# Improving the Information on the Mortality Situation in Hong Kong and Mexico

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# Overall goal

To improve the mortality information in Hong Kong and in Mexico by building on the Human Mortality Database approach

# Specific goals

1. Construct life table series for two countries used as case studies, namely Hong Kong and Mexico

2. Develop a set of standard data quality checks and adjustment methods

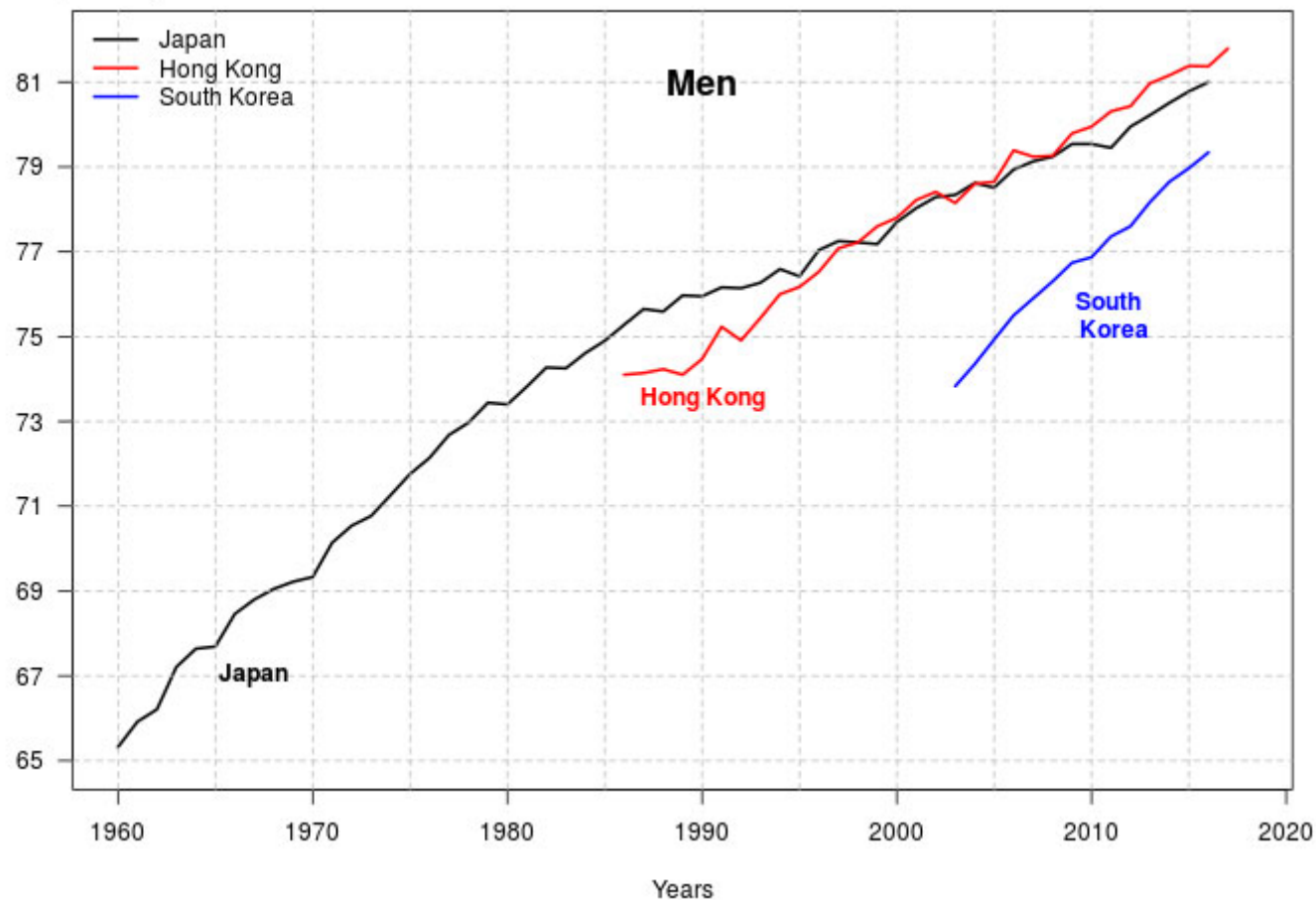3. Assess the reliability of the resulting life table series for monitoring actuarial risks

# Evaluation of Data Quality Using Fixed Set of Indicators

- We have analyzed the resulting preliminary life tables using standard diagnostics used for all HMD countries to evaluate:
  - Internal consistency
  - External consistency
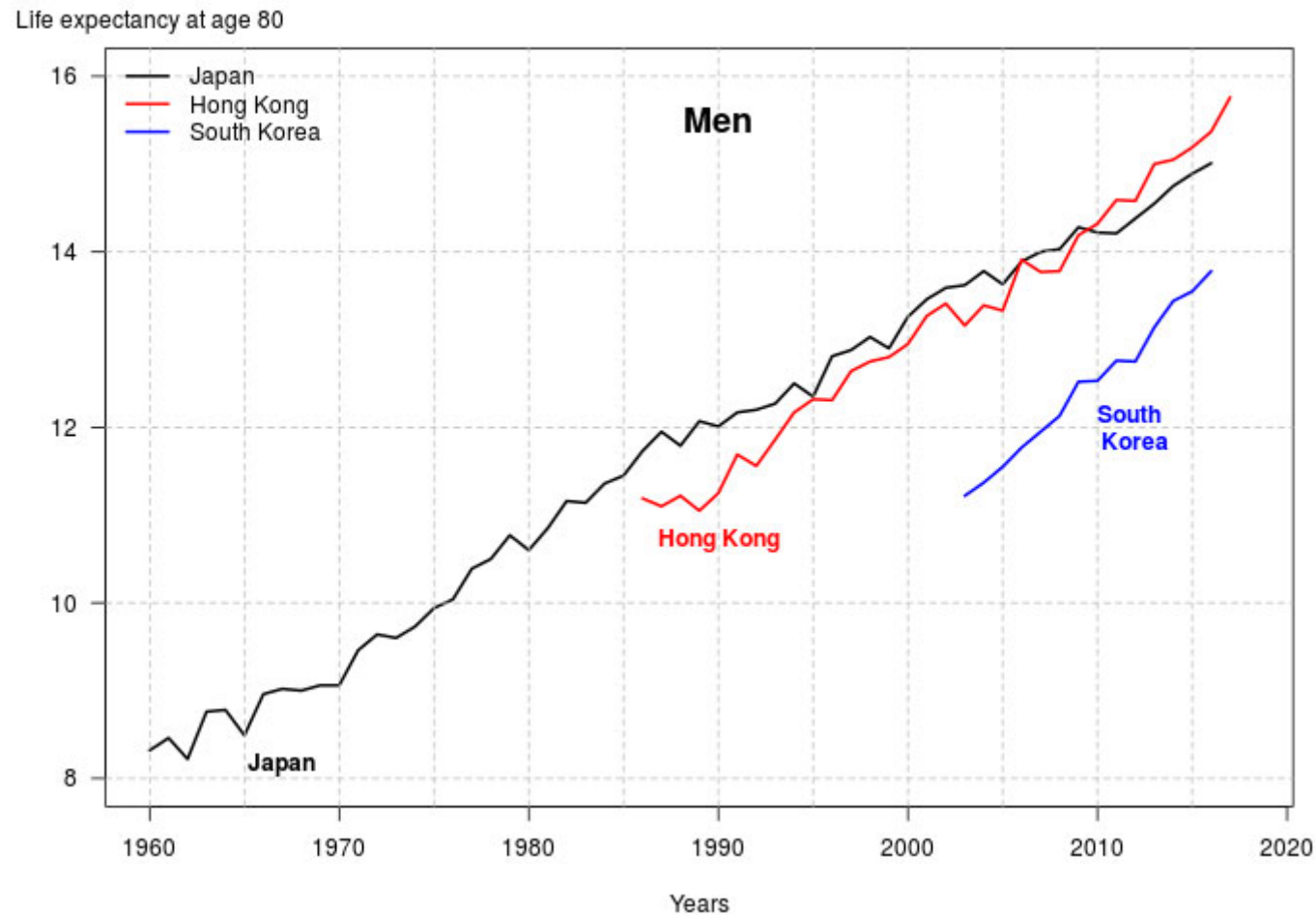  - Internal plausibility
  - External plausibility

# HONG KONG

# Comparison with
# other Asian life expectancy leaders

# Comparison with
# other Asian life expectancy leaders

# Conclusions

- In general, data quality looks excellent for this recent period (1986-).
- We decided to add Hong Kong to the HMD.

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## Hong Kong

**Background and documentation**
**Data sources**

### Complete Data Series [ Explanatory notes]

| | Available dates | Age interval × Year interval | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1x1** | **1x5** | **1x10** | **5x1** | **5x5** | **5x10** |
| **Period data** | | | | | | | |
| Births | 1948 - 2017 | 1-year | | | | | |
| Deaths | 1986 - 2017 | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
| Deaths by Lexis triangles | 1986 - 2017 | Lexis | | | | | |
| Population size | 1986 - 2018 | 1-year | | | 5-year | | |
| Exposure-to-risk | 1986 - 2017 | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
| Exposure-to-risk by Lexis triangles | 1986 - 2017 | Lexis | | | | | |
| Death rates | 1986 - 2017 | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
| Life tables | 1986 - 2017 | | | | | | |
|    Females | | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
|    Males | | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
|    Total (both sexes) | | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
| Life expectancy at birth | 1986 - 2017 | 1-year | 5-year | 10-year | | | |
| **Cohort data** | | | | | | | |
|    Exposure-to-risk | 1905 - 1987 | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |
|    Death rates | 1905 - 1987 | 1x1 | 1x5 | 1x10 | 5x1 | 5x5 | 5x10 |

### Input Data [ Explanatory notes]

| | Available dates | Data | Lexis map |
|---|---|---|---|
| Births | 1948 - 2017 | txt | |
| Births by month | Various | txt | |
| Deaths | 1986 - 2017 | txt | html |
| Population size | 1986 - 2017 | txt | html |
| Notes | | pdf | |
| Reference file | | pdf | |

# MEXICO

# Age Heaping

- Obvious patterns of age heaping in mortality rates prior to 2000.

- Some age heaping persists post-2000 among men aged 30-49.

- If there is age heaping, there may also be more serious forms of age misreporting (i.e., age exaggeration), which is more difficult to diagnose.
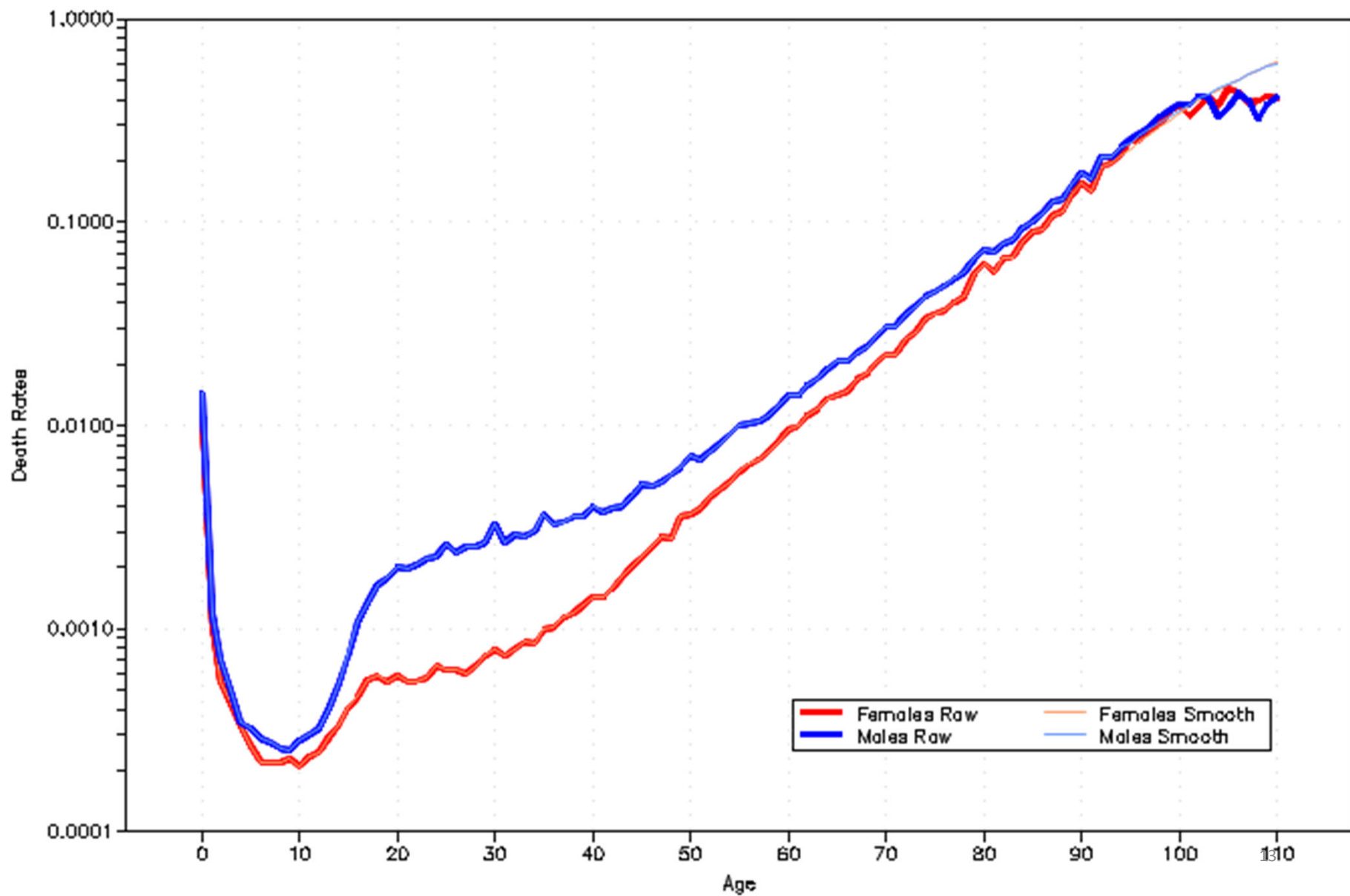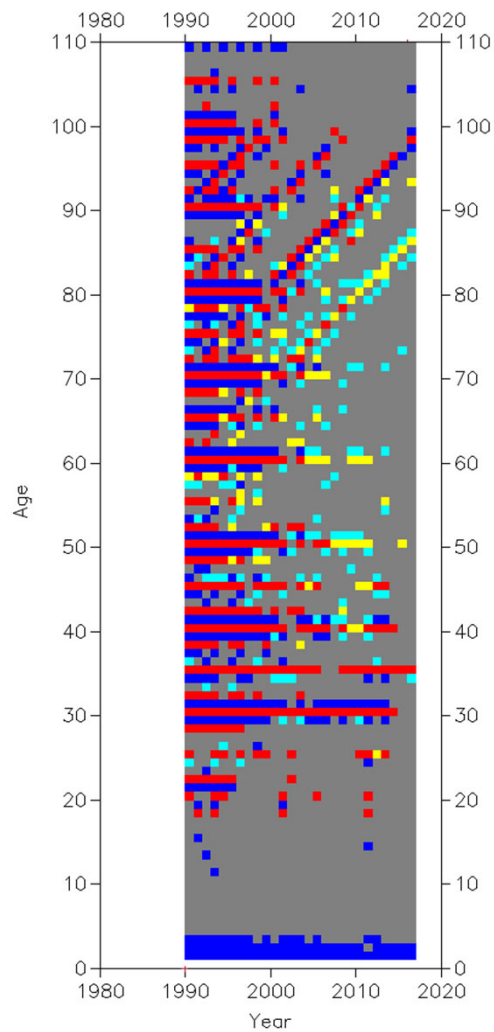
# Death Rates by Age, 1990
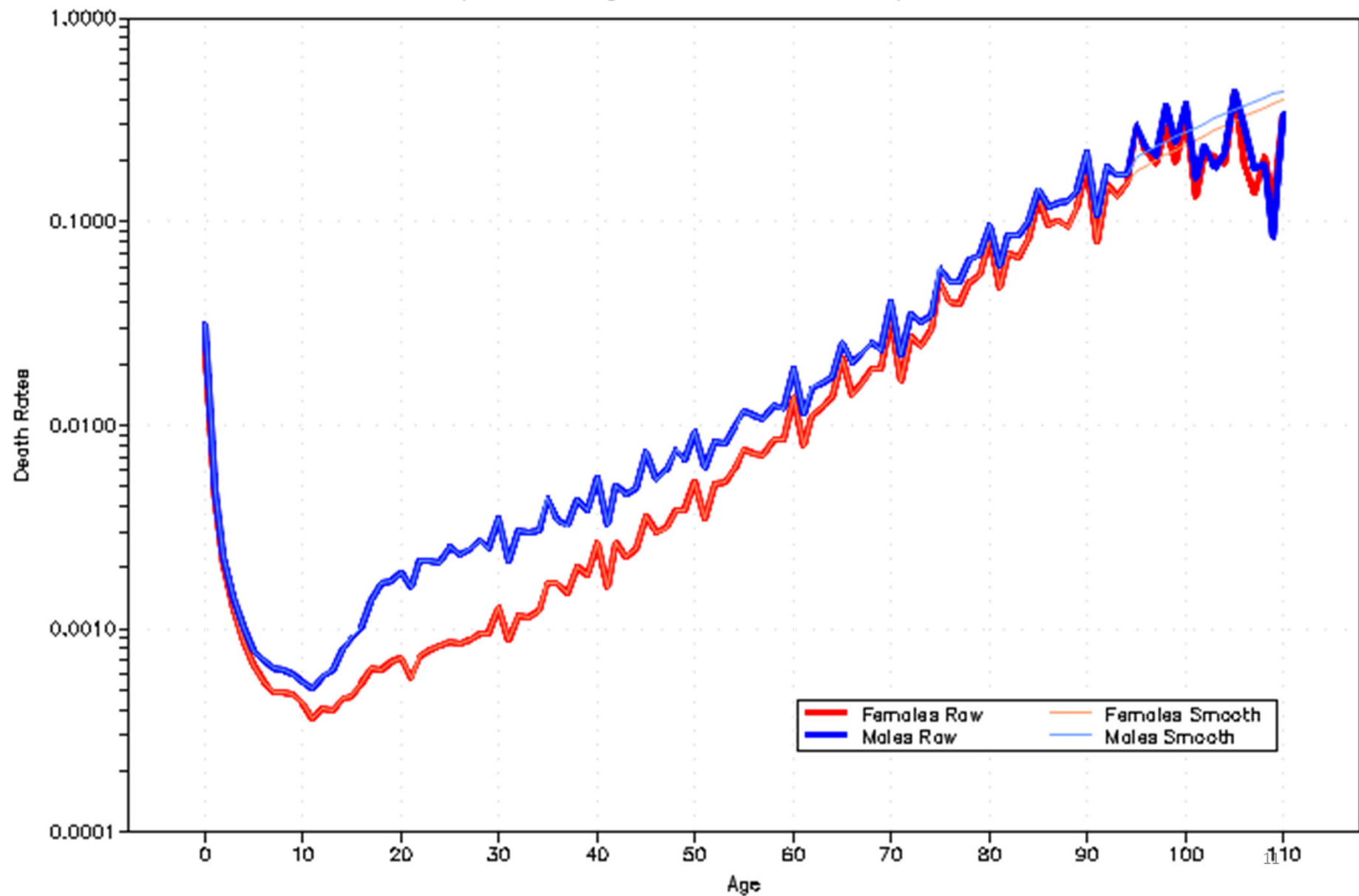
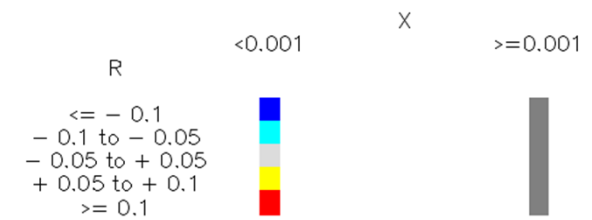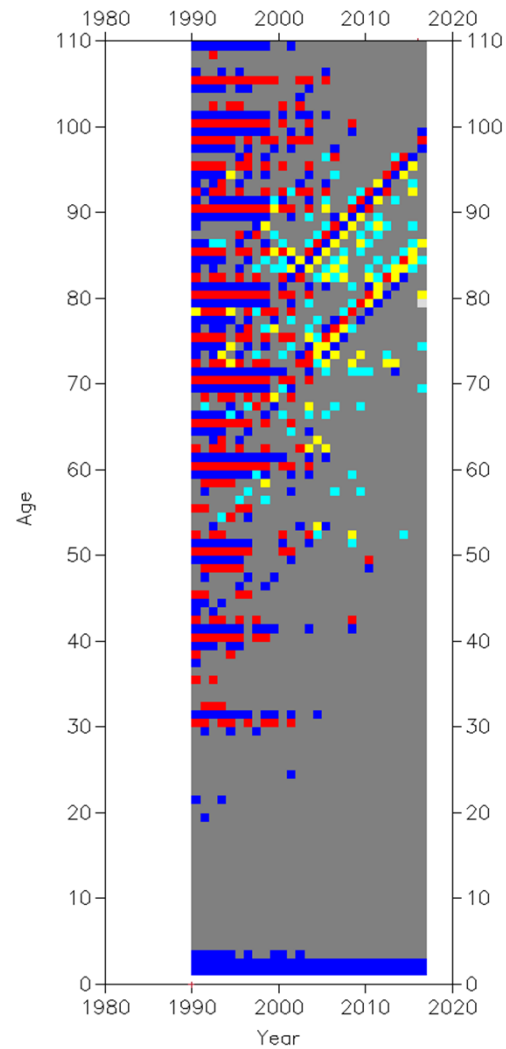# Death Rates by Age, 2000
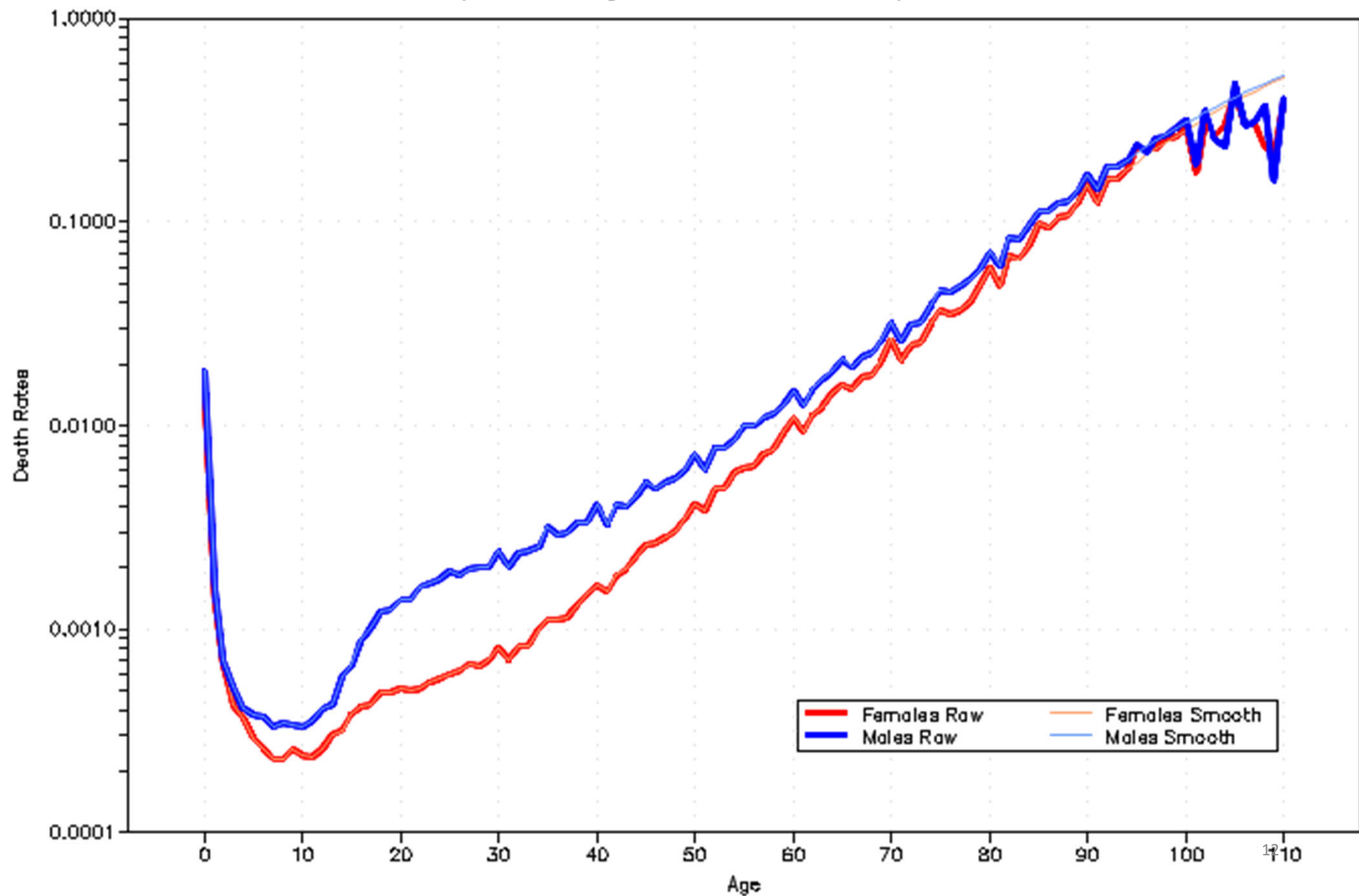
# Death Rates by Age, 2010

# Map of Mortality Deviations
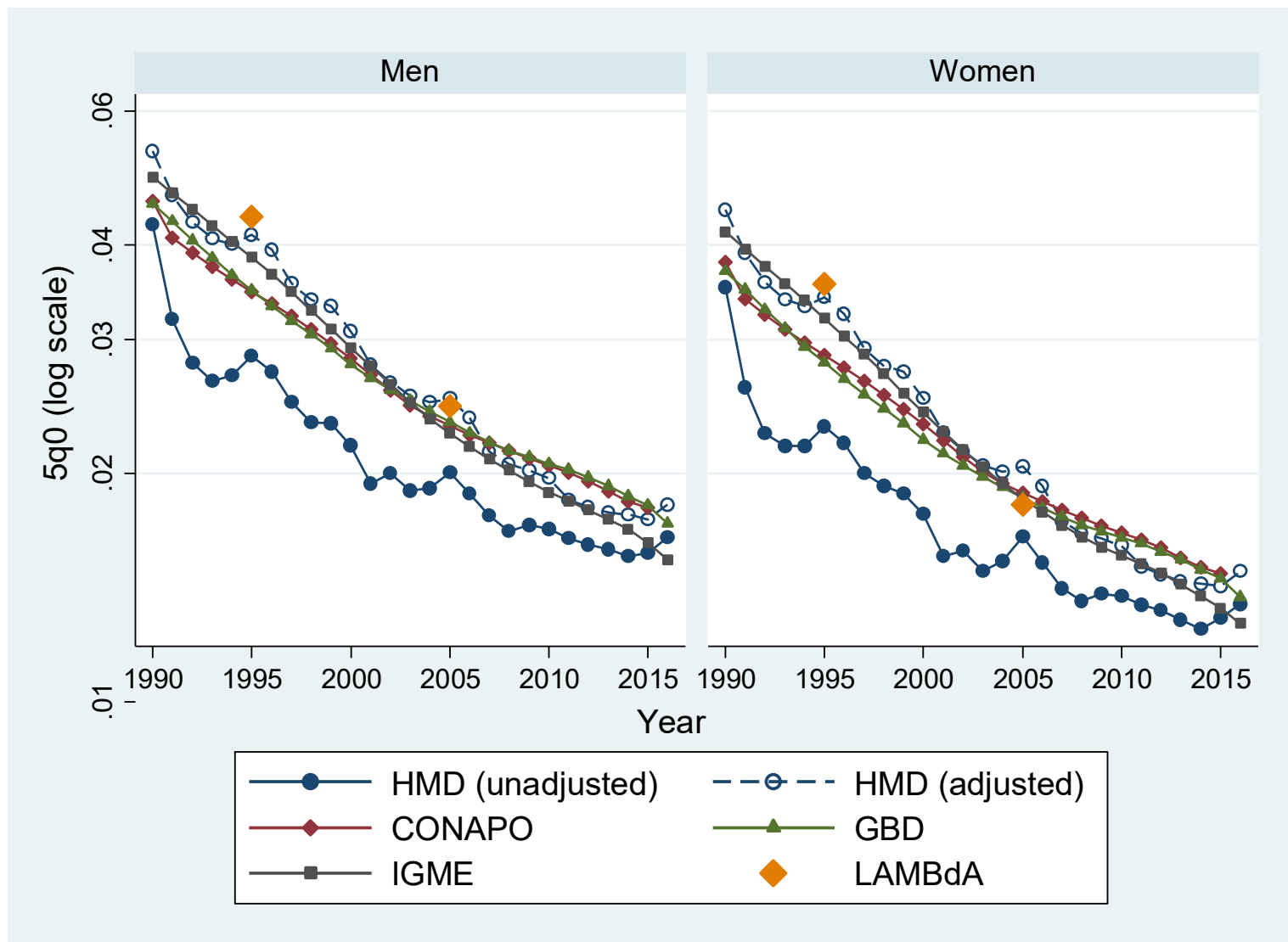
# Comparison of $_5q_0$ with external estimates

# Unadjusted estimates of $_5q_0$ too low?

- Our unadjusted estimates of $_5q_0$ are much lower than the official estimates (CONAPO).
  - Official estimates have been adjusted.
- Our estimates are also lower than those produced by the UNPD and LAMBdA.
- **Conclusion:** Unadjusted estimates probably under-estimate under-five mortality.
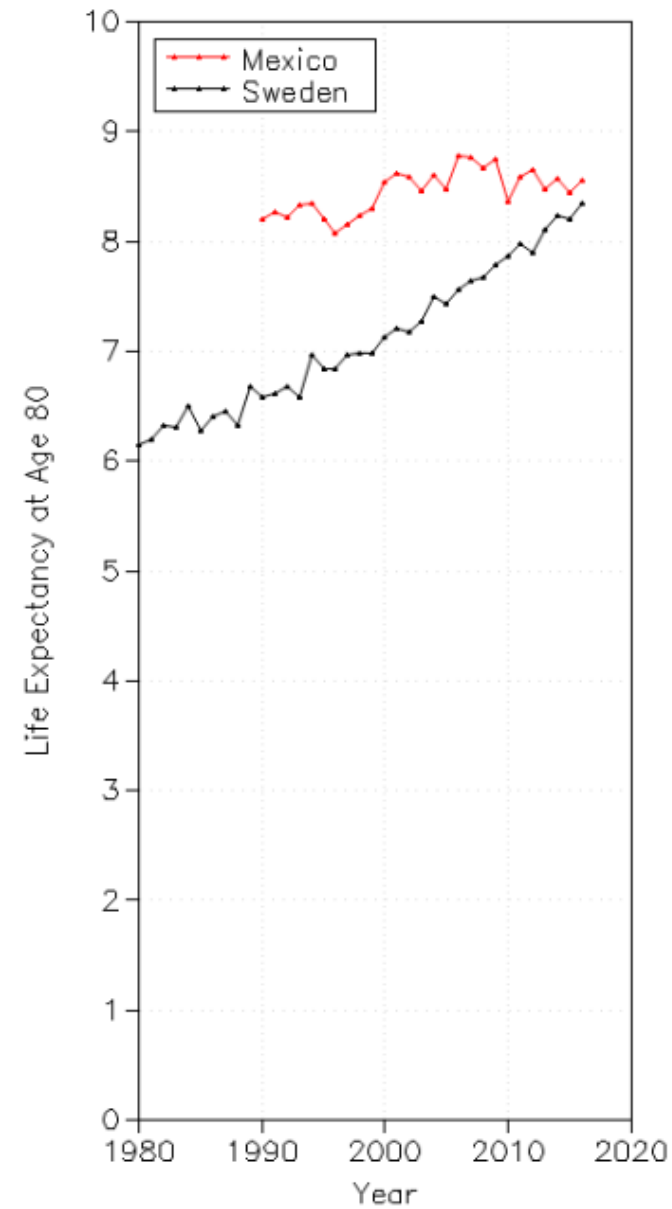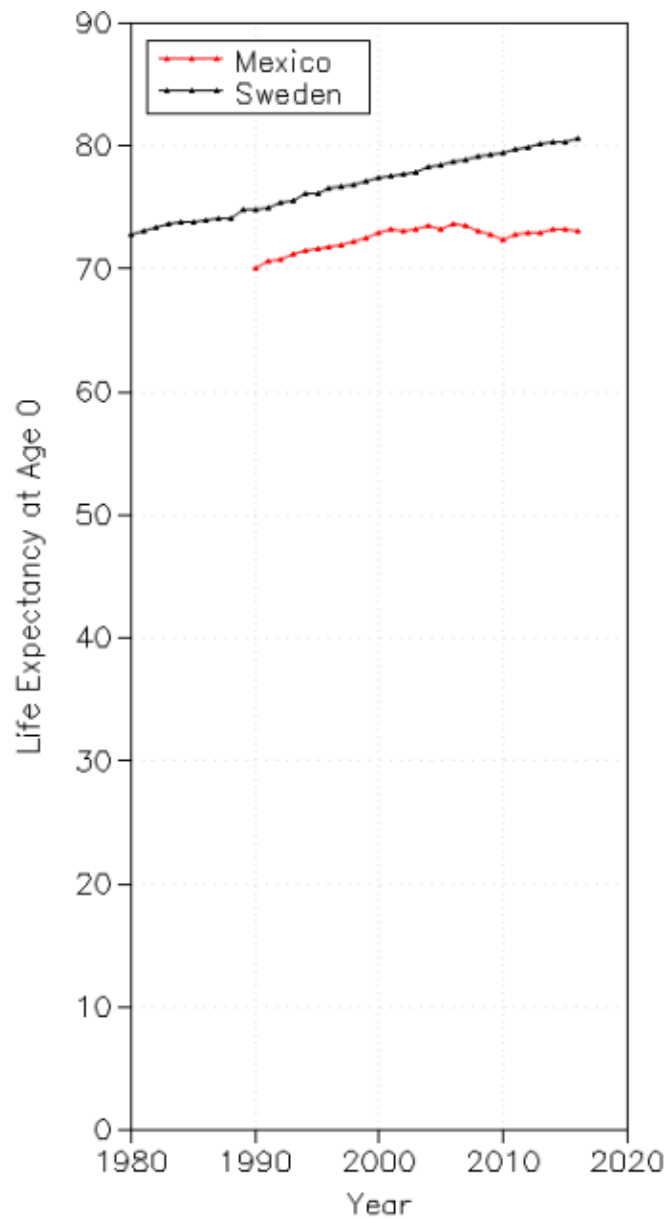
# Unadjusted estimates of $e_0$ too high?
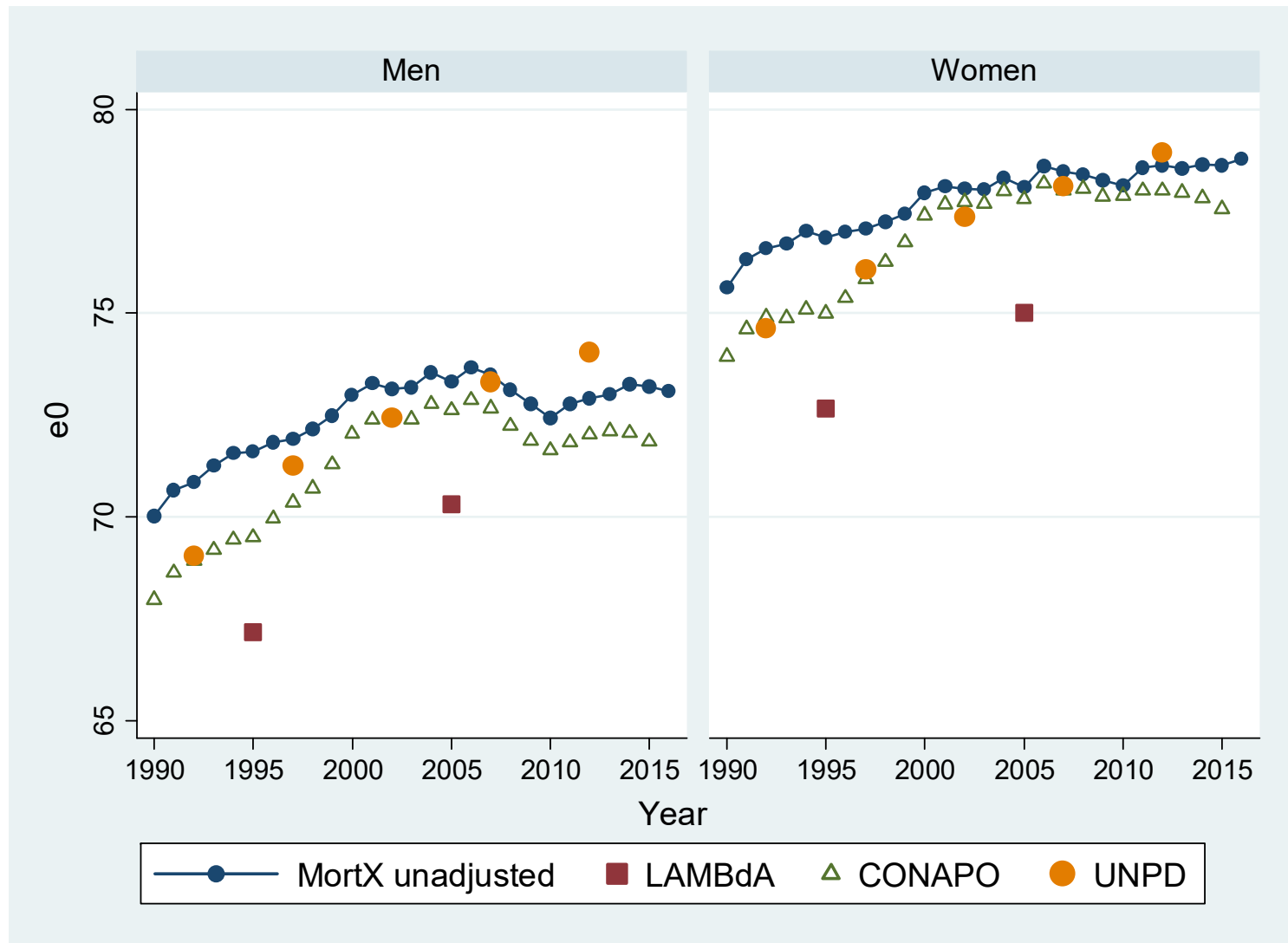
# Unadjusted estimates of $e_{80}$ also too high?
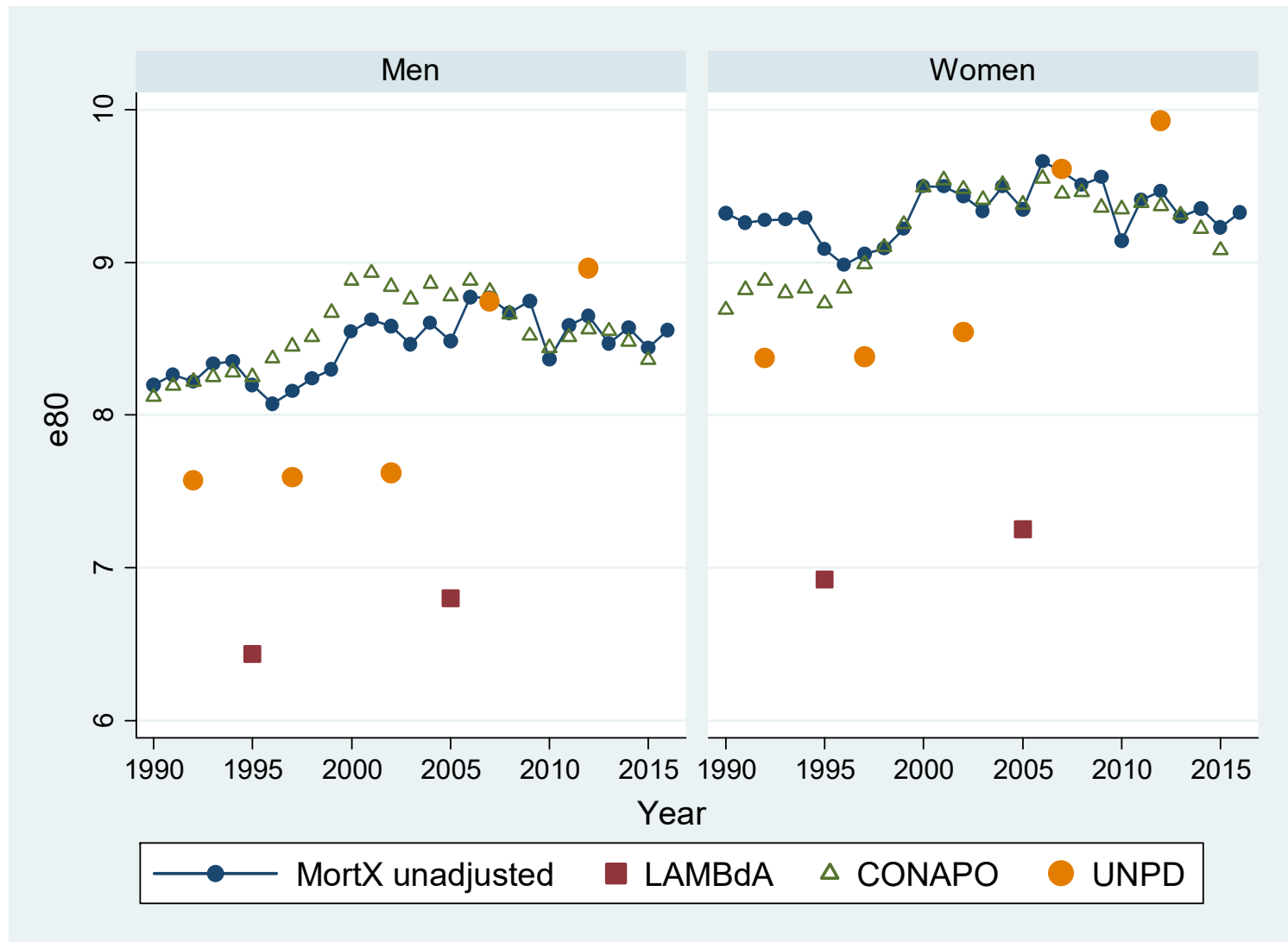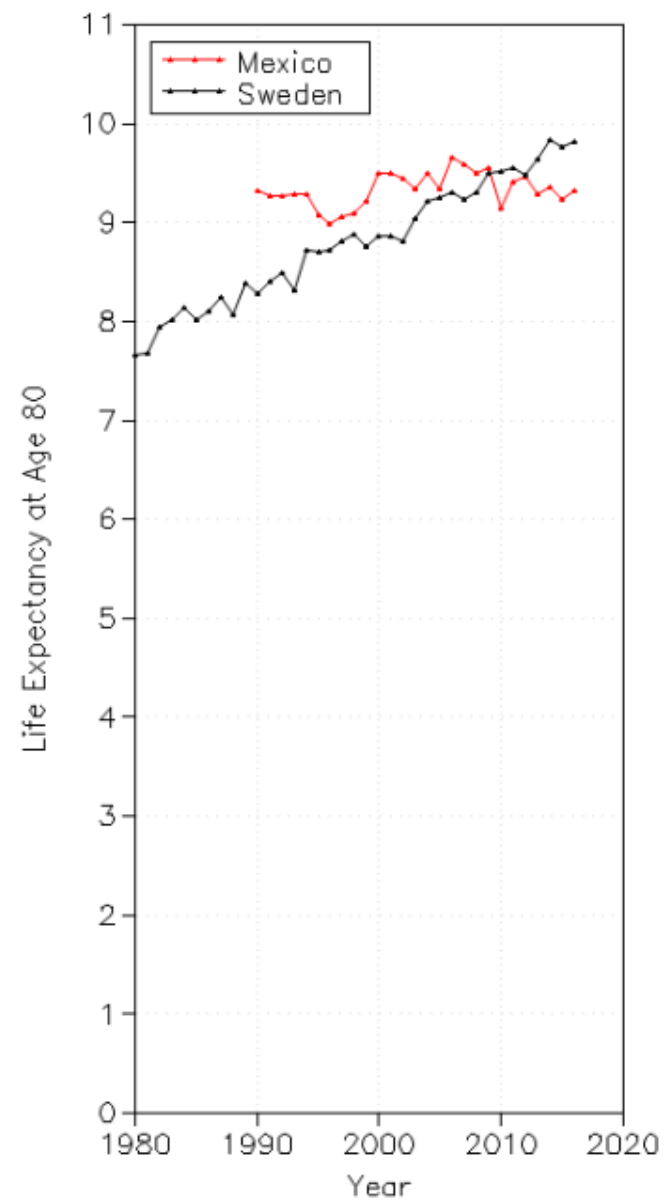
# Compared with Sweden, Men

# Compared with Sweden, Women
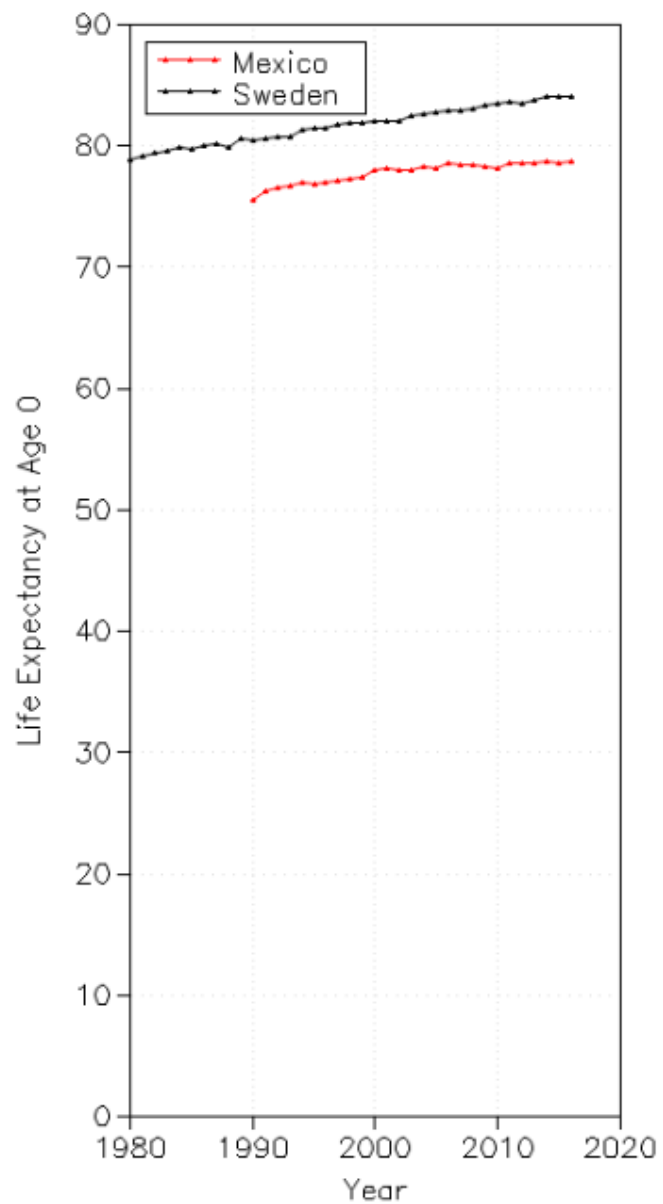
# Suspicious Patterns

- Both sexes: $e_0$ for Mexico well below Sweden during 1990-2016.

- Men: $e_{80}$ was <u>higher</u> in Mexico than in Sweden?

- Women: $e_{80}$ was <u>higher</u> in Mexico than in Sweden in 1990-2009 (but lower after 2010)?

- These implausible patterns suggest age exaggeration/mis-reporting.

# An implausible mortality pattern
## Relationship between mortality risks between ages 60 and 80 and child mortality (<5), Men
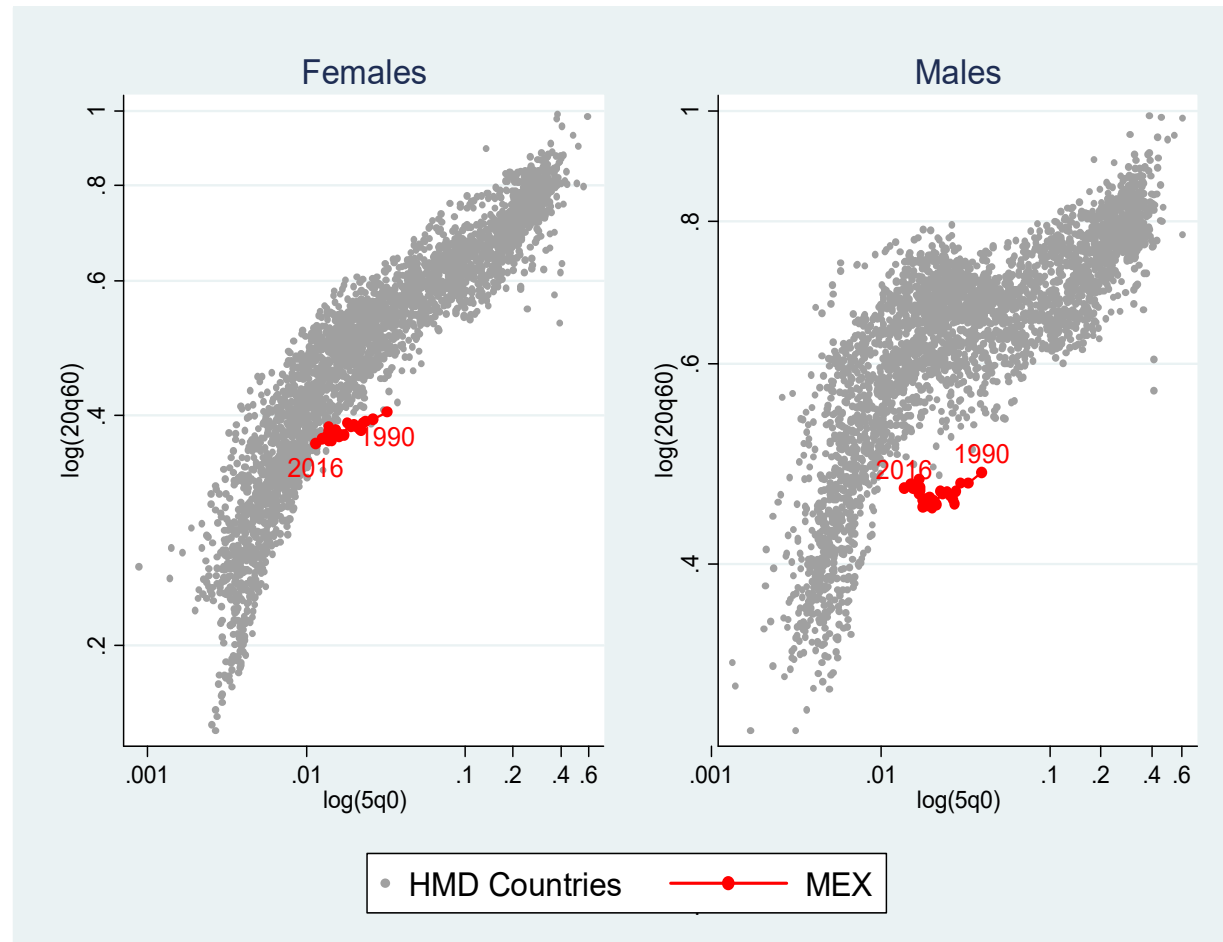
# Even more implausible at higher ages
## Death count ratio: 105+ years to 100+ years
## Mexico (1990-2016), Chile (1992-2008) and Sweden (1950-2016)

# Conclusions of data quality analysis

- We find numerous data quality issues.
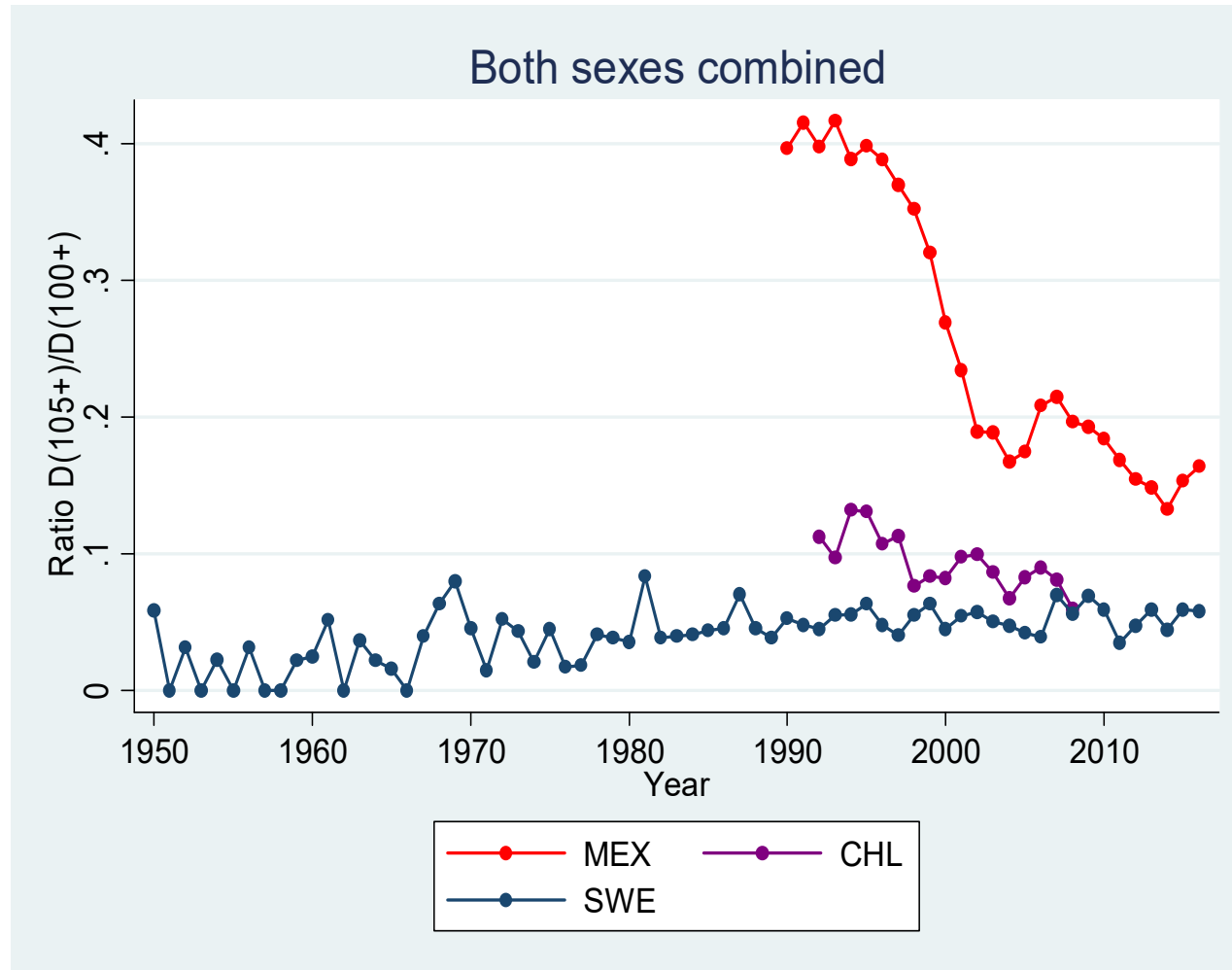    - Obvious age heaping which is typically an indication of age misreporting in general.
    - Infant and child mortality is much lower than estimated by other (more reliable) sources
    - Unadjusted estimates of e0 are much higher than the official estimates (which have been adjusted)
    - Suspicious trends in $e_{80}$ that lead us to suspect age exaggeration/misreporting
    - Implausibly low mortality at older ages relatively to younger ages
- We decided NOT to add Mexico to the  HMD.
- Accurate estimates of life expectancy for Mexico require adjustments to the raw data (or to the rates).
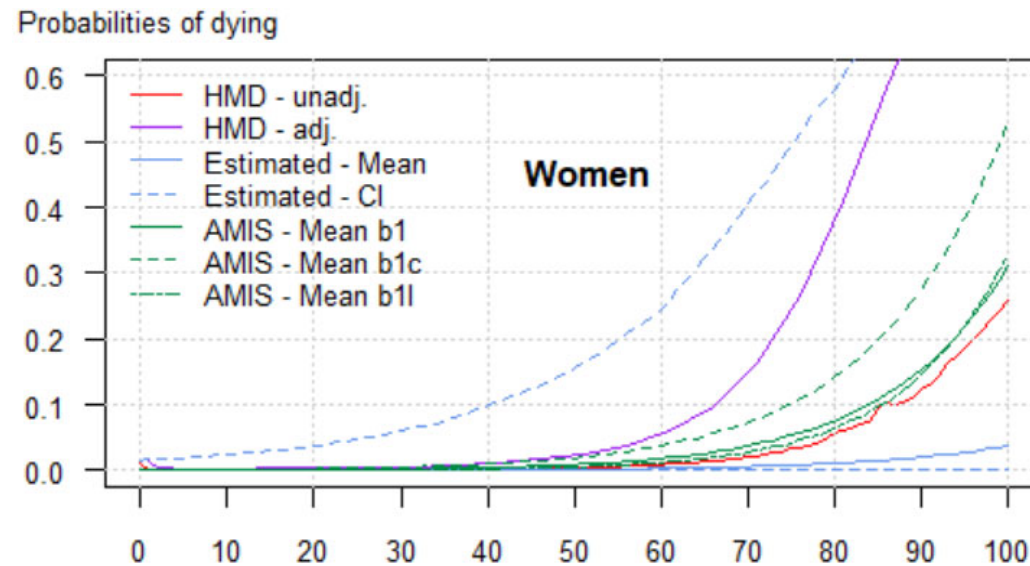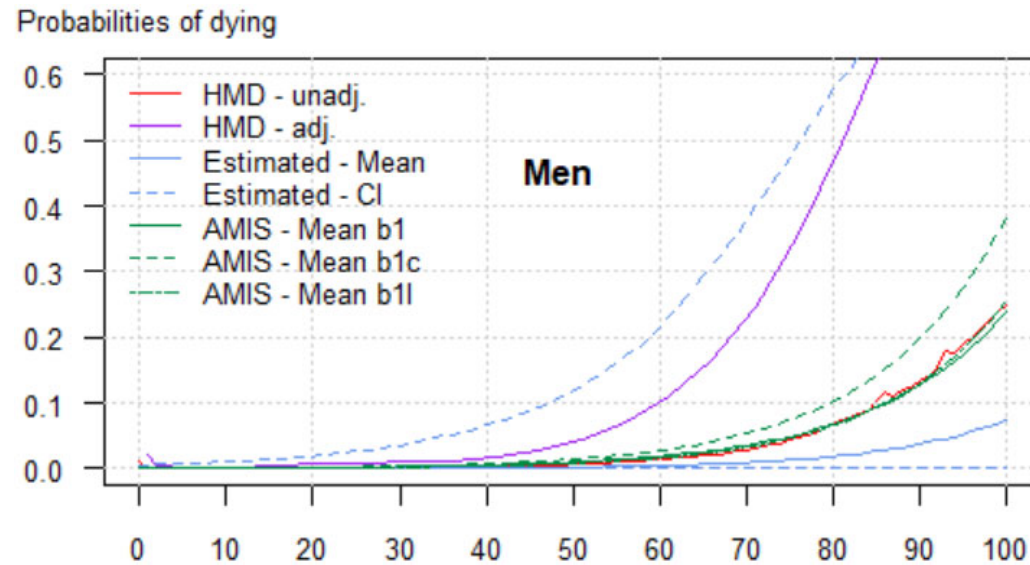
# Adjustments

- Three major adjustments for the under-estimation of

1. Infant and child mortality

2. Adult mortality

3. Old-age mortality

- Two different approaches

1. Recalculation of HMD lifetables after adjustment of under five mortality

2. Log-quadratic model with one and two parameters (Wilmoth et al., 2012)

# Results of adjustments on the expectation of life at birth

| | 1995 | | 2005 | | 2015 | |
|---|---|---|---|---|---|---|
| | Men | Women | Men | Women | Men | Women |
| HMD unadjusted | 70.4 | 75.9 | 72.7 | 77.6 | 73.1 | 78.4 |
| **Difference (Unadjusted – Adjusted)** | | | | | | |
| Adjusted mortality below Age 5 | -0.9 | -0.8 | -0.4 | -0.3 | -0.2 | -0.1 |
| Adjusted mortality at ages 15-59 | -0.6 | -0.4 | -0.4 | -0.4 | N/A | N/A |
| Adjusted both $_5q_0$ and $_{45}q_{15}$ | -1.5 | -1.2 | -0.8 | -0.7 | N/A | N/A |
| 1-Parameter Log-Quadratic Model[c] | -4.0 | -4.3 | -3.4 | -2.7 | -2.2 | -1.9 |
| 2-Parameter Log-Quadratic Model ($_{45}q_{15}$ from LAMBdA) | -4.4 | -3.8 | -3.7 | -2.9 | N/A | N/A |
| LAMBdA Estimates | -3.2 | -3.2 | -2.4 | -2.6 | N/A | N/A |

# Applying the results to assess mortality in AXA insured population



Probabilities of dying

| | |
|---|---|
| HMD - unadj. | |
| HMD - adj. | |
| Estimated - Mean | Men |
| Estimated - CI | |
| AMIS - Mean b1 | |
| AMIS - Mean b1c | |
| AMIS - Mean b1l | |

Probabilities of dying

| | |
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| HMD - unadj. | |
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| Estimated - Mean | Women |
| Estimated - CI | |
| AMIS - Mean b1 | |
| AMIS - Mean b1c | |
| AMIS - Mean b1l | |

# Next steps

- Extend the analysis to other countries of interest to AXA

   provided that complete national statistics are available

- Generalize the indicators used to evaluate the quality of official demographic statistics and the resulting mortality indicators

- Develop a tool for AXA entities to use the results of such analysis to assess their own mortality estimates in the insured population