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Estimation of mortality in South Africa: Challenges and methods

Rob Dorrington

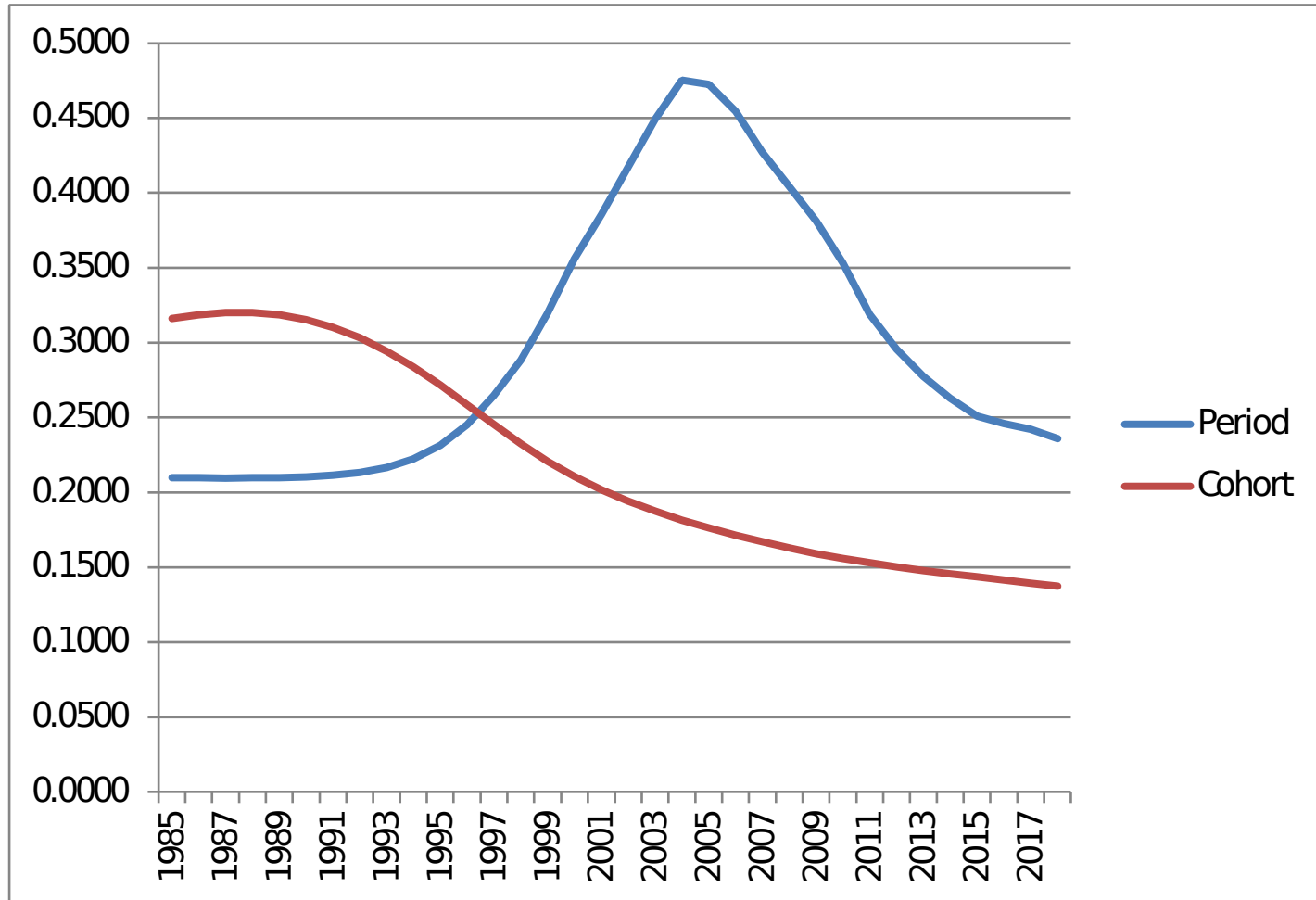
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Range of life tables

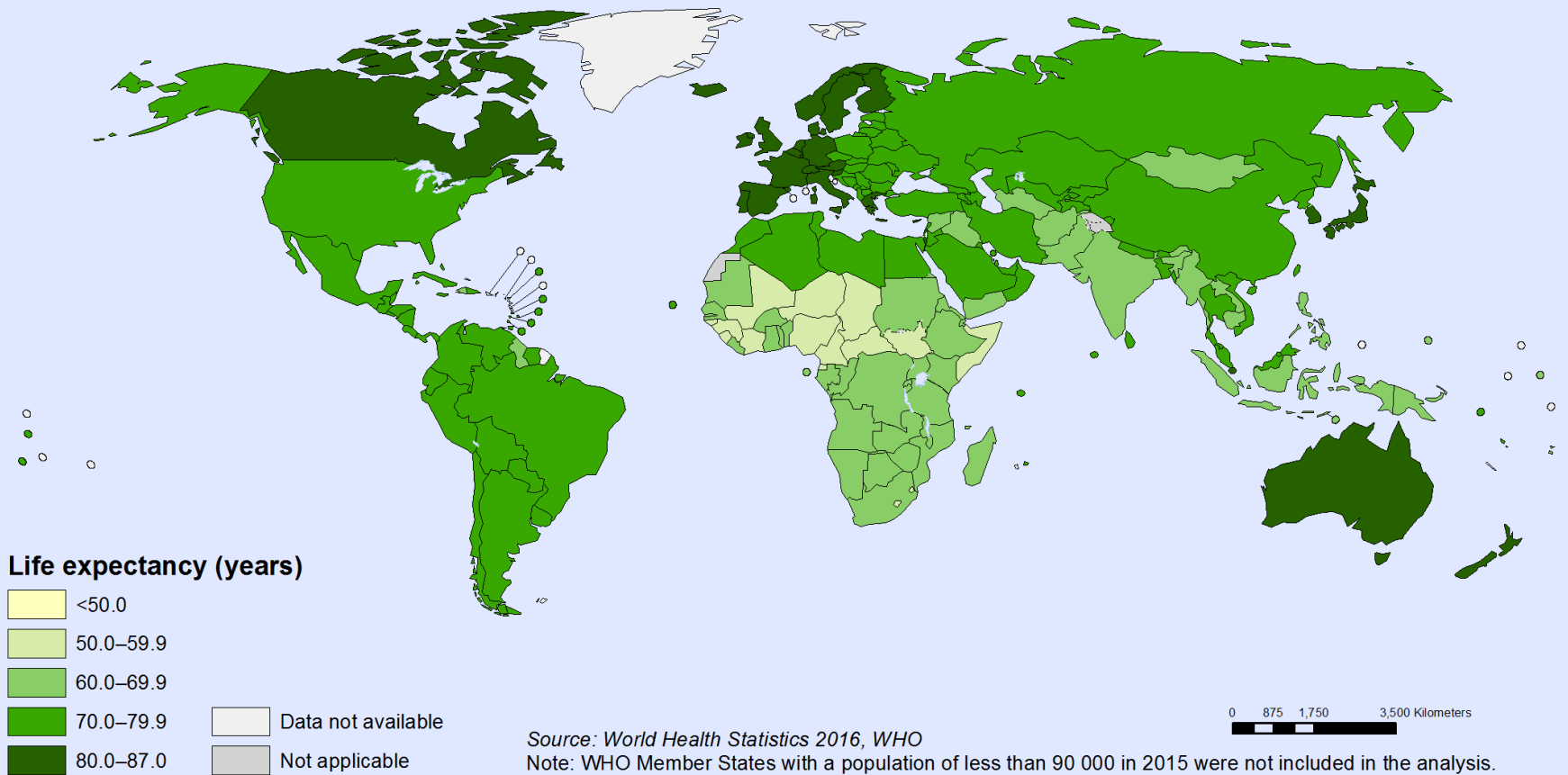
- **National & sub-national** (urban/rural, regional, etc.) (vital registration (VR) & census data)
- **Insured** (Claims and 'inforce' data - company-specific or industry-wide)
 - Type of product, Underwriting class
- **Retired** (Notification of death/VR and 'inforce' data - company-specific or industry-wide)
 - Voluntary annuitant, Pensioner, Size
- **Employed** (Group scheme insurance claim and 'inforce' data - large employers or insurers, etc.)
 - 'class'/income/occupation



Cohort vs period: ${}_{45}q_{15}$ South African females



Life expectancy at birth Both sexes, 2016



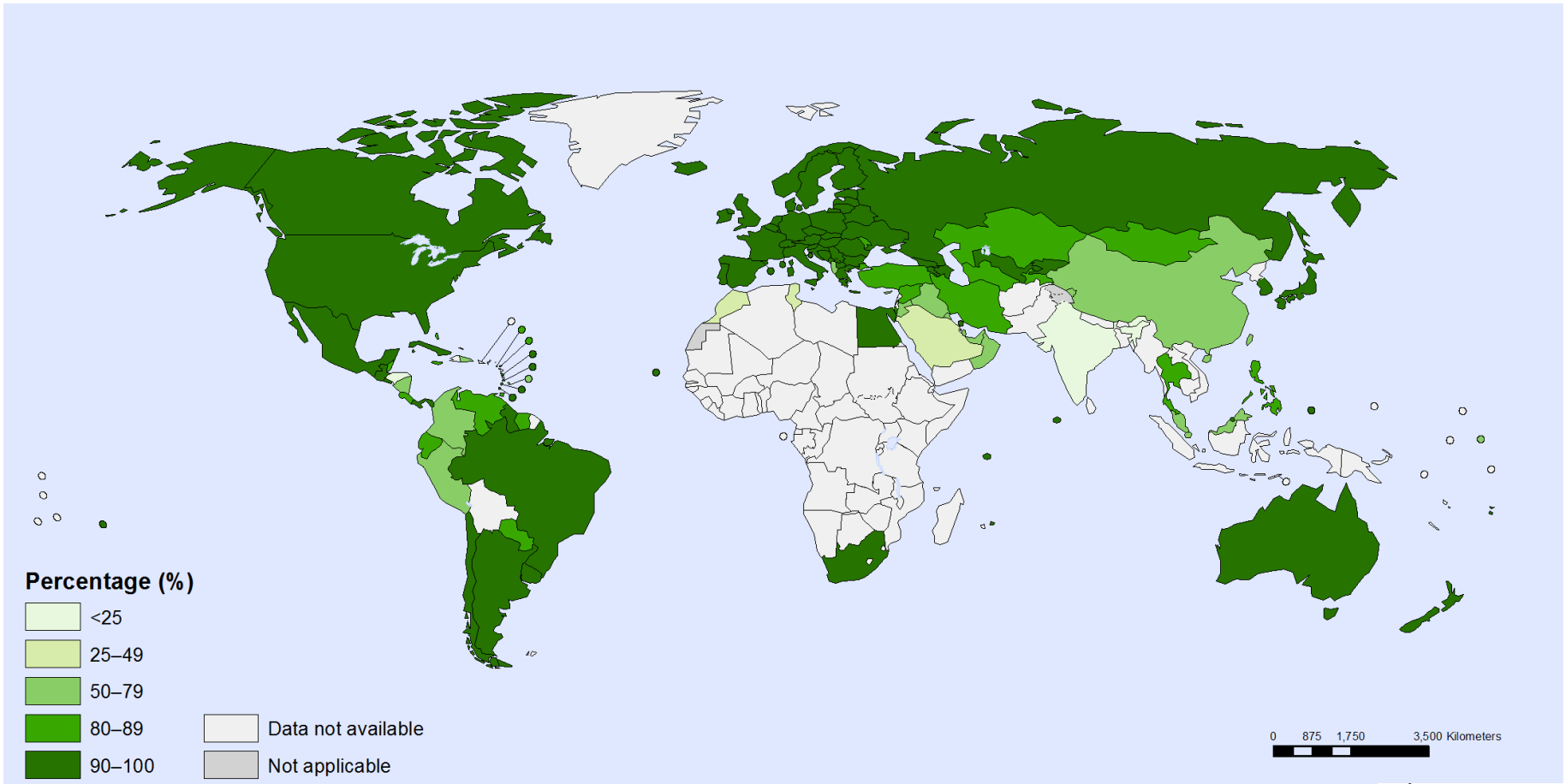
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Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization



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Completeness of cause-of-death data (%), 2007–2016



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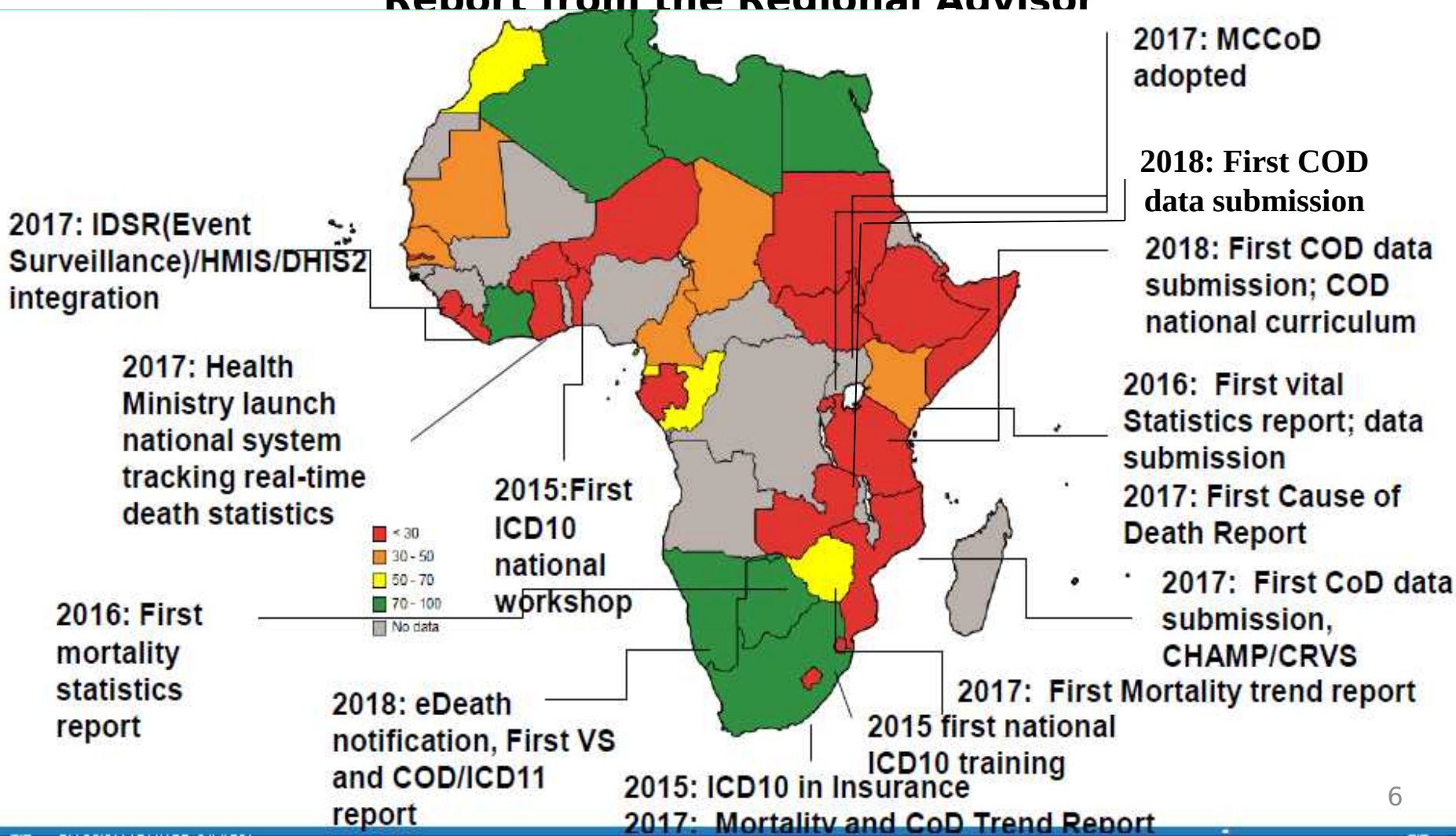


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% Death registration completeness

WHO - FAMILY OF INTERNATIONAL CLASSIFICATIONS NETWORK
ANNUAL MEETING 2018

Report from the Regional Advisor



Methods of estimating mortality when little or no VR data

- Model life tables (if indicator of level)
- Sets of tables:
 - Princeton (Coale & Demeny (1966));
 - Brass logit relational model ($\hat{e}_x(x) = \alpha + \beta \cdot \lambda(l^s(x))$)
 - Brass General Standard & Brass African Standard
 - Variations (e.g. Ewbank et al (1983), Zaba (1979), Murray et al (2003), Bhat (2004))
 - UN Model life tables for developing countries (1982);
 - INDEPTH Network (2002);
 - Sharrow, Clark & Raftery (2014);
 - others



Methods of estimating mortality when little or no VR data

- Deriving estimates of indicators of level (if not 'shape')
 - Indirect estimation
 - Child
 - Full birth/pregnancy histories (FBHs) (from surveys, e.g., DHSs)
 - Summary birth histories (SBHs) (censuses/surveys)
 - Adult
 - Orphanhood – asking respondents about survival status of parents
 - Sibling – asking respondents about the survival status (and date of birth and death (if died)) of siblings who survived to age 15
 - Direct estimation
 - Question in census/survey about deaths in households in past year



Other methods of estimating mortality when little or no VR data

- Delphi technique (IIASA)
 - Not the focus of the population projections
- Regressions with ‘ensemble’ modelling (IHME)
 - Complex and opaque process
 - Not exactly country-specific for African countries



Methods of estimating mortality when less than complete VR data

- Death distribution methods (generalized growth balance or synthetic extinct generations)
- Essentially estimating the completeness of reporting by comparing the recorded deaths in a period to the number of deaths implied by change in population numbers over period
 - Generalized growth balance (Hill (1987))

$$n(x) - P(x+t) = a + b \cdot d^*(x+t)$$
 with $d = \ln(k_1/k_2)/t$ & $b = (k_1 k_2)^{0.5} / c$
 - Synthetic extinct generations (Bennett & Horiuchi (1981, 1984))

$$\int_y^x [D(x,t) \exp \int_y^x r(a,t) da] dx = N(y,t)$$



Particular problems with reported death data in developing countries

- Incomplete or very limited registration of deaths (particularly at older ages – if proportion rural high at old ages)
- Cause of death (% unknown, misclassification, vagueness of classification)
- Limited and inaccurate other information (e.g. place of residence, employment/SEC, etc.)
- Heterogeneity (ethnicity/race, insured/uninsured, urban/rural, employed/unemployed) more extreme?



Problems with rates at old ages

- Old ages – age exaggeration, higher under-reporting, particularly deaths reported by households in censuses
- Problems at old ages dealt with by:
 - Model life table
 - Models of the force/hazard of mortality at old ages (e.g. Gompertz, various logistic curves, Kannisto, etc.)
 - Li & Gerland (to correct for constant proportional age exaggeration) and Ron Richman NEG-GAM (year of birth & age digit preference)

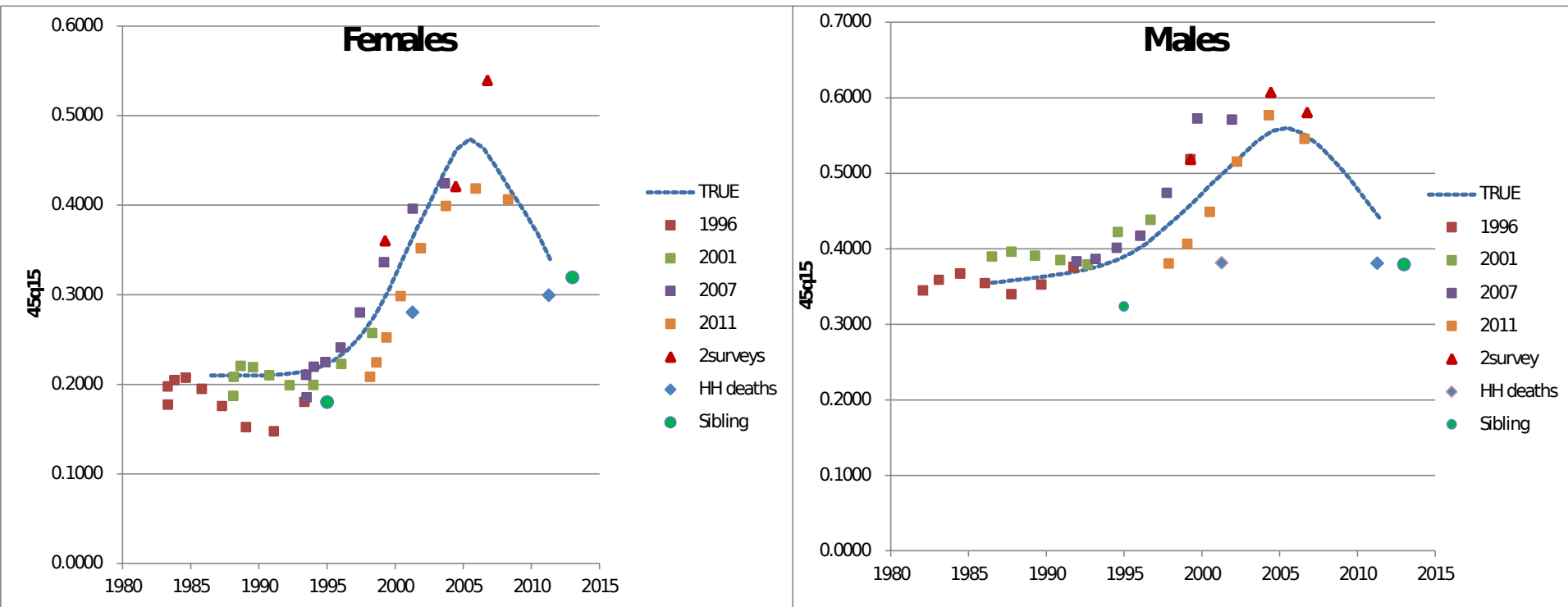


Other problems with the data

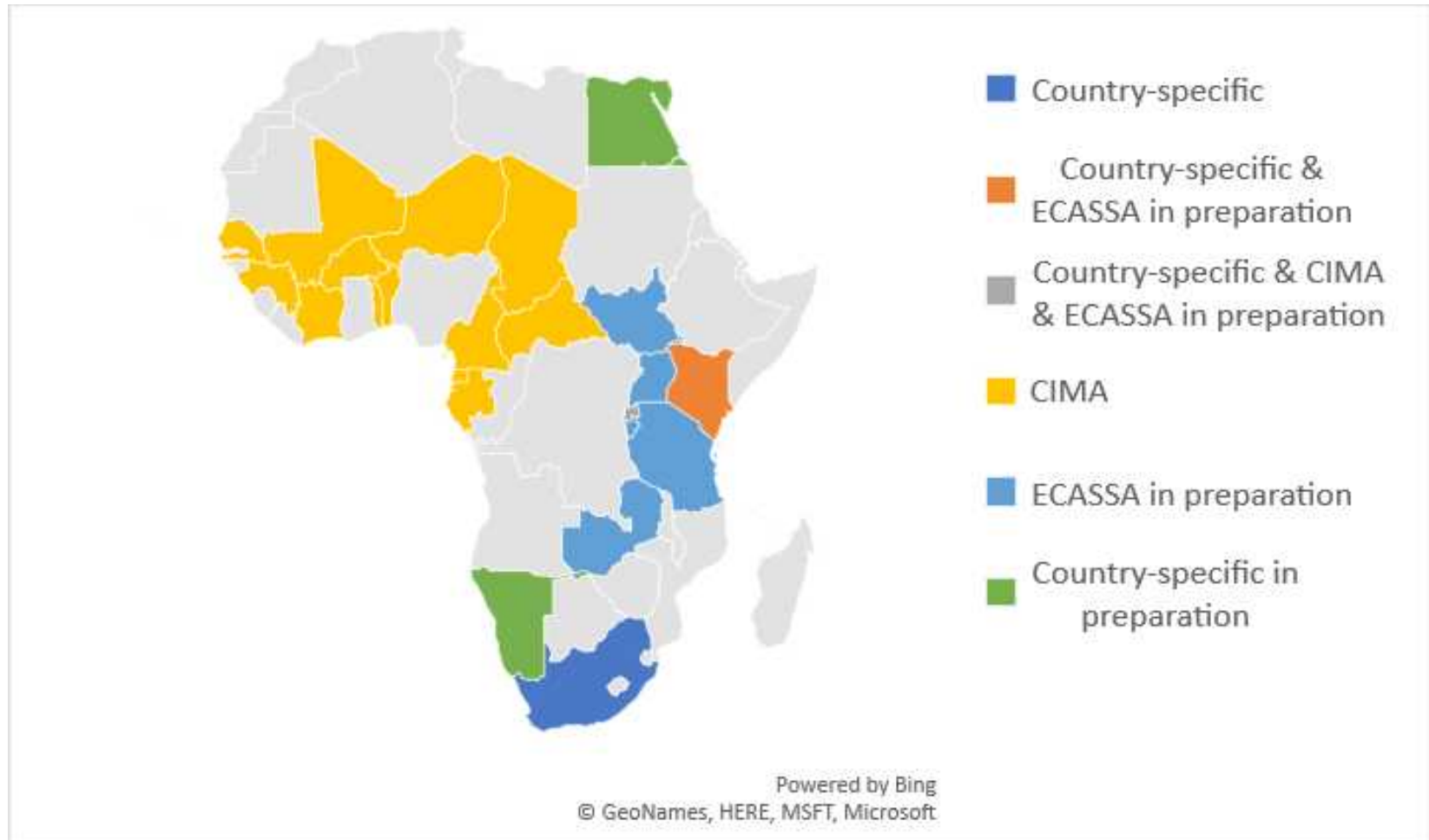
- Exposure
 - Census – coverage/completeness (e.g. SA PES undercount 1996, 2001 & 2011, ‘demographic undercount’)
 - Age exaggeration, digit preference
- Direct measures
 - Deaths reported by households
 - Disintegration of households on deaths of older adults/breadwinner
 - HDSSs
 - not representative (select site(s), mostly rural, bias due to monitoring)
- Unknown/underestimated uncertainty



Performance of indirect measures



Insurance-specific life tables



Problems producing industry-specific life tables in Africa

- Small insured population, particularly at the old ages
- Limited aggregation of data
- Possibly increasing heterogeneity with the shrinking of the previously privileged population in some countries
- No organised monitoring of mortality of employed (by 'class') vs unemployed
- Lack of country-specific skills (at least of 'volunteers')

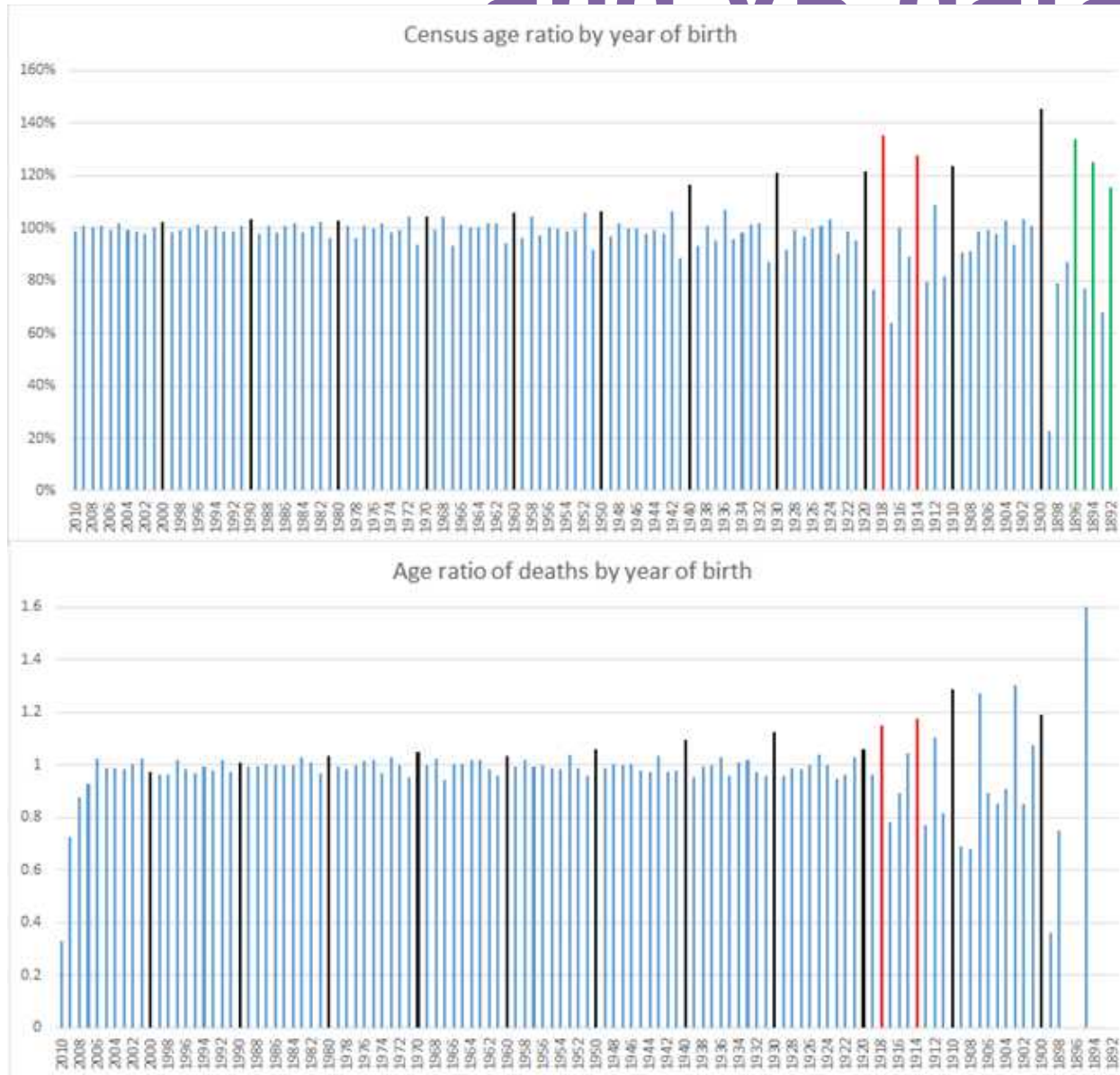


South Africa: national

- South African Life Tables (SALTs): For 3 population (ethnic/race) groups (excluding Africans): centred around censuses 1946-1985 (some groups even earlier)
- Registered deaths
 - Completeness (adults): risen from circa 50% in mid-1980s to circa 90% for adults in since 2005
 - Causes: About 10% ill-defined cause, some misclassification (e.g. AIDS), injuries of 'undetermined intent'
- Other data:
 - DHSs
 - HDSSs
 - SBH, orphanhood

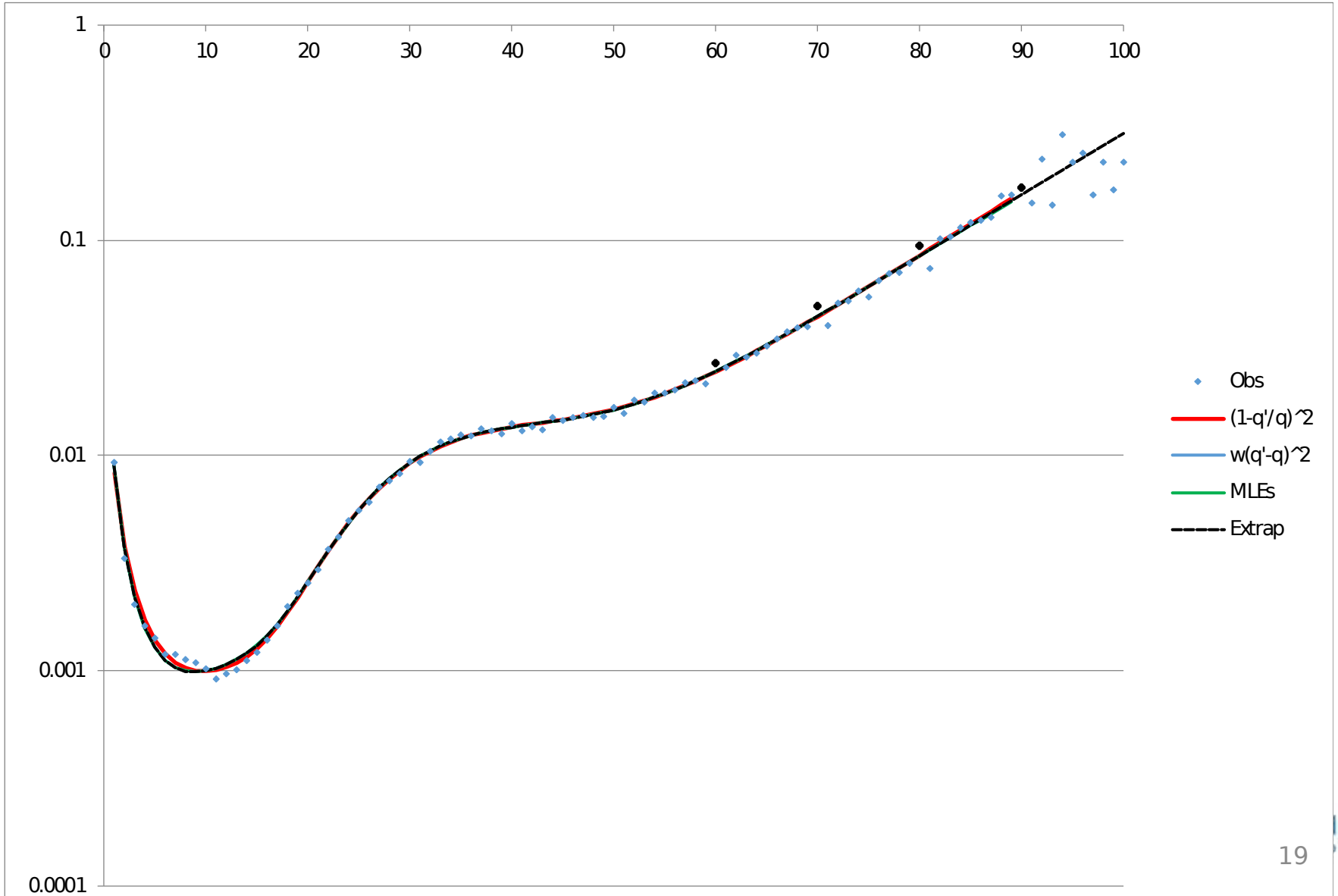


'Age-ratios' in 2011 census and VR data

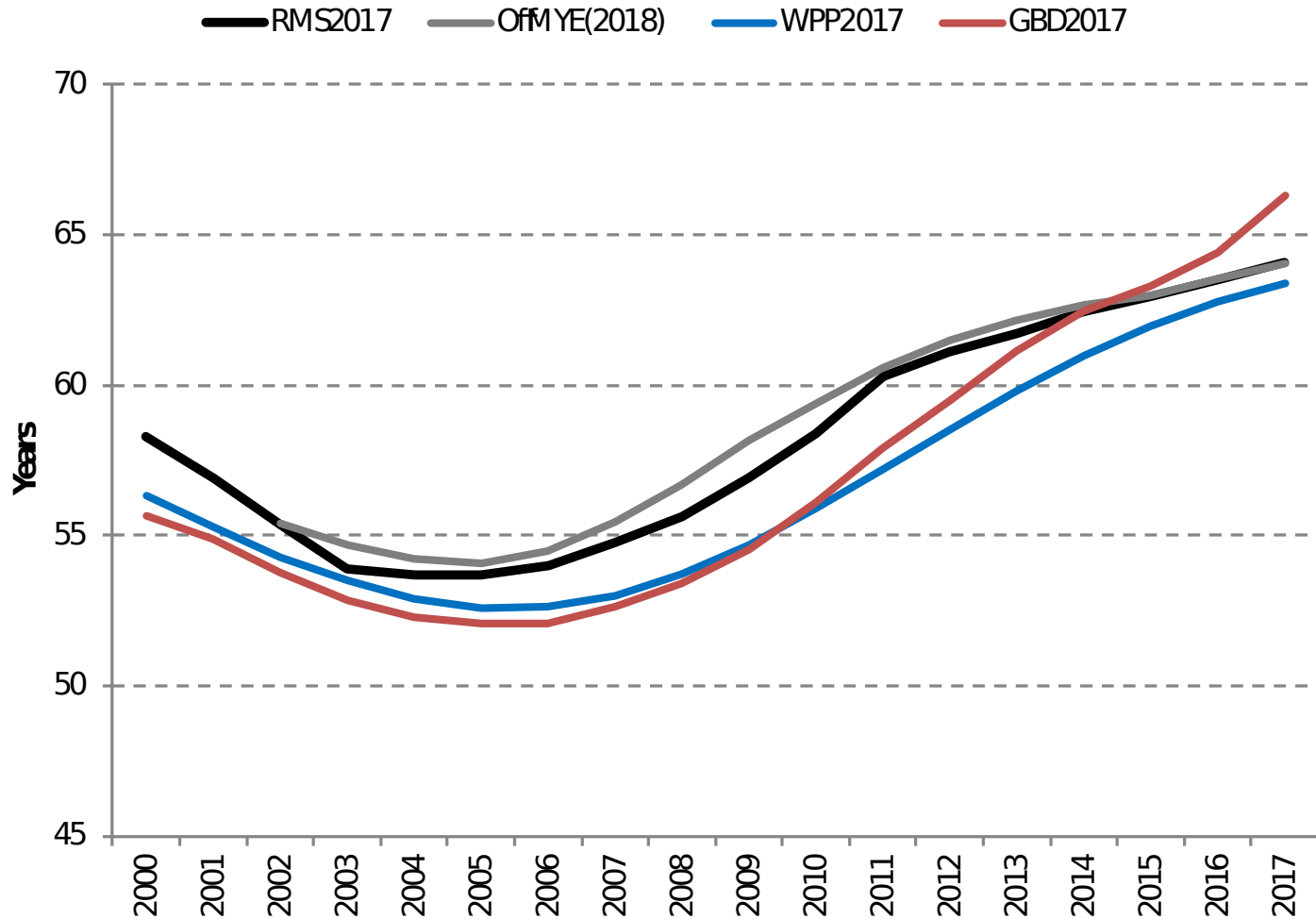


- Black – years of birth ending in “0”
- Red – 1914, 1918 years of birth

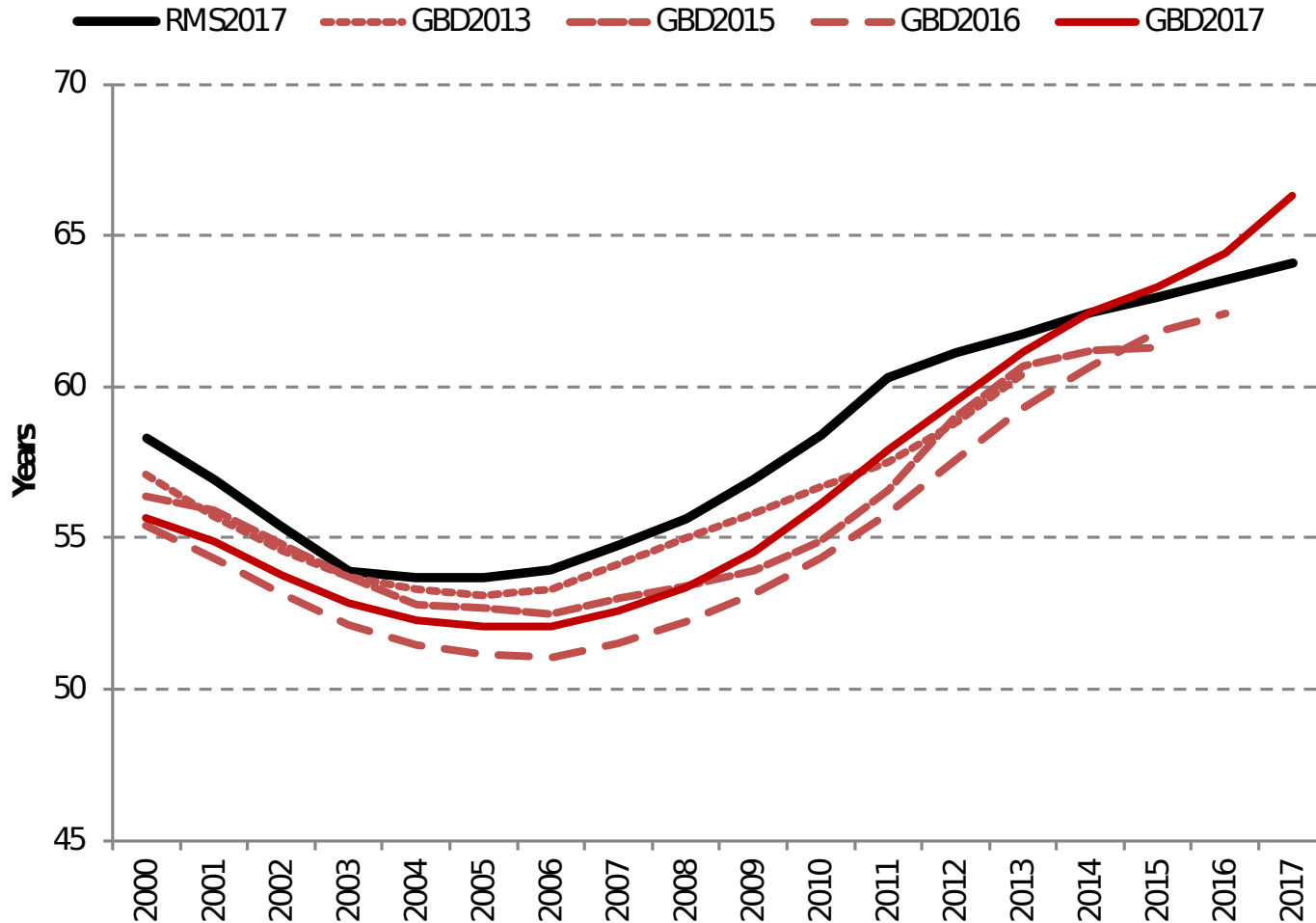
Graduation 2010-2012



Various estimates of e_0



Underestimation of uncertainty

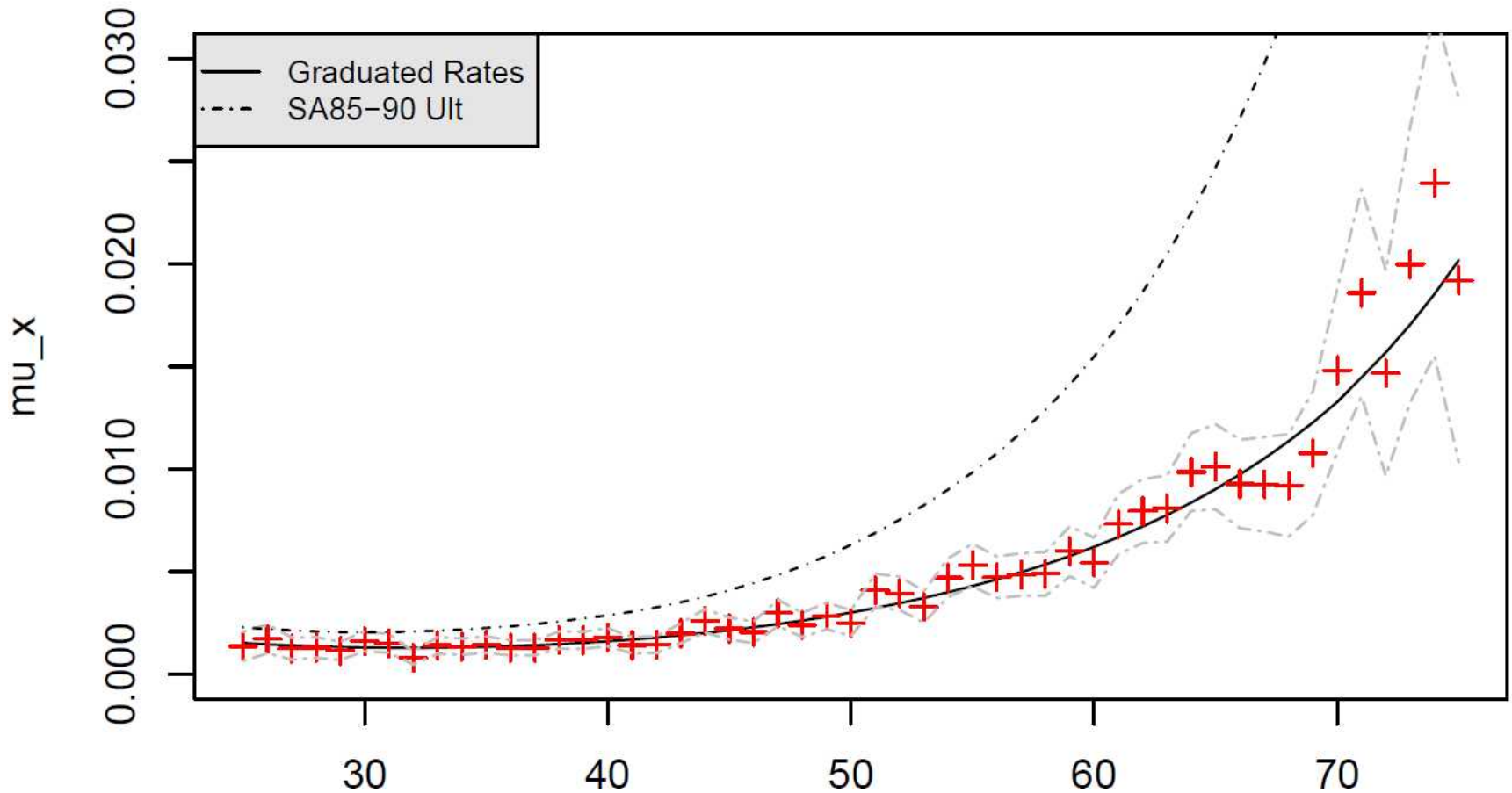


South Africa: industry/profession

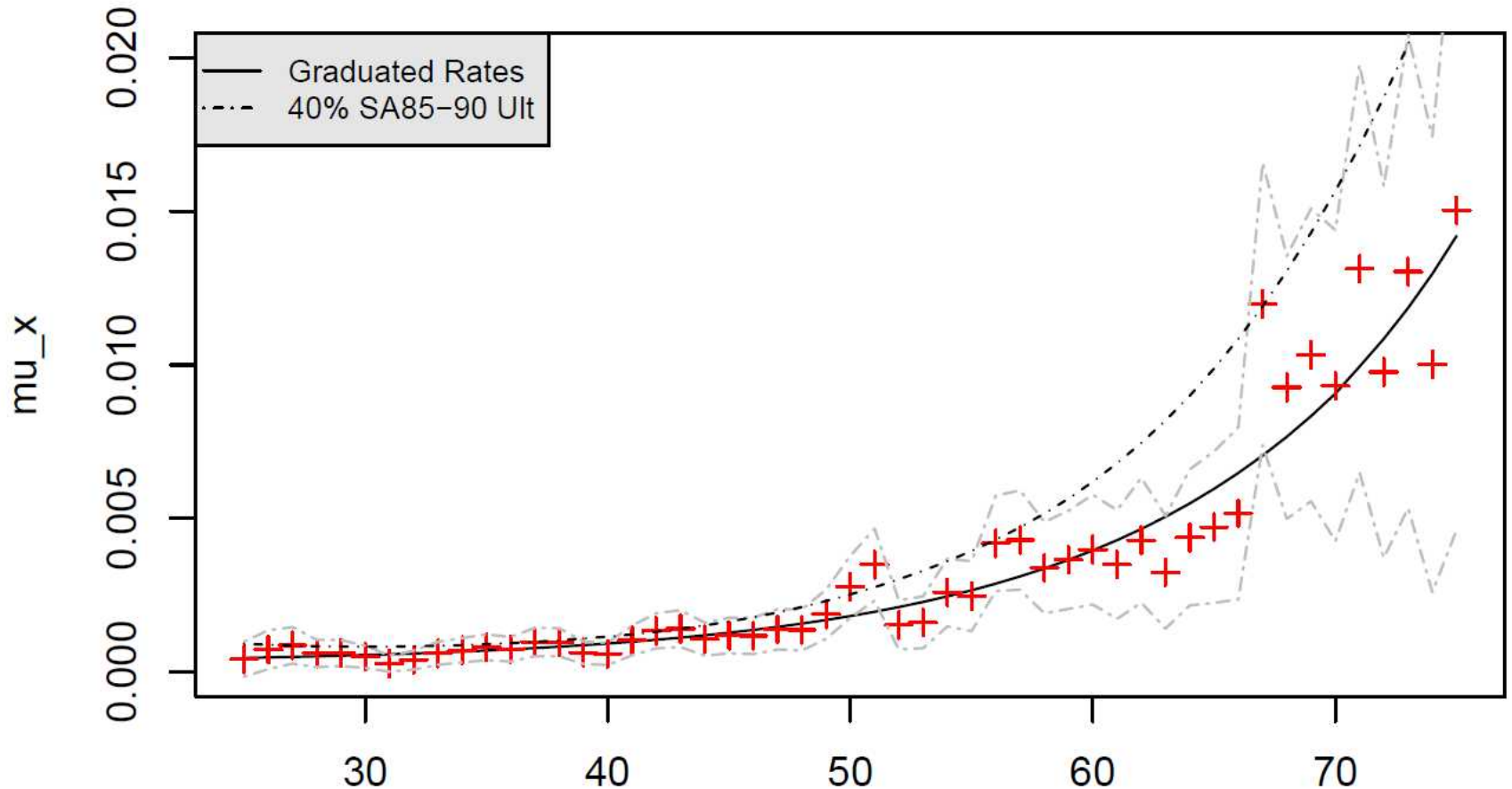
- Standard life tables:
 - Life insurance: SA56-62, SA72-77, SA 1985-90 (Dorrington & Rosenberg (1996))
 - Annuitants: SAIML98 & SAIFL98 (Dorrington & Tootla (2007))
- No new standards, but a number of CSI reports
 - Assured lives mortality investigations 1991-1994, 1995-1998, 1999-2002 & 2003-2010 (for new-generation products)
 - Funeral insurance mortality investigation, 2001 - 2002
 - Annuitant report 2001-2004 & Pensioner mortality investigation 2005-2010
- Mortality of employed (members of group insurance schemes) (Clur et al (2013) & Schriek et al (2013))



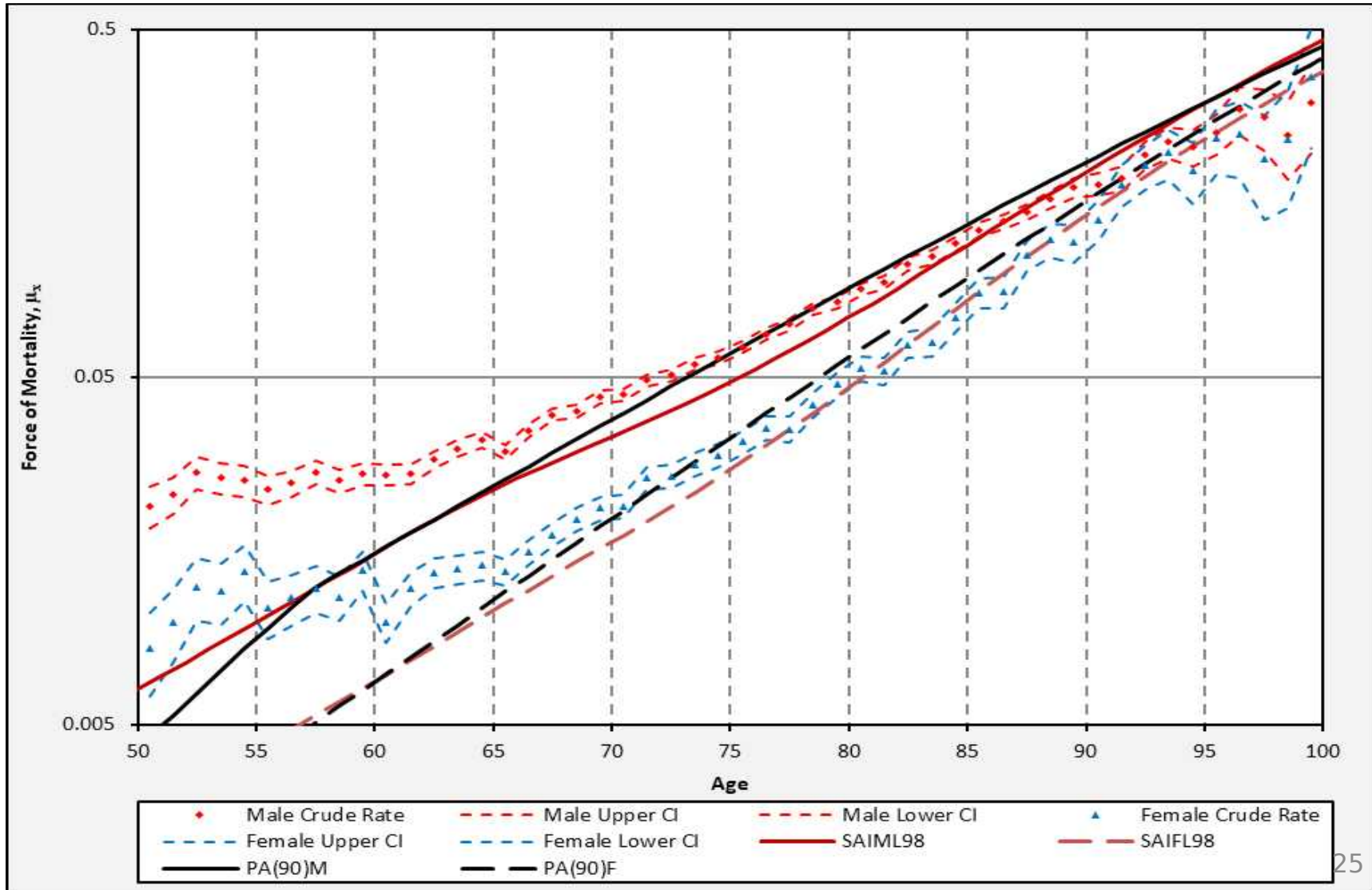
Male assured 2003-2013



Female assured 2003-2013



Pensioner mortality 2005-2010



Other sources of demographic estimates of mortality of countries

- World Population Prospects (2017 revision): National and global regions (<https://population.un.org/wpp/>)
- Institute of Health Metrics and Evaluation: Global Burden of Disease (GBD) 2017: National and global regions (includes 'provincial' for a number of countries) (<http://ghdx.healthdata.org/gbd-results-tool>)
- US Census Bureau International Database (<https://www.census.gov/programs-surveys/international-programs/about/idb.html>)
- Latin America Human Mortality Database (<http://www.lamortalidad.org/>)

Final thoughts

- Data on mortality still extremely limited in many African countries
- Some signs of improvement in building/maintaining CRVS systems

BUT

- Also signs of weakening of systems and local skills in some countries
- The requirements of MDGs and particularly SDGs, and the production of estimates by international agencies undermine the development of skills locally
- Uncertainty about the estimates is often underestimated

