Understanding Mortality Developments

History and future and an international view

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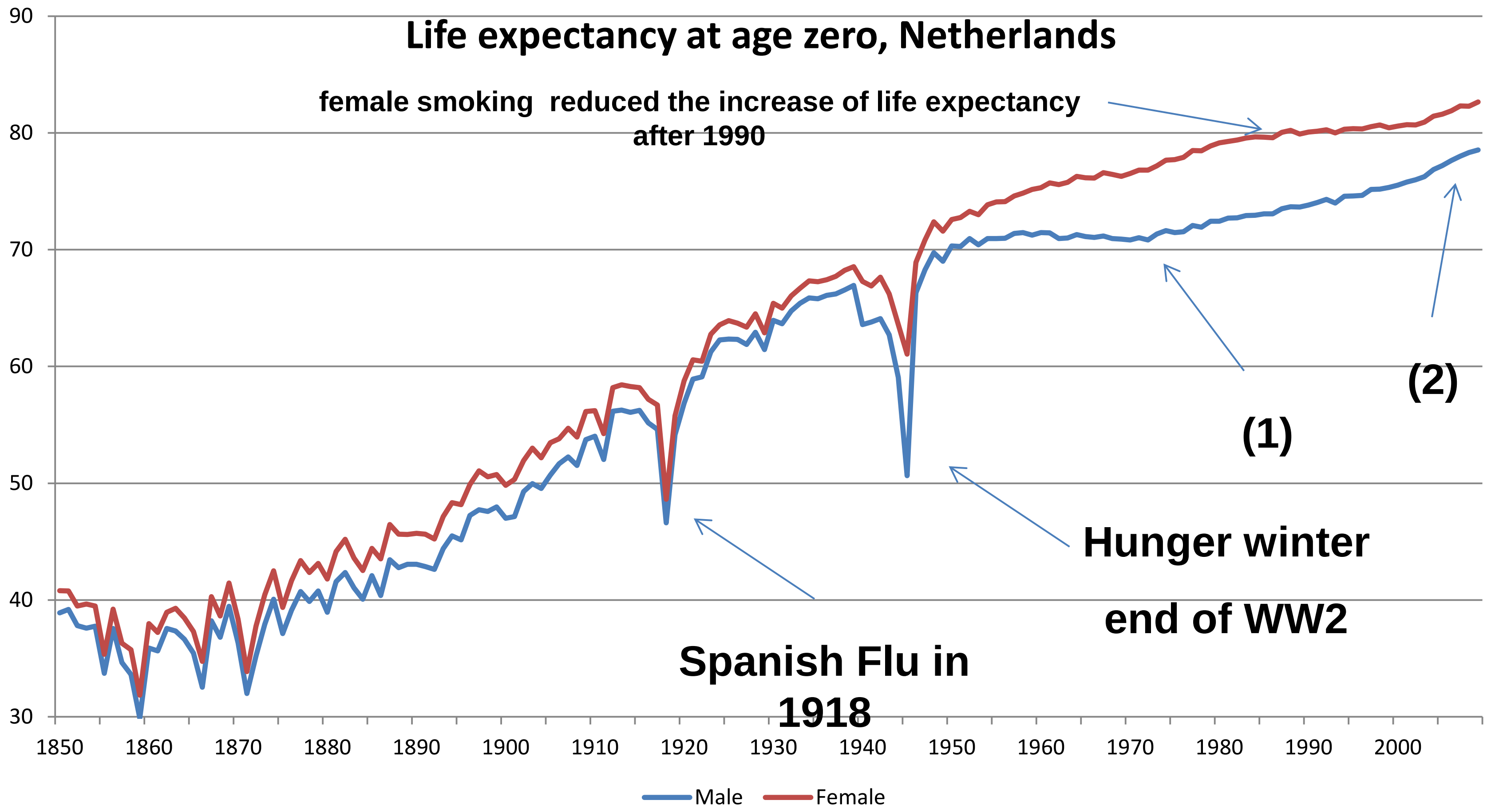
Starter

- Mortality and trend modelling is not just a mathematical and econometric exercise.
- History is a bad predictor of the future.
  - Expert judgement need to be added, particularly from a medical/demographic view
  - What happened in the past should first of all be understood

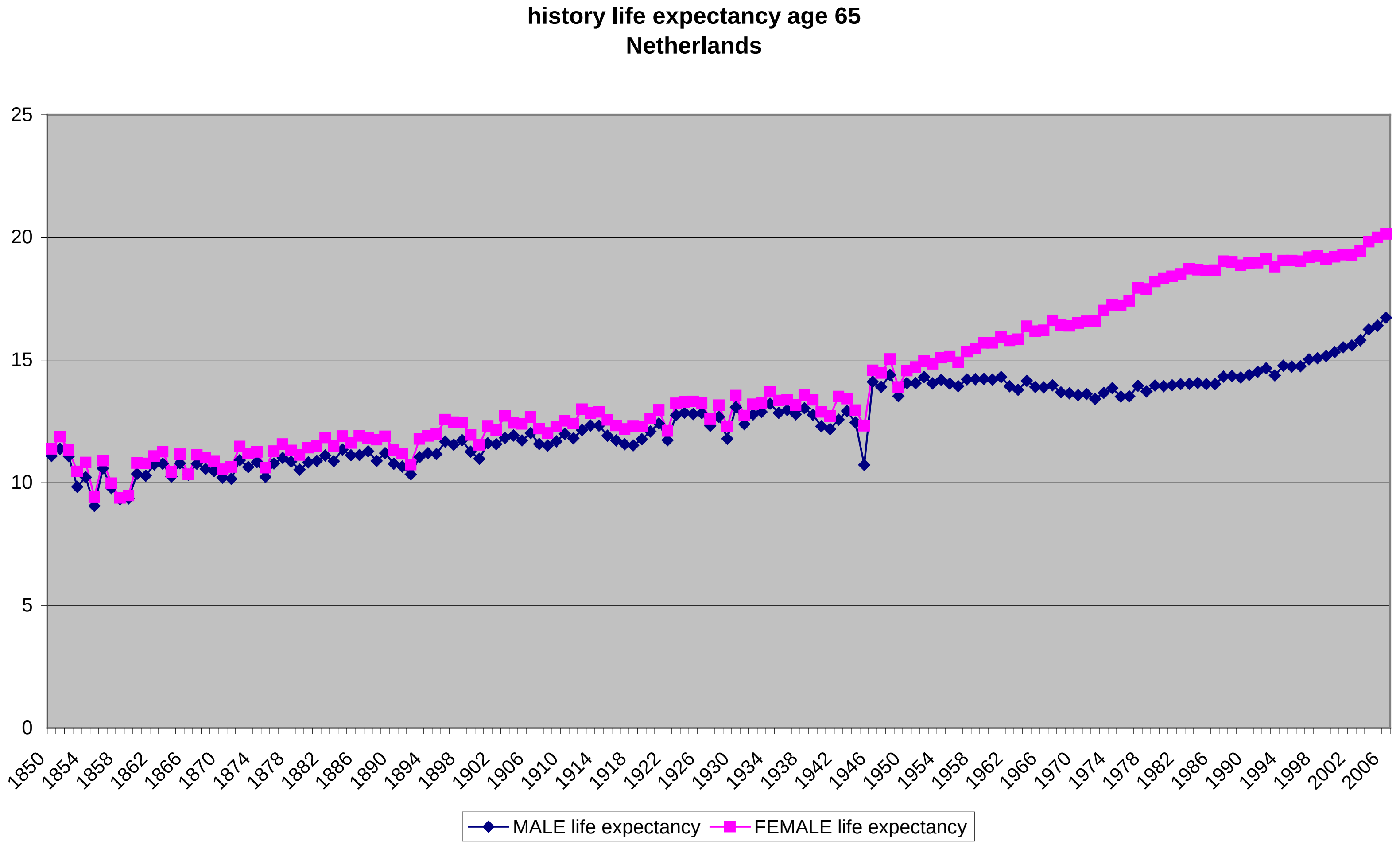
Content

UNDERSTANDING THE HISTORY

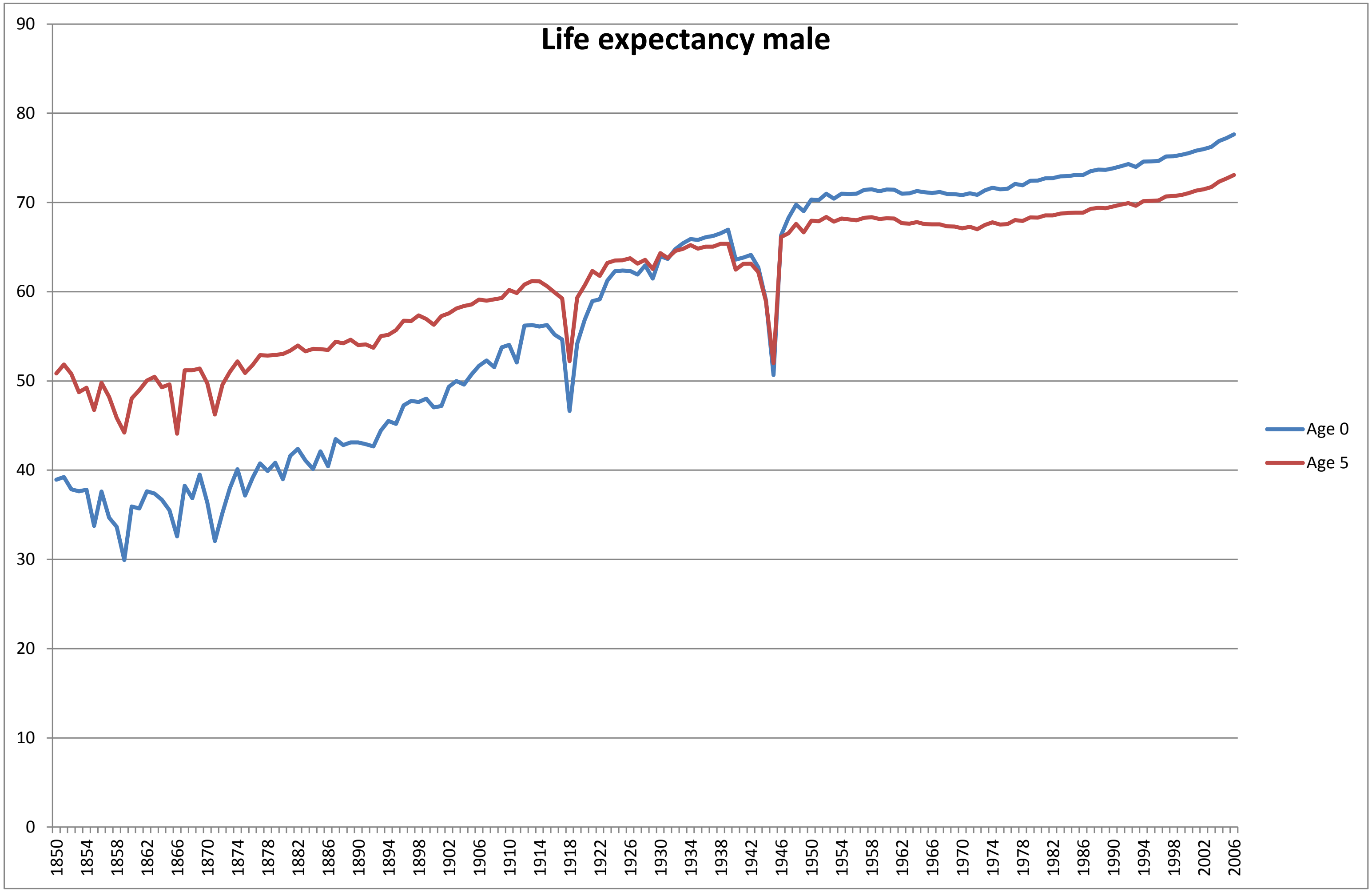
We should understand the history



We should understand the history



We should understand the history



EXPLAINING THE HISTORY

Explaining the history

- (1) The “Hump”
  - In the early 50[ts] for the ages 45-75 for male the mortality rates went up. This was caused by:
    - Smoking of cigarettes
    - Traffic accidents
    - Heart failure
  - All these impacts are the result of behaviour
    - Smoking
    - Eating habits in combination with less healthy exercise habits
    - More driving in cars
  - This flat period of development make the insurers not aware of the potential longevity risk in their portfolio

Explaining the history

- (1) The "Hump" (cont.)
  - During the seventies all three causes changed
    - Less smoking for male
    - Traffic get safer (in 1969 yearly more than 3000 traffic deaths in NL, nowadays around 600)
    - Medical developments regarding heart attacks in combination with a healthier way of living (healthier food, more exercise)
  - … and the mortality rates went down again

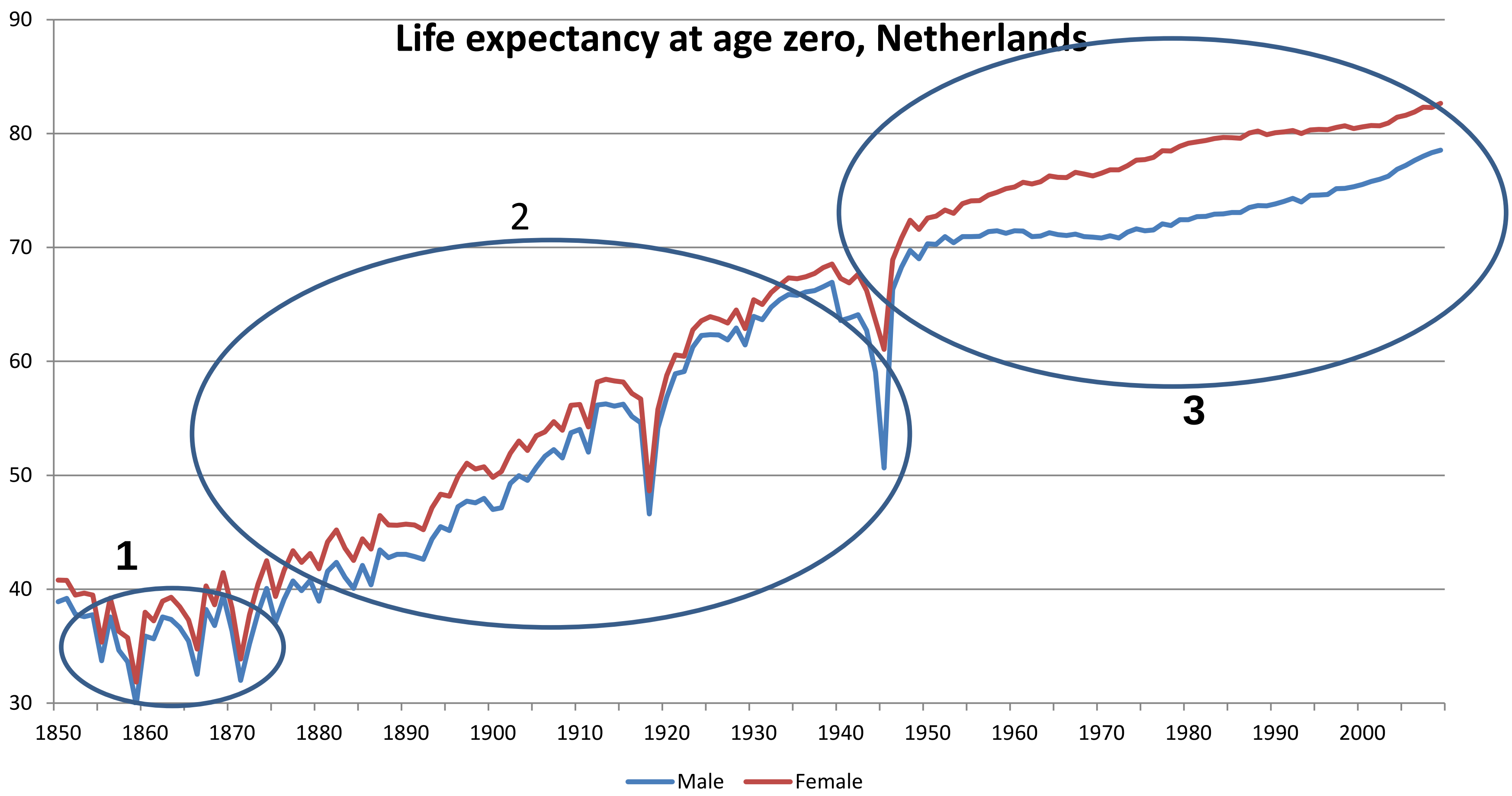
Explaining the history

- (2) Trend change in 2001
  - The increase of the life expectancy suddenly went up to more than 0.3 years per year (before that between 0.15 and 0.2), both for male and female
  - Happened in almost the whole Western World
  - Reasons
    - Continuation of less smoking (particularly male)
    - Angioplasty as a treatment in case of an heart attack. This increased the survival chance dramatically

Mortality development

- The development of life expectancy depends on:
  - Medical development
    - And is it available?
  - Behaviour
    - Drinking, smoking, eating habits,...
  - Environment
    - Drinking water, one of the most important reasons of the increase of the life expectancy in the developed countries
    - Pollution
      - Water, air
    - Climate
      - And so climate change
  - New diseases
  - Resistance against medicines (antibiotics)

We can split development in 3 parts:



We can split development in 3 parts

- (1)
  - No development of e(0)
  - High volatility
    - People less protected against extreme weather, flu epidemics
    - Tuberculosis
  - High mortality for young children
    - In 1850: e(0) male: 38.3; e(5) male: 50.8!
  - Comparable with the underdeveloped countries

We can split development in 3 parts

- (2)
  - After the industrial revolution
  - Steep increase of life expectancy
    - Medical developments
    - Cleaner drinking water
      - Seen as THE most important reason for improvement
    - Environment
      - Better protection: heating in houses, toilets etc.
    - Comparable with emerging countries

We can split development in 3 parts

- (3)
  - Typical for developed countries
  - Developments like the quality of drinking water are reaching the limits
  - Change in life expectancy depends more of:
    - Behaviour
    - Medical developments
  - Both can have positive or negative effects.
  - Particularly behaviour can cause more independency in development between male and female.

TRENDS, HOW TO MODEL?

How to model?

- In (1) and (2) it is rather easy to predict the future using the history
- In (3) this is very complex. History can hardly be use as dataset to predict the future.
  - More shocks (like in 2001) can be expected
  - Also a decrease of life expectancies is possible in the coming 50 years:
    - Climate change
    - Resistance of antibiotics.
    - Behaviour (obesities)
    - …

How old can a human become?

- The oldest confirmed human became 122 years and 164 days
- Jeanne Calment
- Born: 25 February 1875
- Secret?

- On all her food olive oil
- Port wine diet
- 1 kg of chocolate a week

How old can a human become?

- It cannot be proven that the max age is increasing
- Medical experts mention that a real life span exist per person, depending on the genetic passport, but will be limited to around 125-130 years.
- Mortality rates seem to be almost constant above age 105 at a level 0.5-0.6.

Conclusion (from my side)

- Pure mathematical models to predict the future mortality are less accurate
- Expert judgment is always needed for several decisions moments
  - Particularly input from the medical world is needed
- There is also a risk that the life expectancies are getting lower than expected

NEW STOCHASTIC TREND MODEL

New stochastic model

- Recently developed a new stochastic model for trend uncertainty
- This model is based on a multi-drift simulation, not the one-year volatility.
- Creates both one-year risk as multi-year risk measurements

New stochastic model

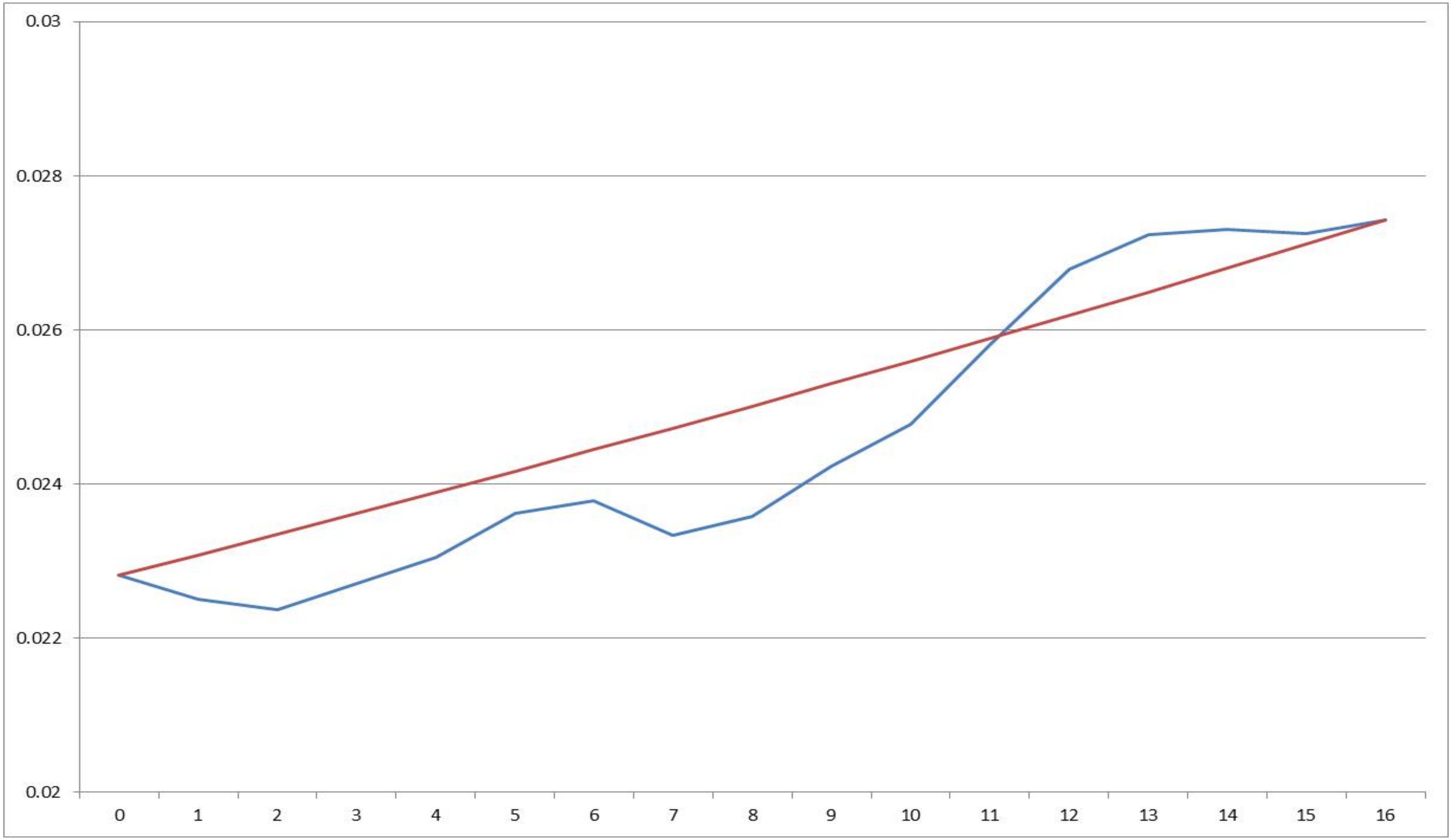
- Like in Lee Carter mortality development can be split in a drift plus a one year volatility.
- Other than in LC the volatility is not used to project future mortality, but the drift is analysed.
- To reduce the volatility a two-years average is taken
  - Volatility should be modelled as a separate sub-risk (later more)

New stochastic model

- The period we are analysing is first split into 16 years periods
- Each 16-year period is split into 2 8-year periods
- Each 8-year period is split into 2 4-year periods
- Each 4-year period is split into 2 2-year periods.

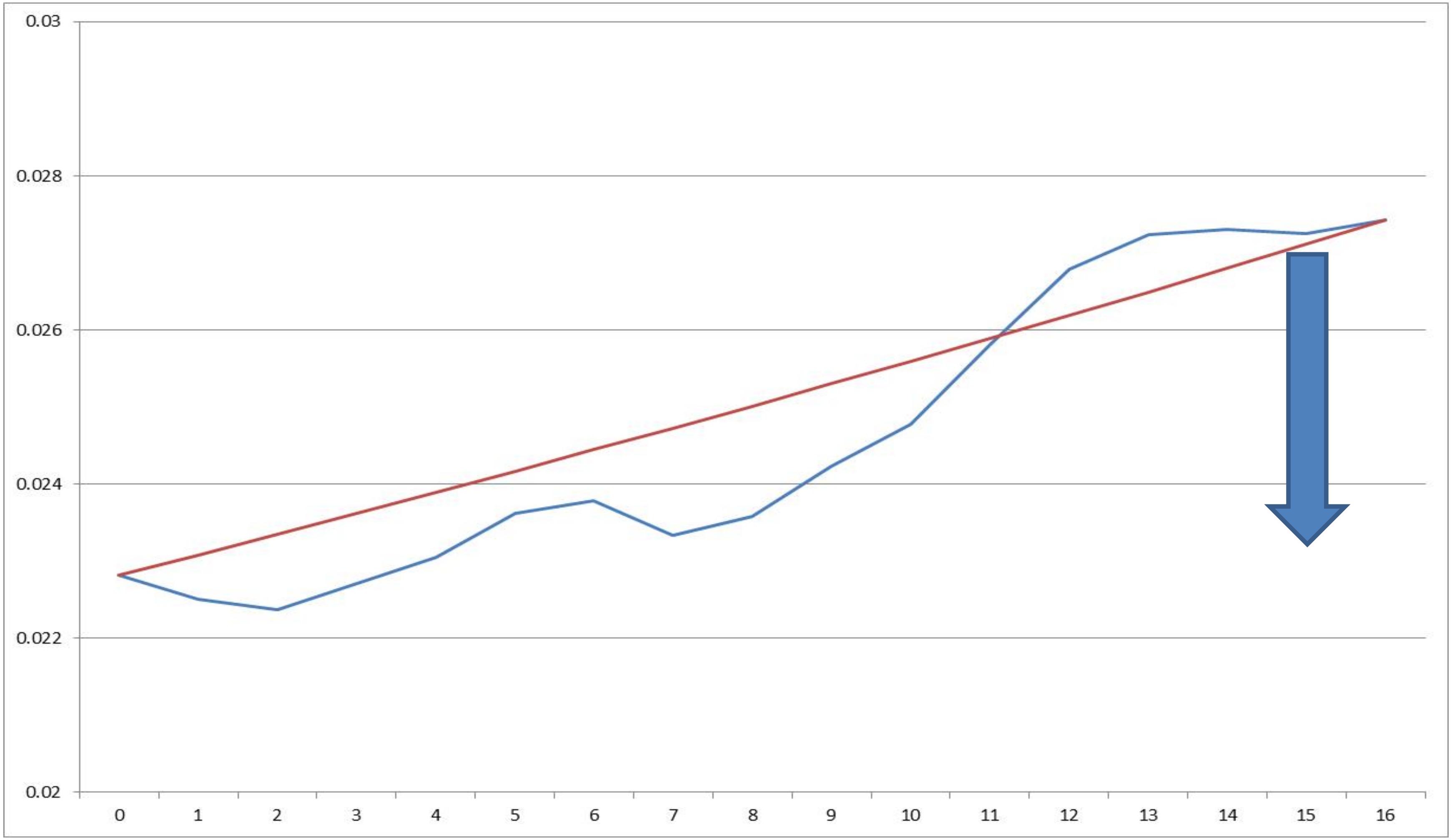
Example

16 year drift



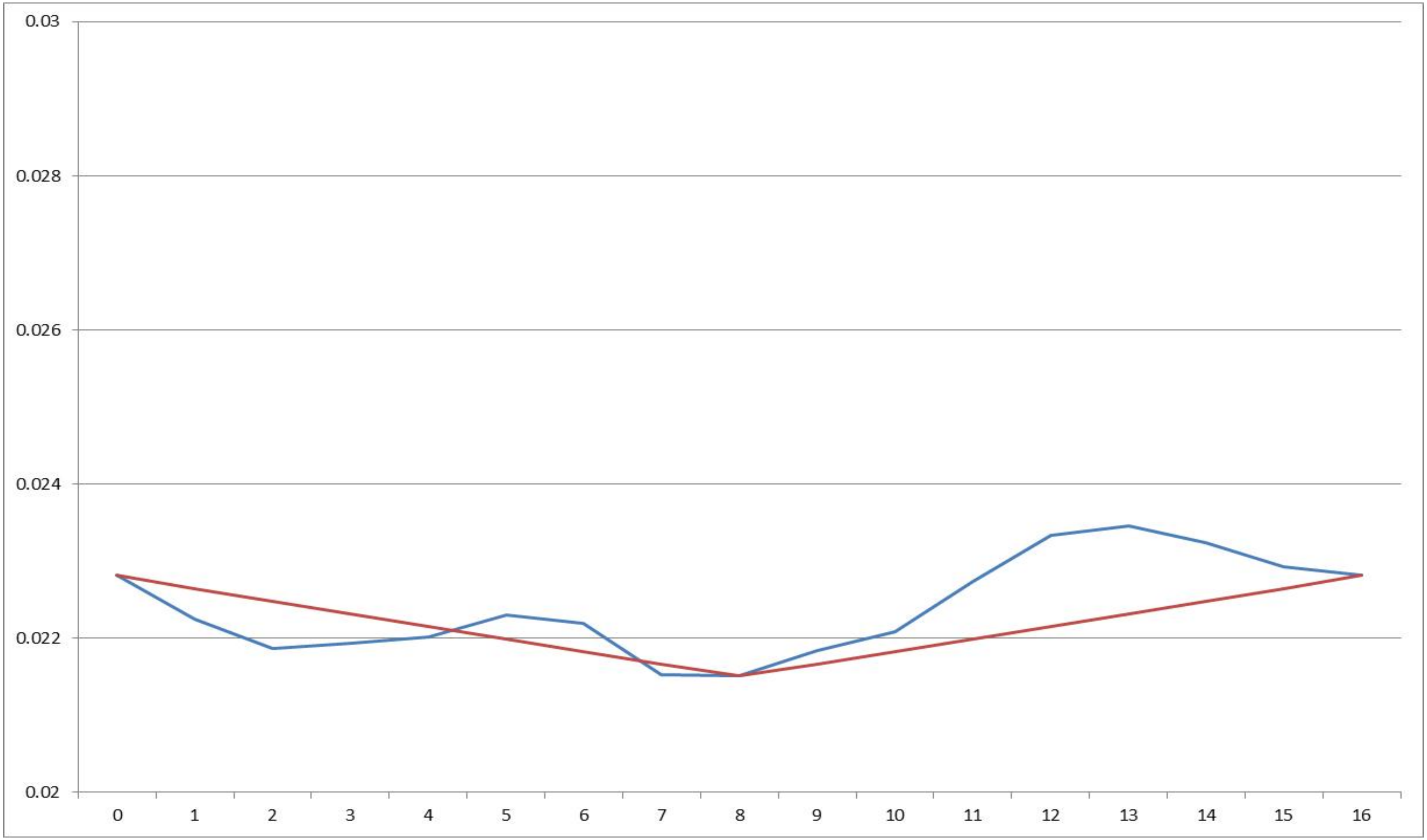
Example

16 year drift



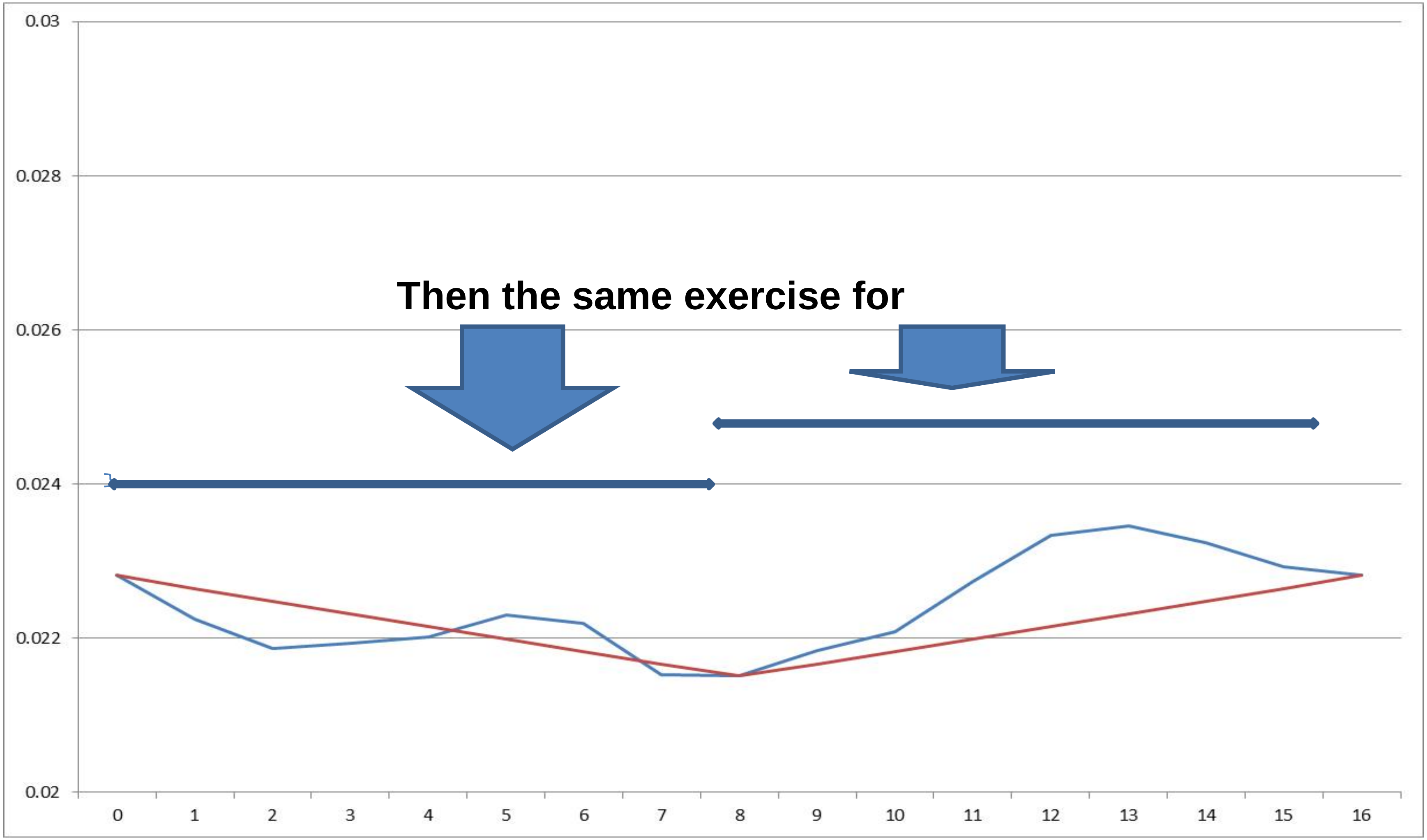
Example

8 year drift



Example

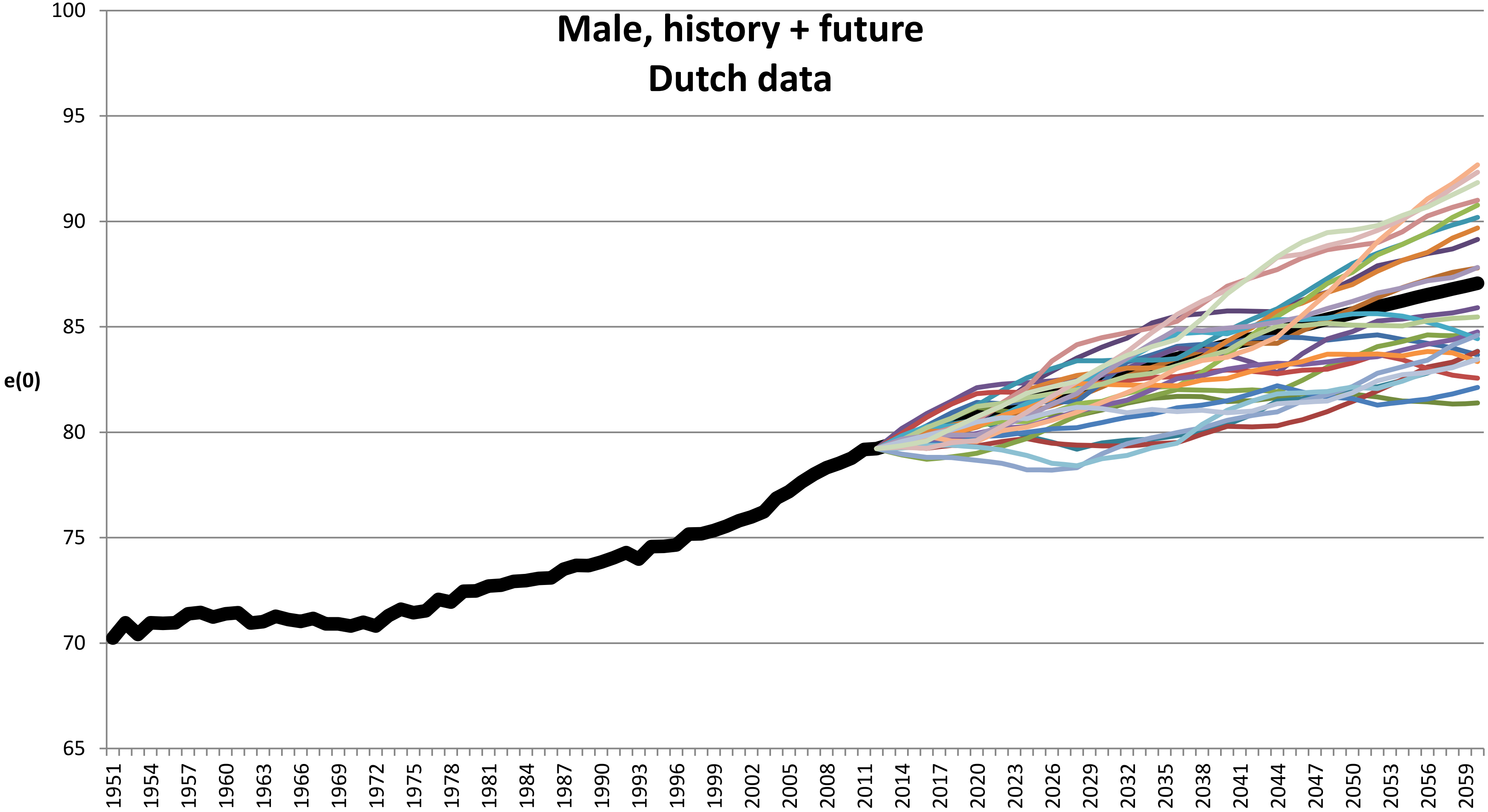
8 year drift



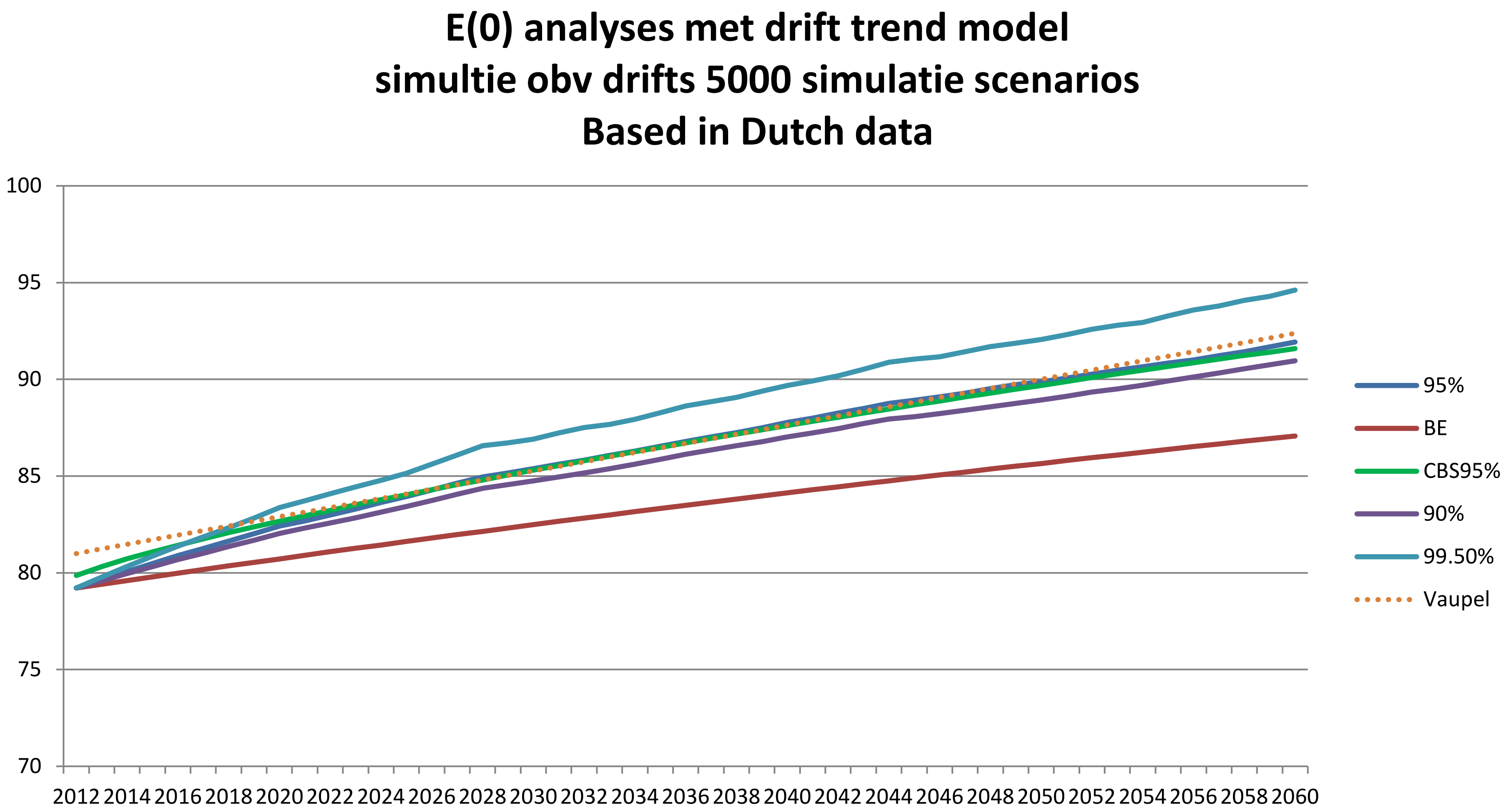
How to use?

- Now we have many scenario’s
- Before going into a simulation these scenario’s are translated into the measurement we want: e.g. life expectancy or liabilities over a portfolio
- In this way dependencies are taken into account
- The distributions are defined around the life expectancies or liabilities
  - For the e(0) in this presentation I used Normal, with some (negative) skewness

Results of the new model



First outcomes



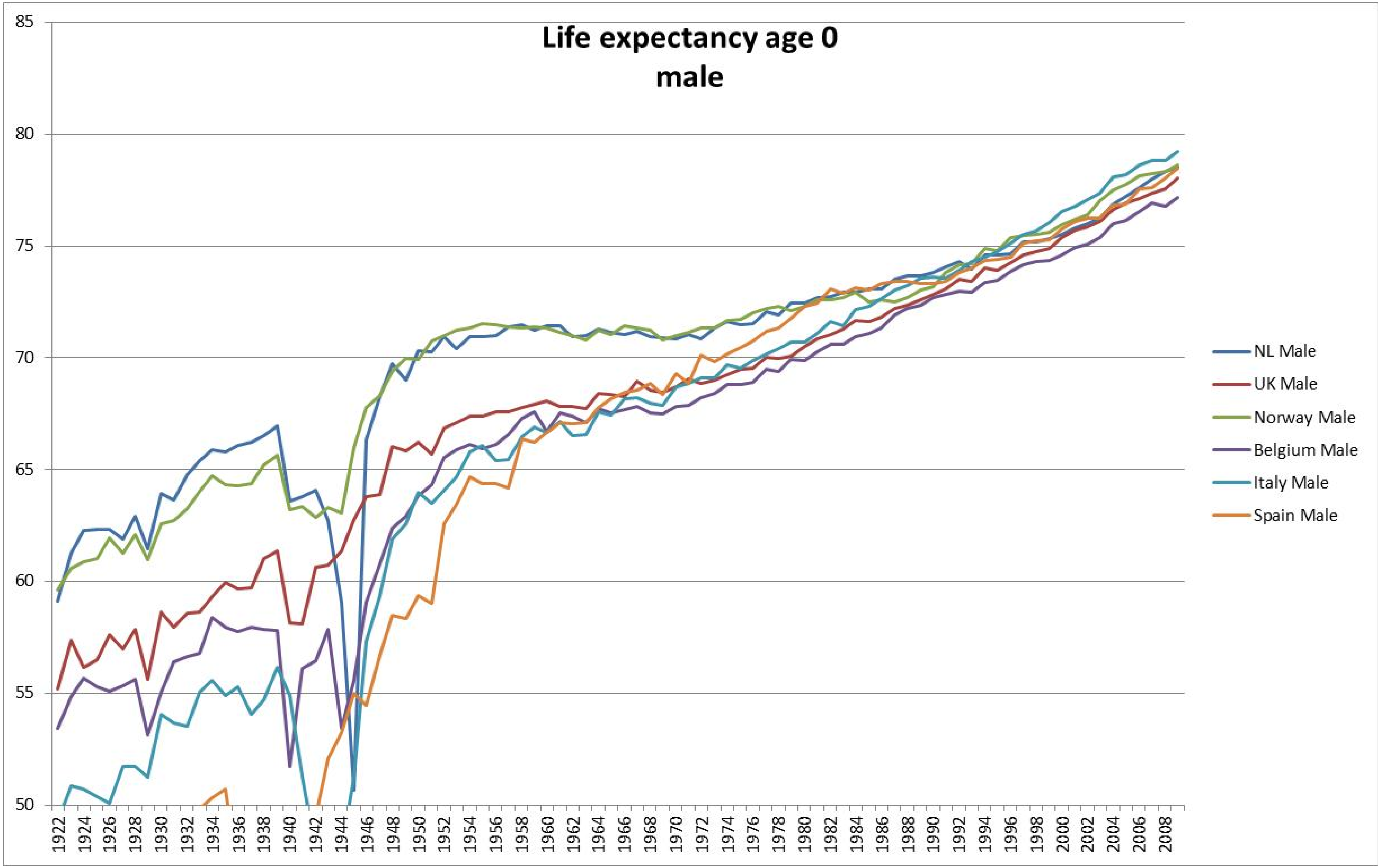
INTERNATIONAL VIEW

International view

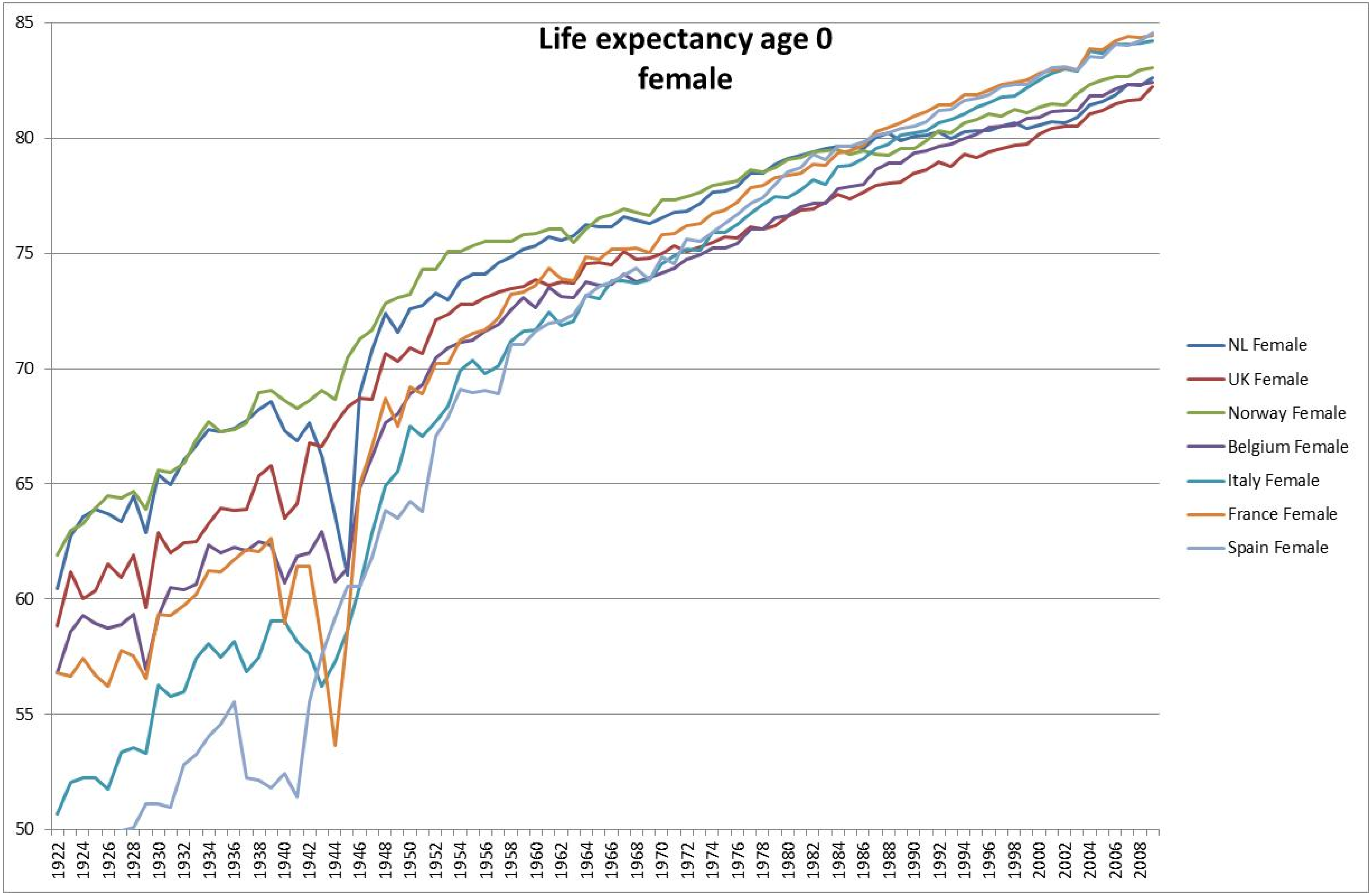
- Following the ideas countries that are in situation 3 should have comparable trend developments (same level of development)

- Also following several studies the uncertainty should be comparable over the countries (I would like to add: “under the same circumstances”) and can be used in case a lack of data exist in a country
  - Li Lee
  - CBS

Countries in (3)



Countries in (3)



Countries in (3)

Model outcomes for male

male	*2012*	*BE 2060*	*2060 incl. 95% unc.*	*95% uncertainty*
AUSTRIA	78.24	88.13	92.66	4.53
BELGIUM	77.78	86.28	90.80	4.52
DENMARK	77.82	87.17	92.34	5.17
FRANCE	78.62	88.46	92.50	4.04
ITALY	79.96	88.66	93.78	5.13
NETHERLANDS	79.28	87.85	92.82	4.97
NORWAY	79.36	87.77	92.77	5.00
UK	78.99	89.39	93.19	3.80
USA	76.84	85.91	89.95	4.04
SWISS	80.57	89.27	92.80	3.53
SWEDEN	79.97	87.24	90.53	3.29
FINLAND	77.38	87.49	92.78	5.29
CANADA	79.65	88.85	92.33	3.47

Countries in (3)

Model outcomes for female

female	***2012***	***BE 2060***	***2060 incl. 95% unc.***	***95% uncertainty***	
AUSTRIA	83.53	90.89	94.51	3.62	
BELGIUM	82.92	88.78	92.53	3.75	
DENMARK	81.91	89.31	94.43	5.12	
FRANCE	85.03	91.75	94.92	3.18	
ITALY	84.84	91.58	95.80	4.22	
NETHERLANDS	82.94	88.37	92.74	4.37	
NORWAY	83.60	89.83	93.99	4.16	
UK	82.83	90.26	93.83	3.56	
USA	81.44	86.48	90.07	3.59	
SWISS	84.79	90.69	93.59	2.90	
SWEDEN	83.77	88.51	91.32	2.81	
FINLAND	83.81	91.49	95.80	4.31	
CANADA	83.74	89.49	92.56	3.07	

Conclusions/developments

- Indeed the uncertainty results of comparable countries are close, but still under research:
  – Larger countries have a somewhat lower uncertainty
  – Need to look at Sweden and Swiss

- Now working on optimizing distributions (skewness) and adding conditional modelling.
- Also adding Latin America and more information about Asia

Conclusions/developments

- Paper
- I'm working on a paper to get this all more "official"
  - 2 professors (from University of Trieste and University in Rio) and the IAA support me on this

ING

- In ING we have to deal with countries with higher mortality than in for example the Netherlands, but also a much steeper trend
- These countries are still in (2) but most likely will grow into (3)
  - E.g. some Central European Countries
    - Not in the same speed
  - Korea versus Japan

ING models

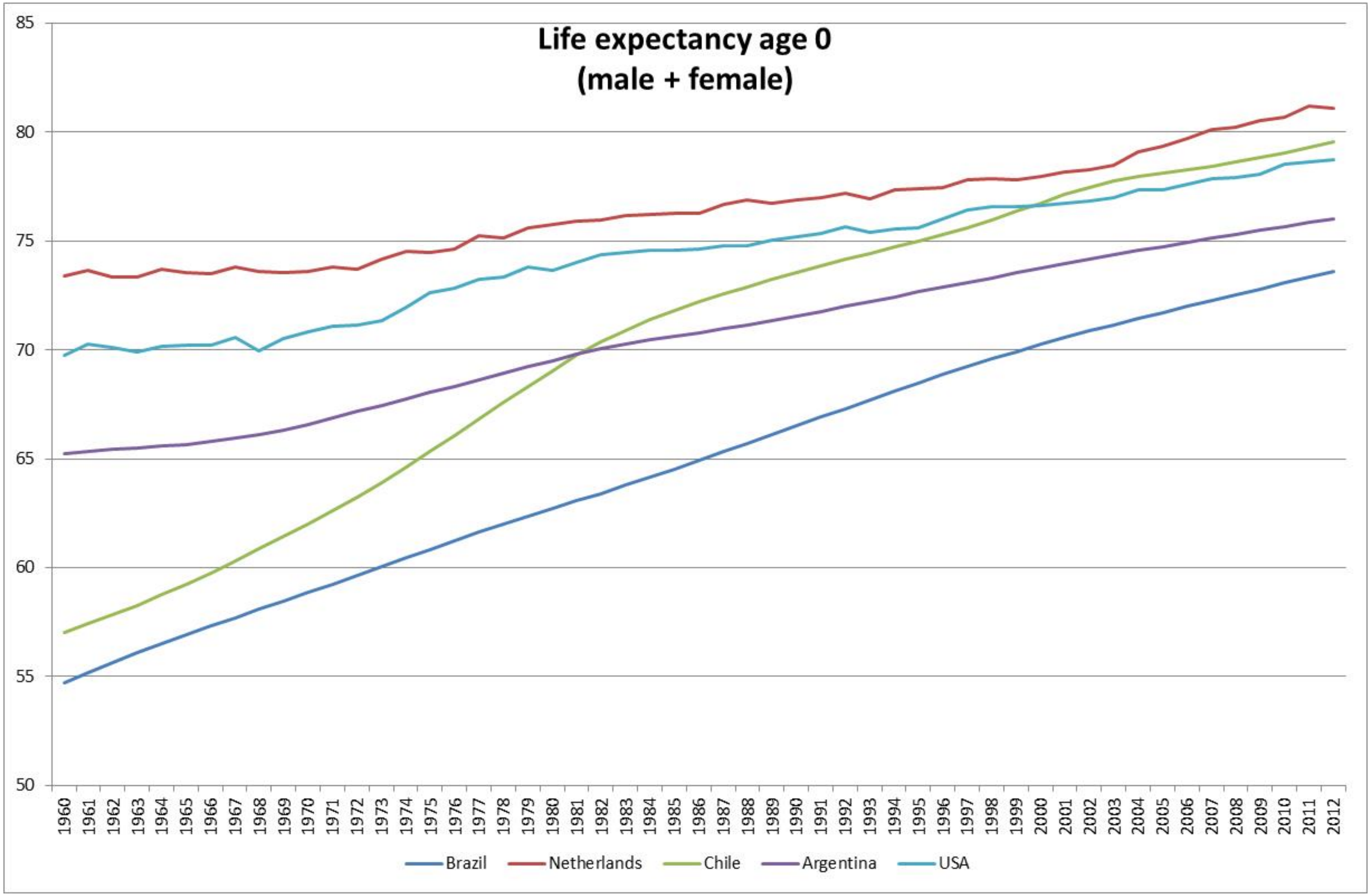
- The ideas in this presentation and in the following paper were already in use in setting Best Estimate Mortality for several countries.
- Life expectancy in CE grows to the LE in Western European countries
- Life expectancy in South Korea grows to the LE in Japan

- In case not enough data is available the scenarios to calculate uncertainty are based on Western Data

What about Brazil?

- In the next couple of sheets it is shown how Brazil mortality develops compared to several other countries or country groups
- (data World Bank)

What about Brazil?


Life expectancy age 0
(male + female)
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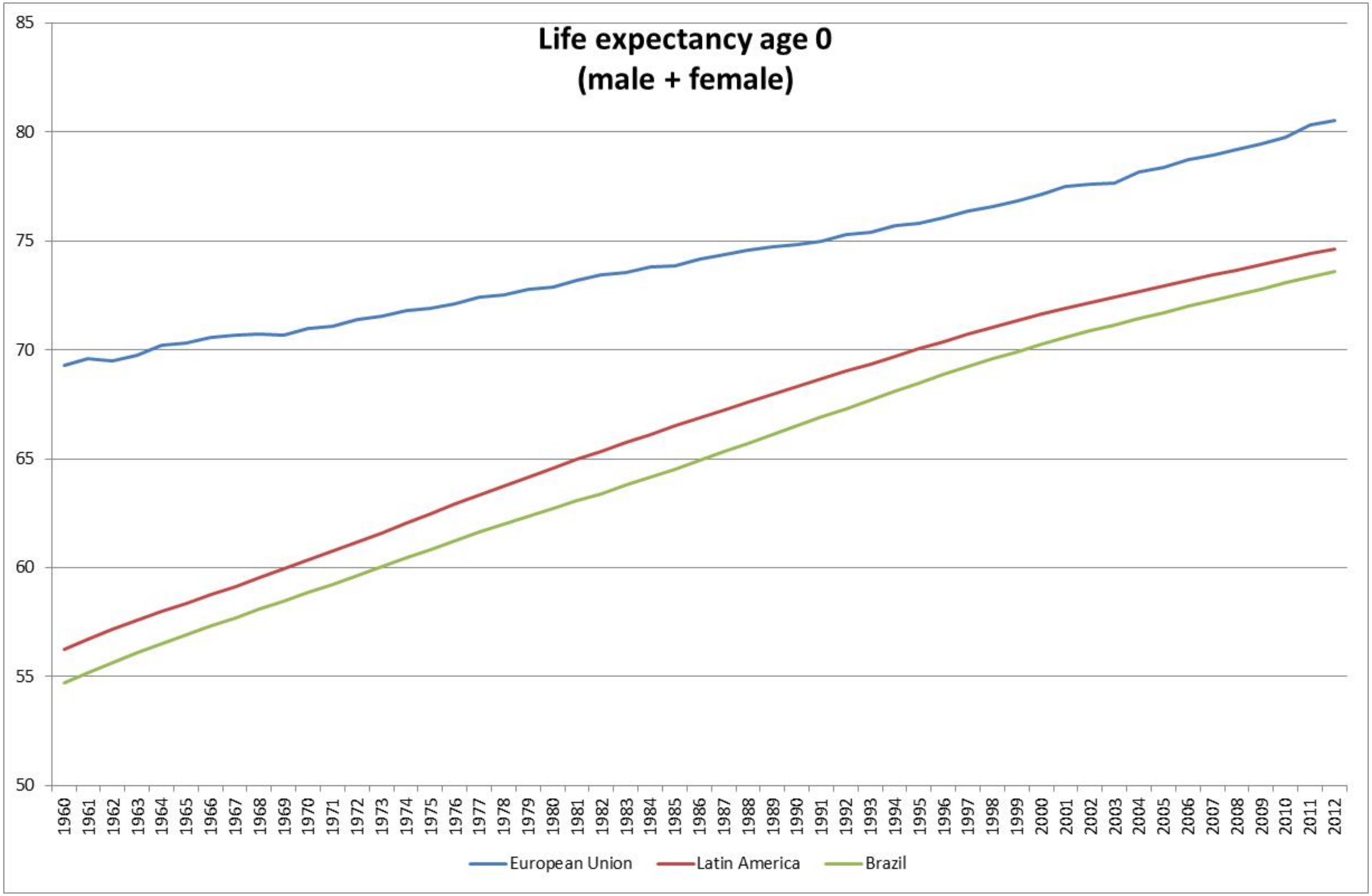
Life expectancy age 0
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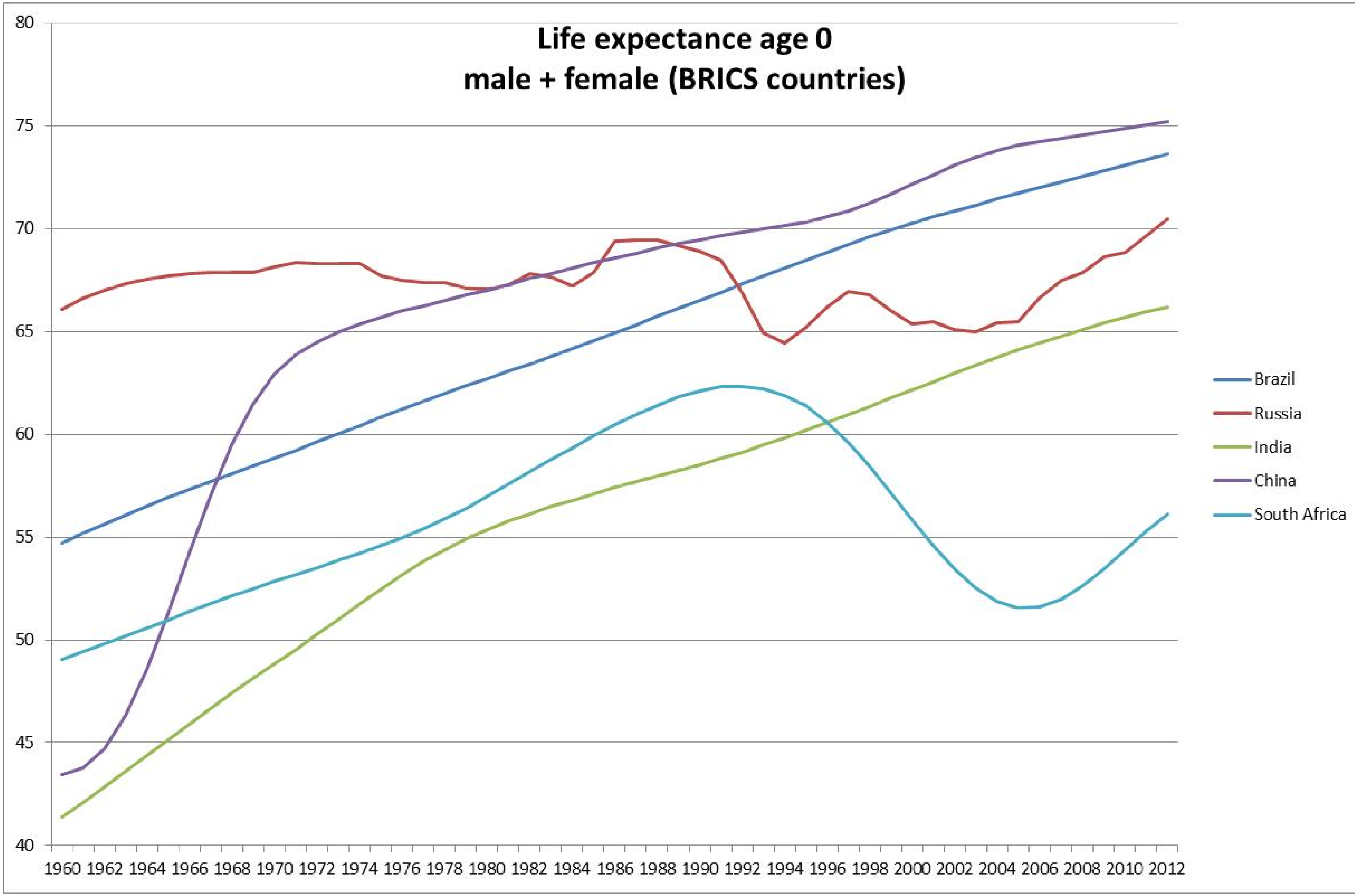

Life expectance age 0
male + female (BRICS countries)
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1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012
Brazil
Russia
India
China
South Africa

Some conclusions

- Increase of Life Expectancy in Brazil higher than in “developed countries”
- Development Brazil in line (with some distance) with Latin America
- Development rather stable
- But….

Some conclusions

- But..

- Brazil too large for models proposed in this presentation

- Within Brazil all 3 categories exist
- Seperate tables / models?
  - E.g. like in Russia

Isso é tudo graças