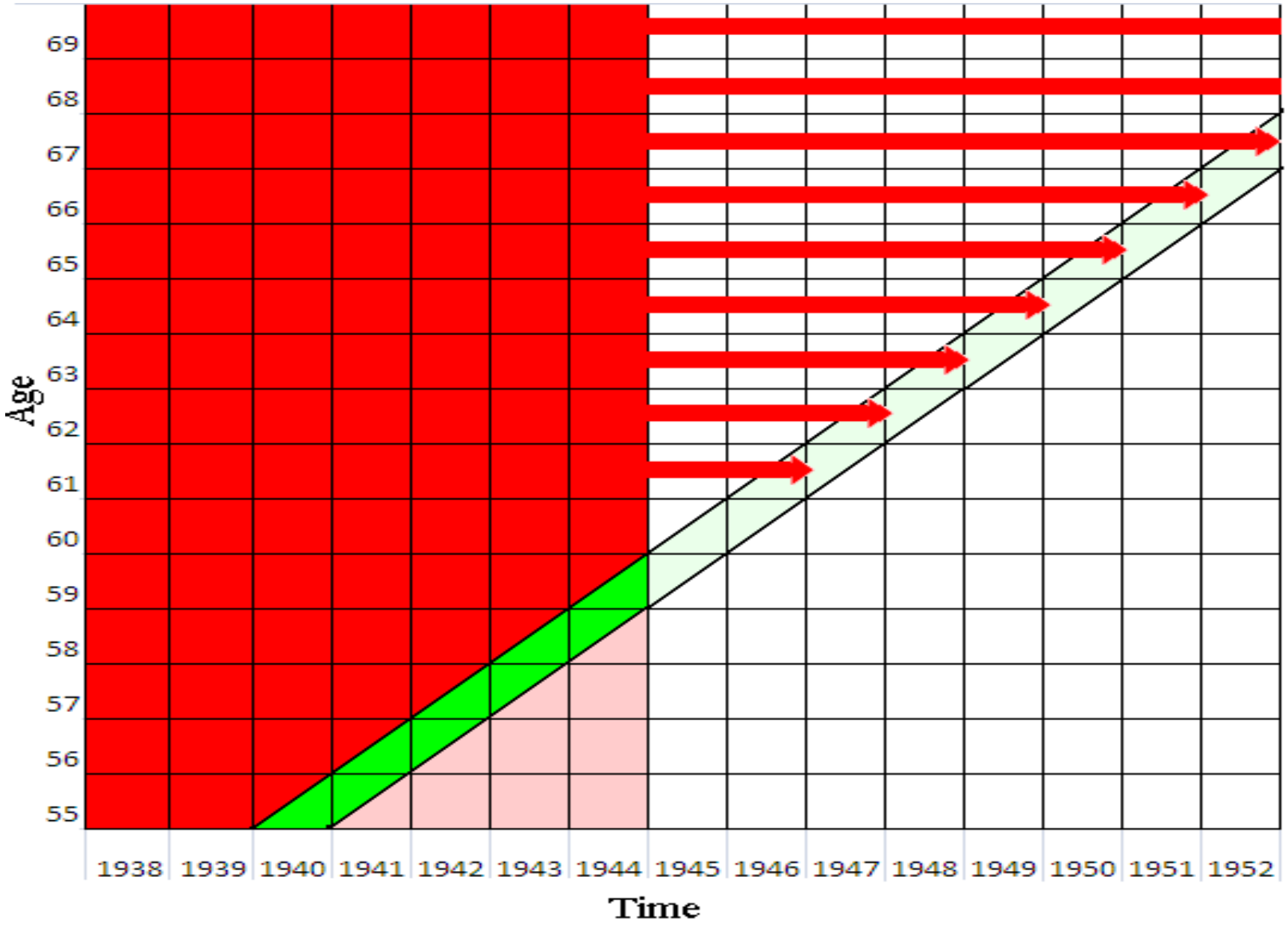
Stable but still variable…

$$\bar{r}_{x,z,n} = \frac{\sum_{k=0}^{n} \alpha^k \, r_{x,z-k}}{\sum_{k=0}^{n} \alpha^k}$$

n is number of previous cohorts, α is weight <0;1>

$$\bar{r}_{x,z,n} = \frac{{}_{25}\tilde{r}_{x,z,n} + {}_{75}\tilde{r}_{x,z,n}}{2}$$

Where ${}_{25}\tilde{r}_{x,z,n}$ is lower quartile of n prev.cohorts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Age
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
Time

How – methodology – IV.

Than we can start with

$$m_{x+1,z} = m_{x,z} \cdot \bar{r}_{x,z,n}$$

How to choose first age?

$$Geomean(m_{x-4,z}; m_{x+4,z})$$

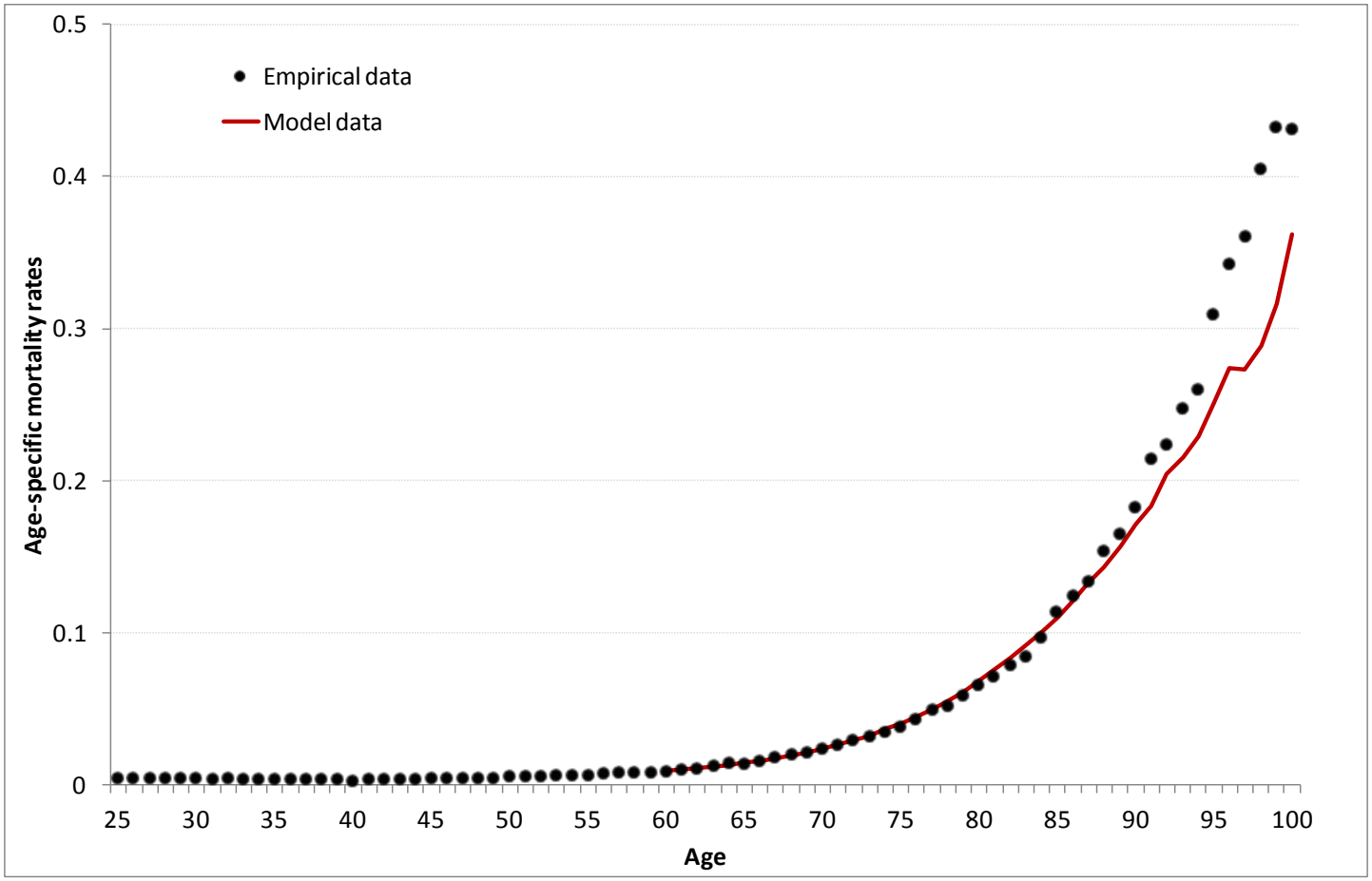
Data

- Cohort data from Sweden
- Human Mortality Database
- 1x1 Death rates from 1676–1980

Results

- For evaluation of our methodology we used some already extinct cohorts
- …but we used empirical data only for ages up to 60 years
- Empirical data for ages above 60 are used only for comparison

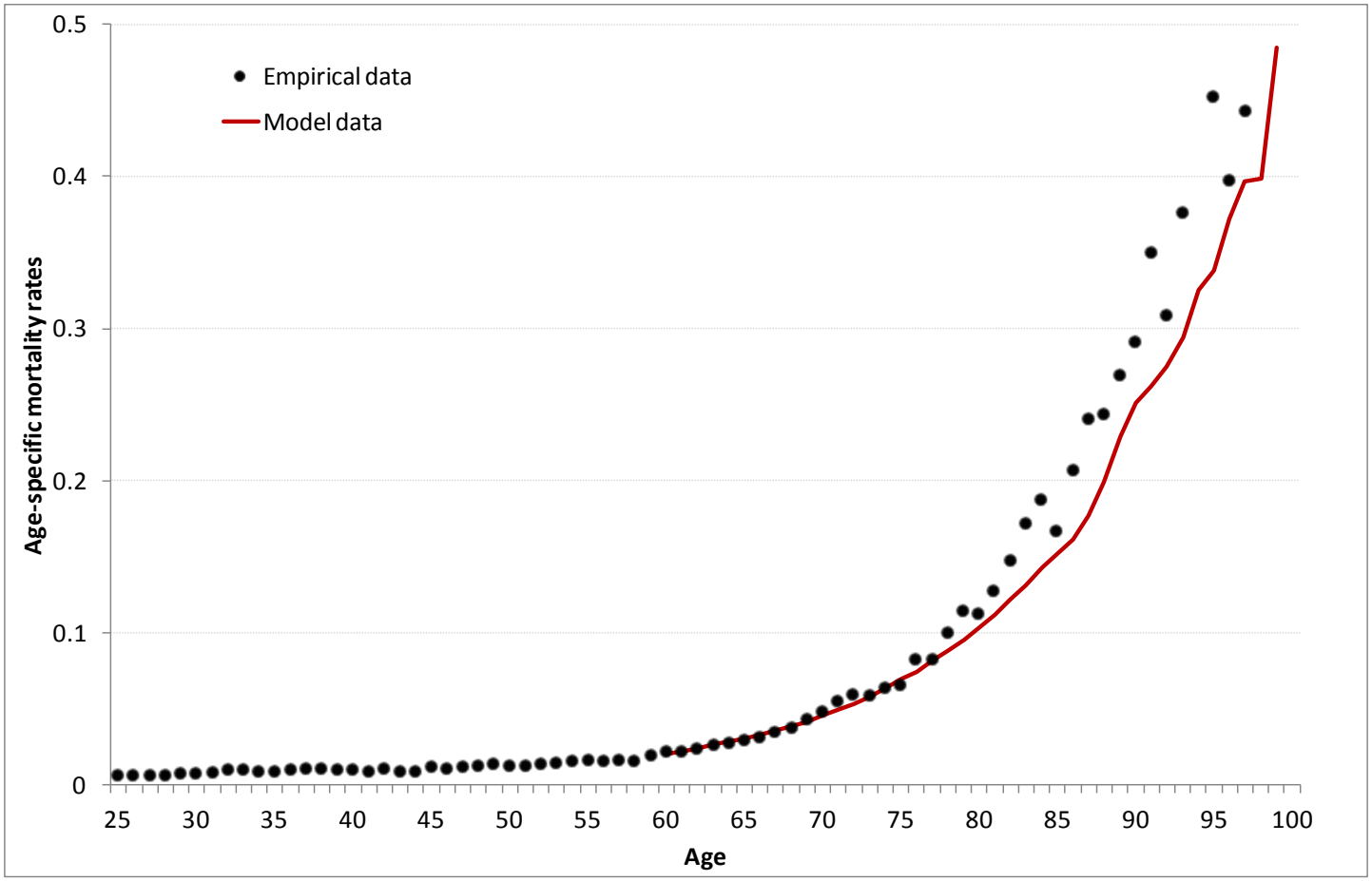
Results – cohort 1900, SWE, F.



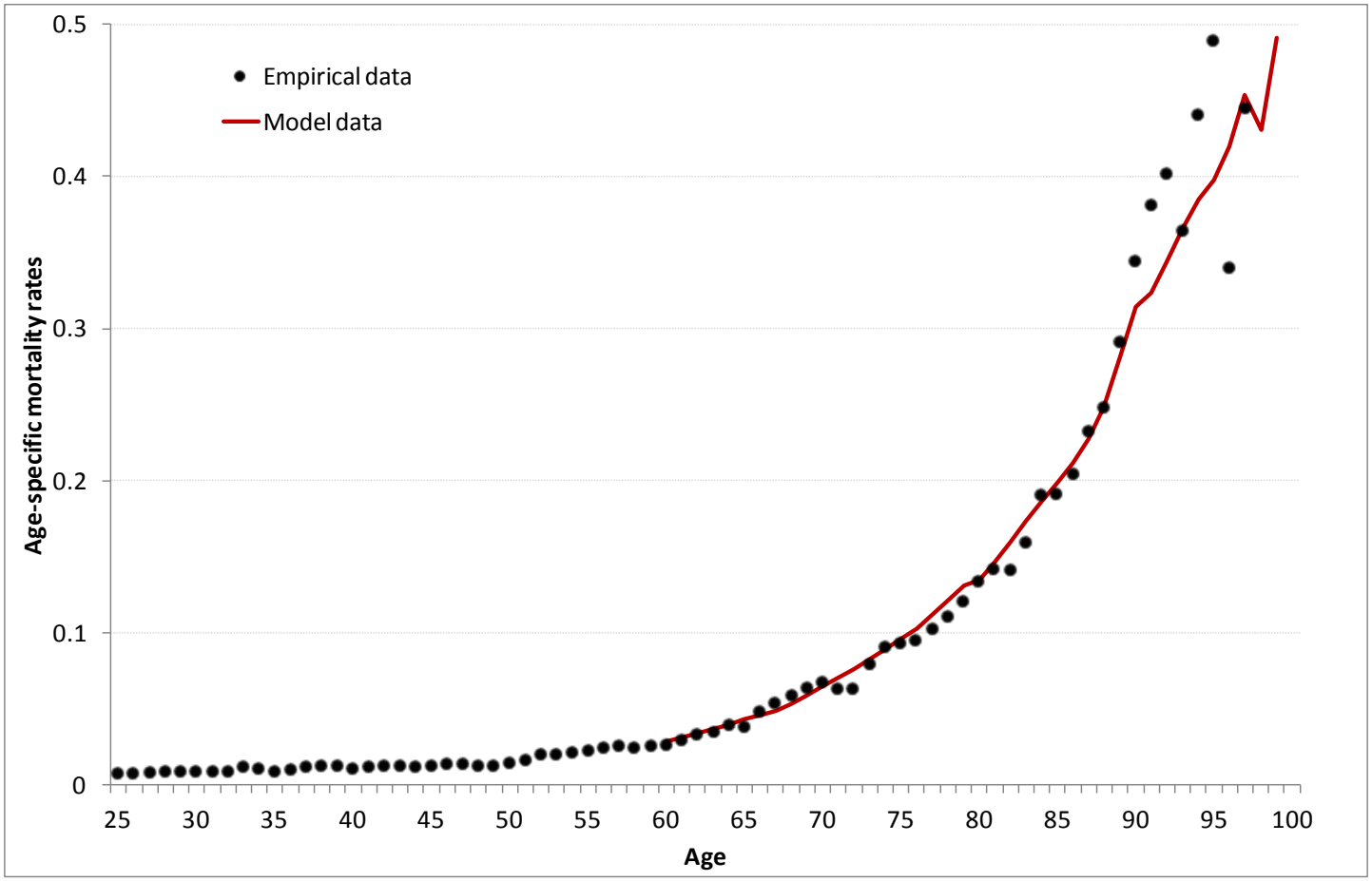
Results

- You may think, that it is not such difficult to estimate the mortality for relatively recent cohorts (born at the beginning of the 20th century)
- Let`s try some others…

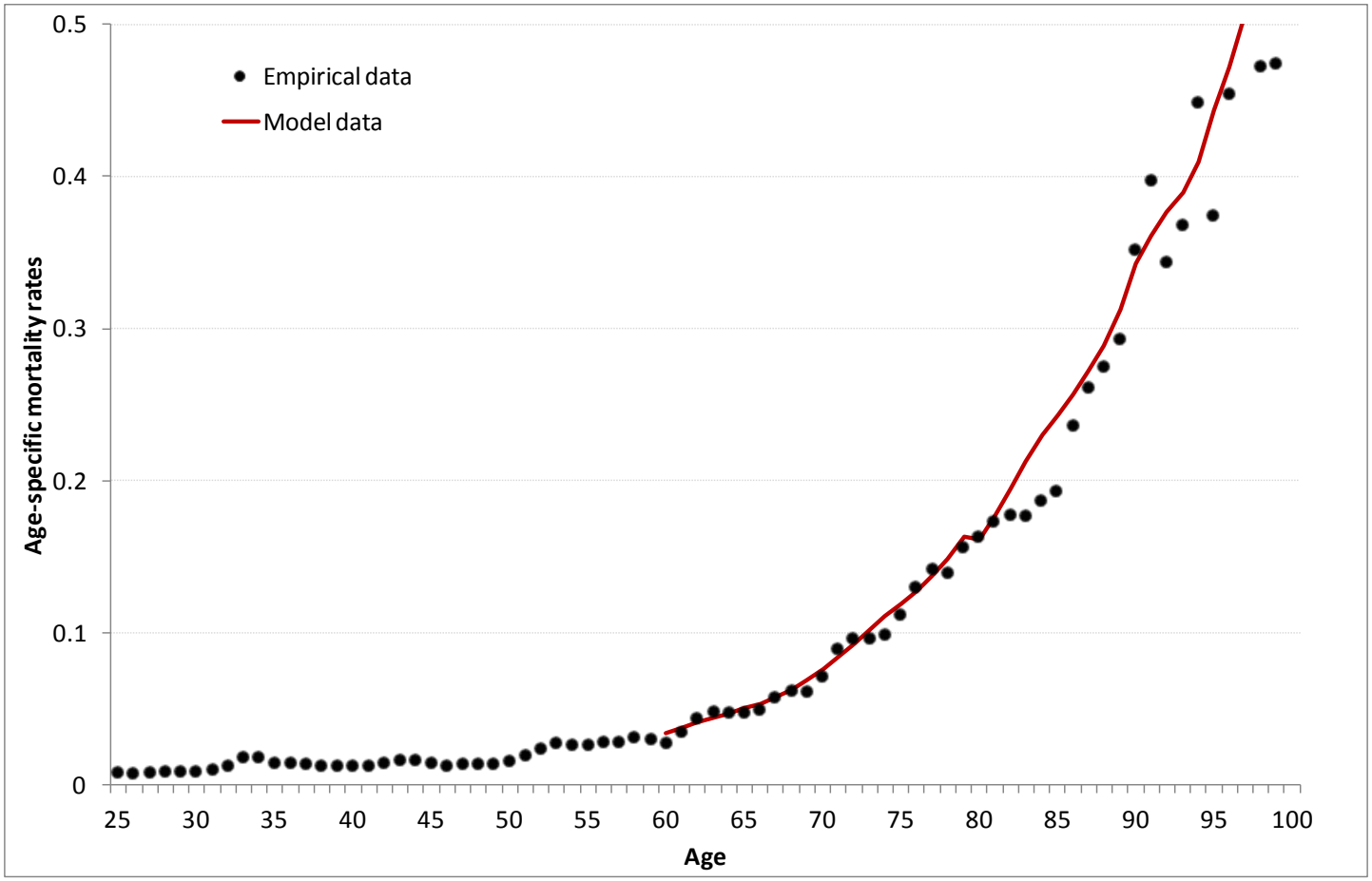
Results – cohort 1820, SWE, F.



Results – cohort 1800, SWE, F.



Results – cohort 1750, SWE, F.



Results

- Let`s go back to our model cohort 1940 – what would be the result estimated by our model in comparison to fitted functions or to transversal tables…?

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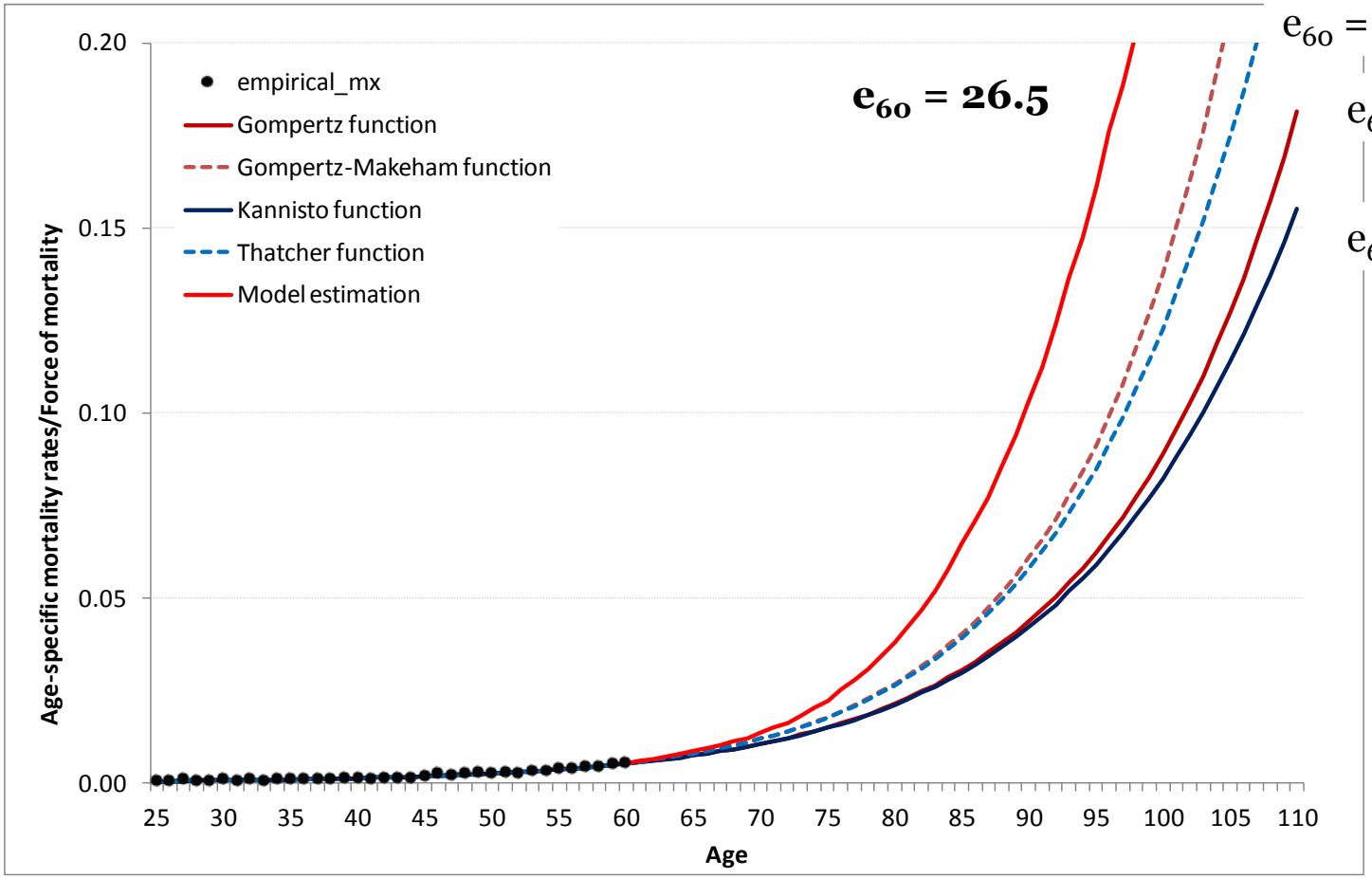
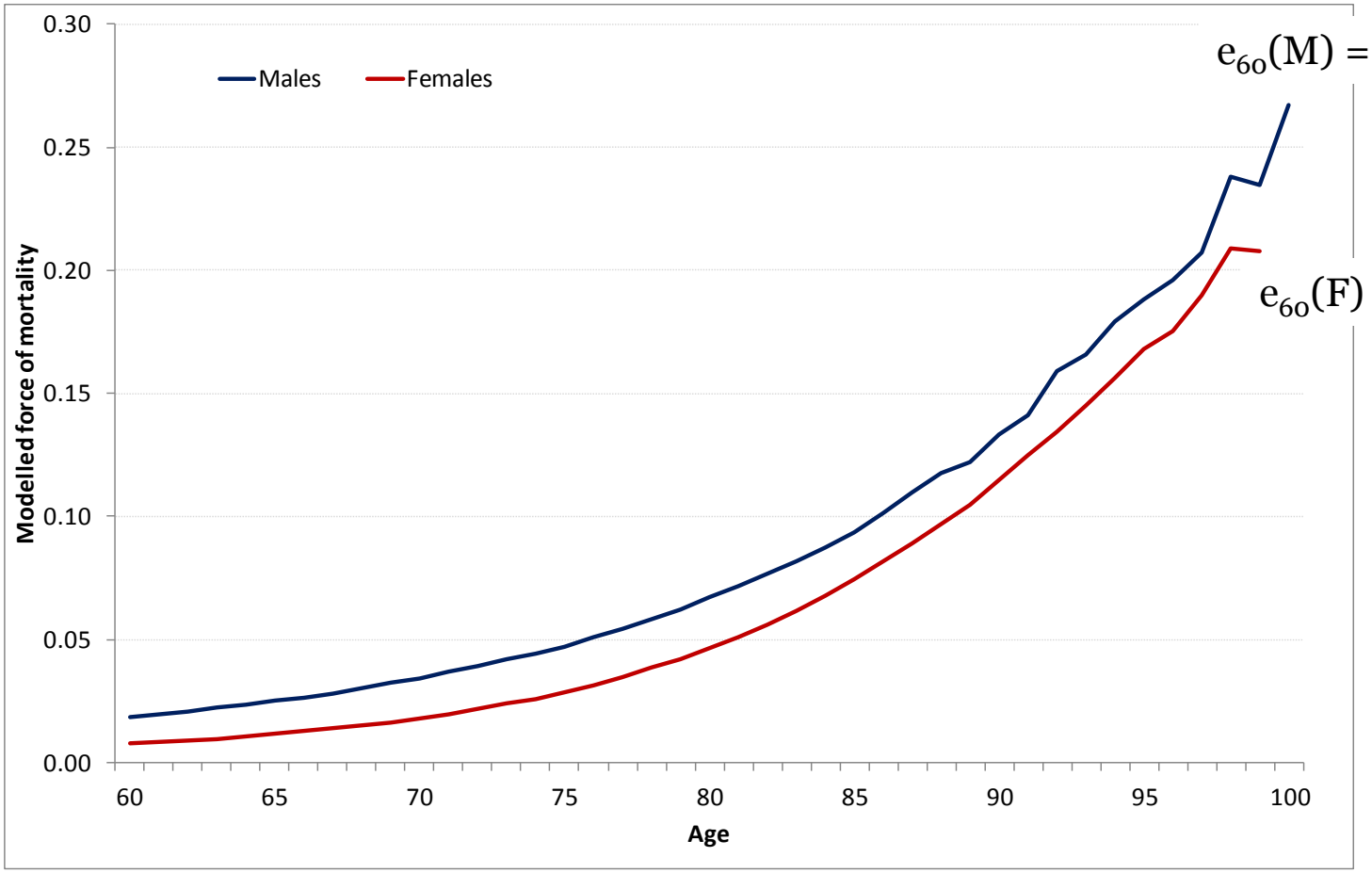


Conclusions

- NEGATIVES
  - We still need some time series of historical data
  - With less historical data the results could be weak
  - We have tried it for Sweden – the question is, what will be the results for other countries
- POSITIVES
  - Easy and simple
  - Good results, for all the tested cohorts the model fits well
  - Respects past trends but could be modified easily (for some abrupt changes in the trend)

HMD (year 2000):
$e_{60}(F) = 21.2$
$e_{60}(M) = 16.9$

Cohort 1940 (CZE)



Thank you for your attention

Looking forward to discussion…

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