Trends in Healthy Survival: A Cohort Approach

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REVES 23, Paris, 27 May 2011

Goal

- Improve measurement of trends in mortality vs. disability to better inform debates about expansion vs. compression of morbidity

Existing approaches for synthetic cohorts

- Sullivan method (Sullivan 1971)
  - Pros: Relies on widely-available data (period life table and age-specific cross-sectional prevalence of disability)
  - Cons: Makes the “stationarity” assumption, i.e. assumes that observed cross-sectional prevalence of disability is equal to that of the synthetic cohort (Brouard and Robine 1992)

Existing approaches for synthetic cohorts

- Multistate method (Rogers et al. 1990, Lièvre et al. 2003)
  - Pros: Most rigorous approach for synthetic cohorts
  - Cons: Requires longitudinal data. This limits the applicability of this approach.

Health expectancies for actual cohorts

- Pros: Stationarity assumption of Sullivan method is valid, so observed age-specific prevalence of disability for cohorts can be combined with cohort life tables to calculate true "unconditional" health expectancies. Same results as multi-state approach, but without longitudinal data.
- Cons: Applies only to cohort now extinct (right truncation). Prevalence of disability data typically not available for periods far in the past (left truncation).
- Rarely used in the literature (Soneji 2006)

Proposed approach

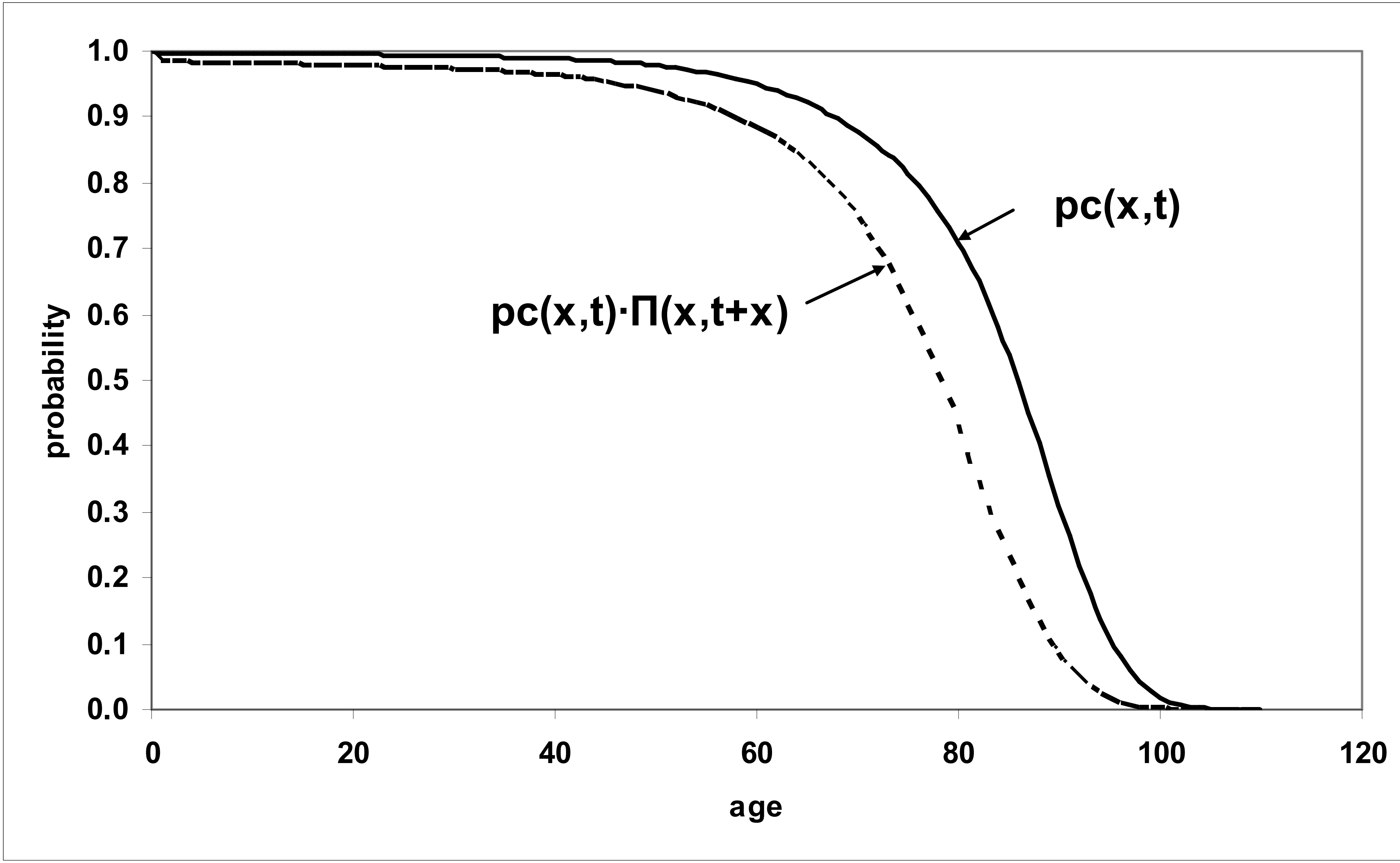
- Cohort approach
- Focus on cohort survival to a given age x instead of life expectancies
- No need to observe entire life course of cohorts
- Not limited to cohorts now extinct – also applies to truncated cohorts
- Provides theoretically correct measures without large data requirement of multistate method

Notation

- Probability that an individual born at time t will be alive at age x: $p_c(x,t)$
- Probability that a newborn born at time t will be alive and "healthy" at age x:

$$p_c(x,t)\cdot\Pi(x,t+x)$$

where $\Pi(x,t+x)$ is the proportion of "healthy" individuals aged x at time t+x



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probability
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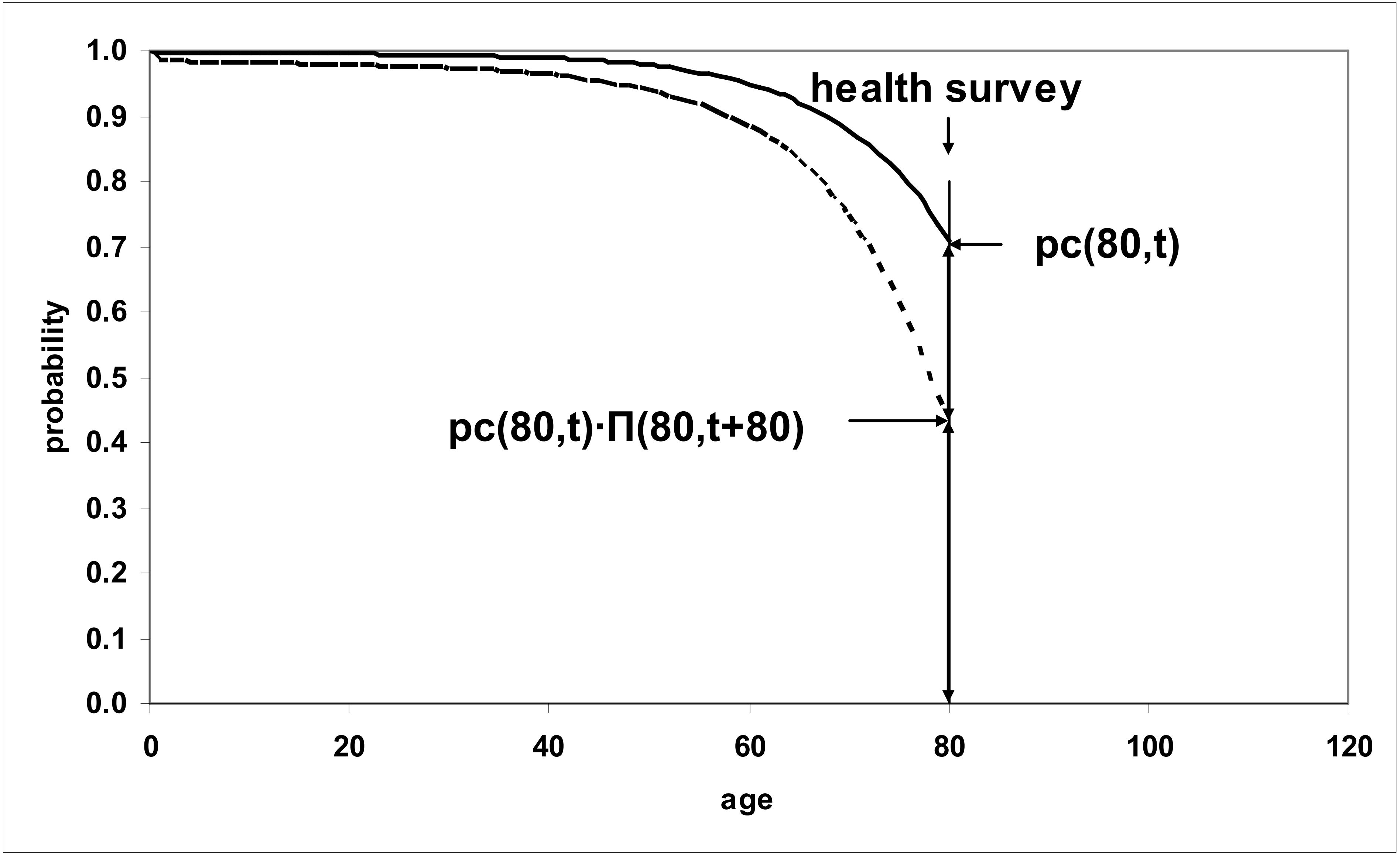
age
pc(x,t)
pc(x,t)·Π(x,t+x)

Estimating healthy survival to a given age x for a cohort

- $\Pi(x,t+x)$ can be observed in a health survey
- $p_c(x,t)$ can be obtained from corresponding cohort life table
- $p_c(x,t)\cdot\Pi(x,t+x)$ is the true probability that a newborn will be alive and healthy at age x in the cohort born at time t. No assumptions are needed.



health survey
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pc(80,t)·Π(80,t+80)
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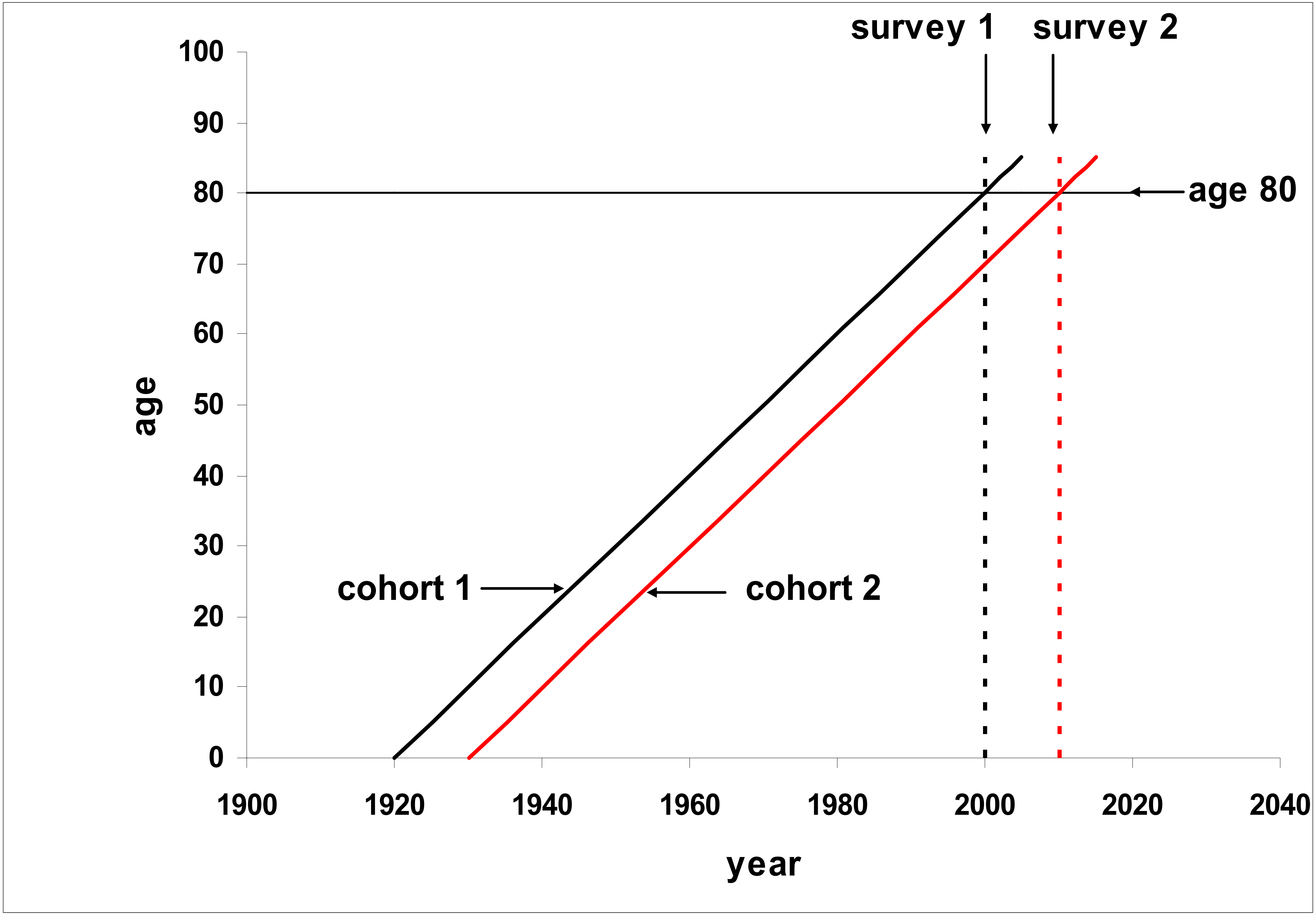
Trends in healthy survival

- At a given age x, trends over time in $p_c(x,t)$ vs. $p_c(x,t) \cdot \Pi(x,t+x)$ indicates whether improvements in survival are matched by similar improvements in "healthy survival" for actual, successive cohorts
- No particular assumptions are needed
- Requires availability of cohort life tables up to age x, in addition to cross-sectional health surveys. No need for longitudinal data.


survey 1
survey 2
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age
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cohort 1
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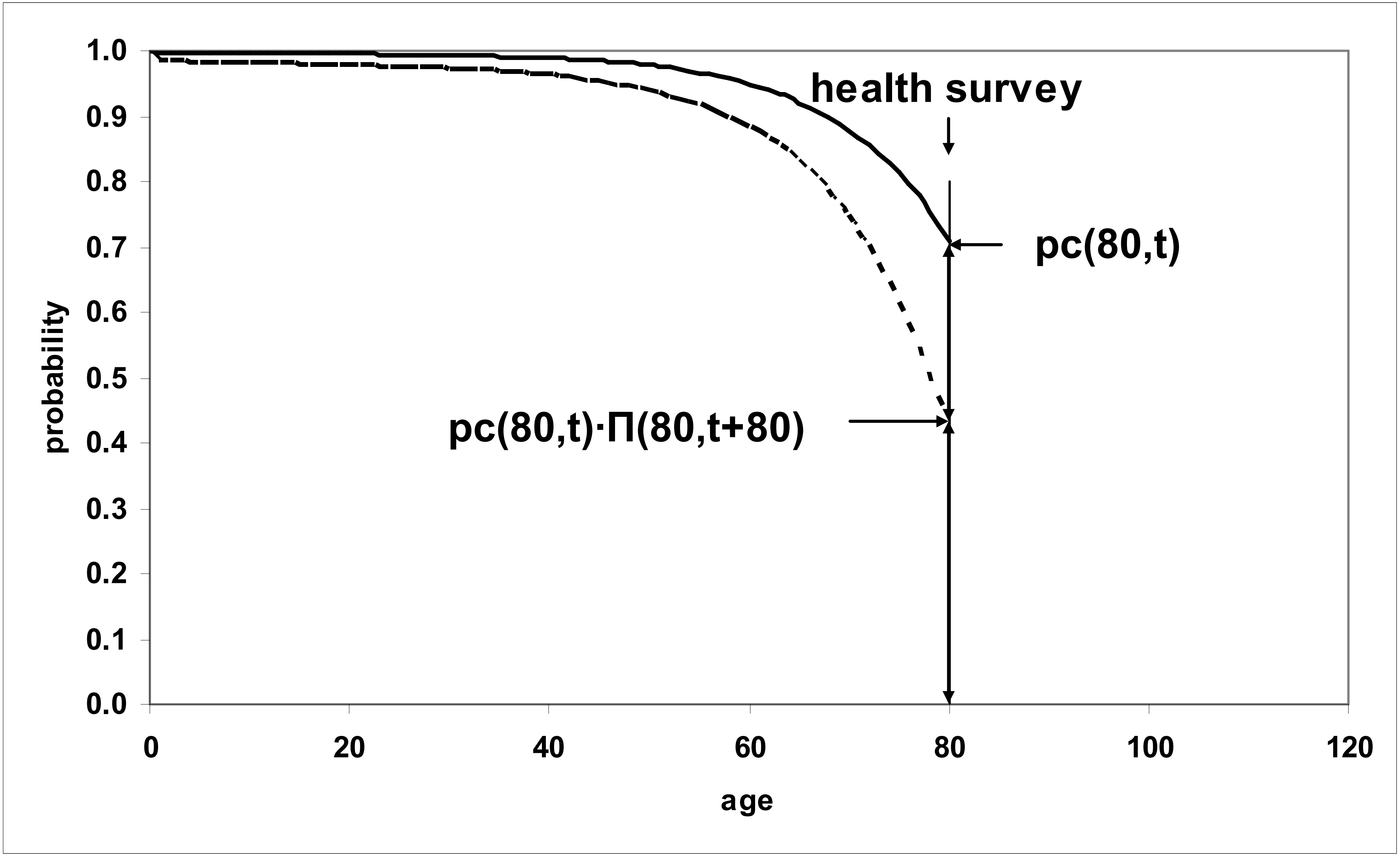
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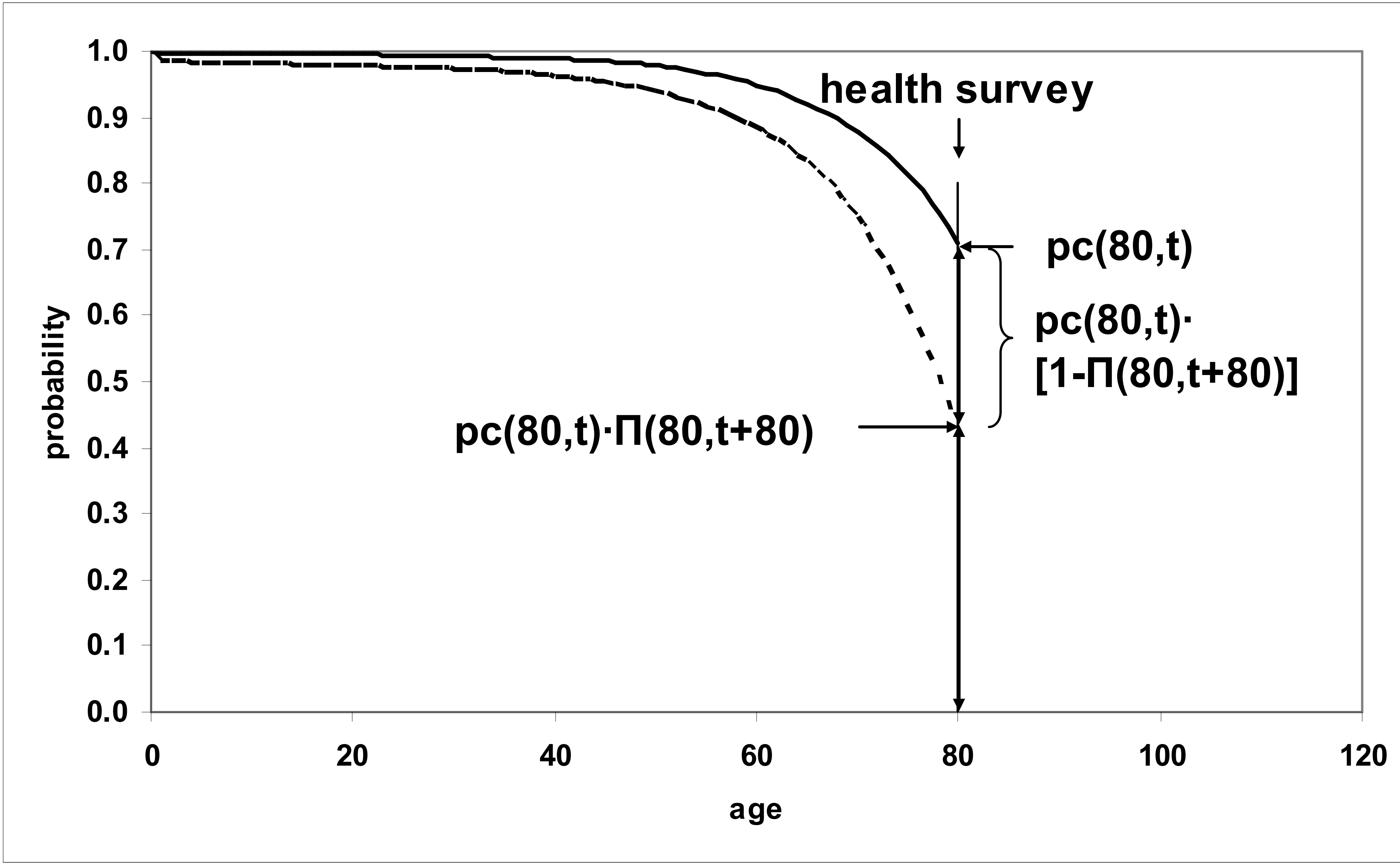
Interpreting trends in healthy survival

- If, at a given age x, $p_c(x,t)$ is increasing faster than $p_c(x,t) \cdot \Pi(x,t+x)$, this indicates <u>expansion</u> of morbidity in absolute terms
- If, at a given age x, $p_c(x,t)$ is increasing more slowly than $p_c(x,t) \cdot \Pi(x,t+x)$, this indicates <u>compression</u> of morbidity in absolute terms
- Simply look for increases vs. decreases in:

  $p_c(x,t) - p_c(x,t) \cdot \Pi(x,t+x)$

  $= p_c(x,t) \cdot [1-\Pi(x,t+x)]$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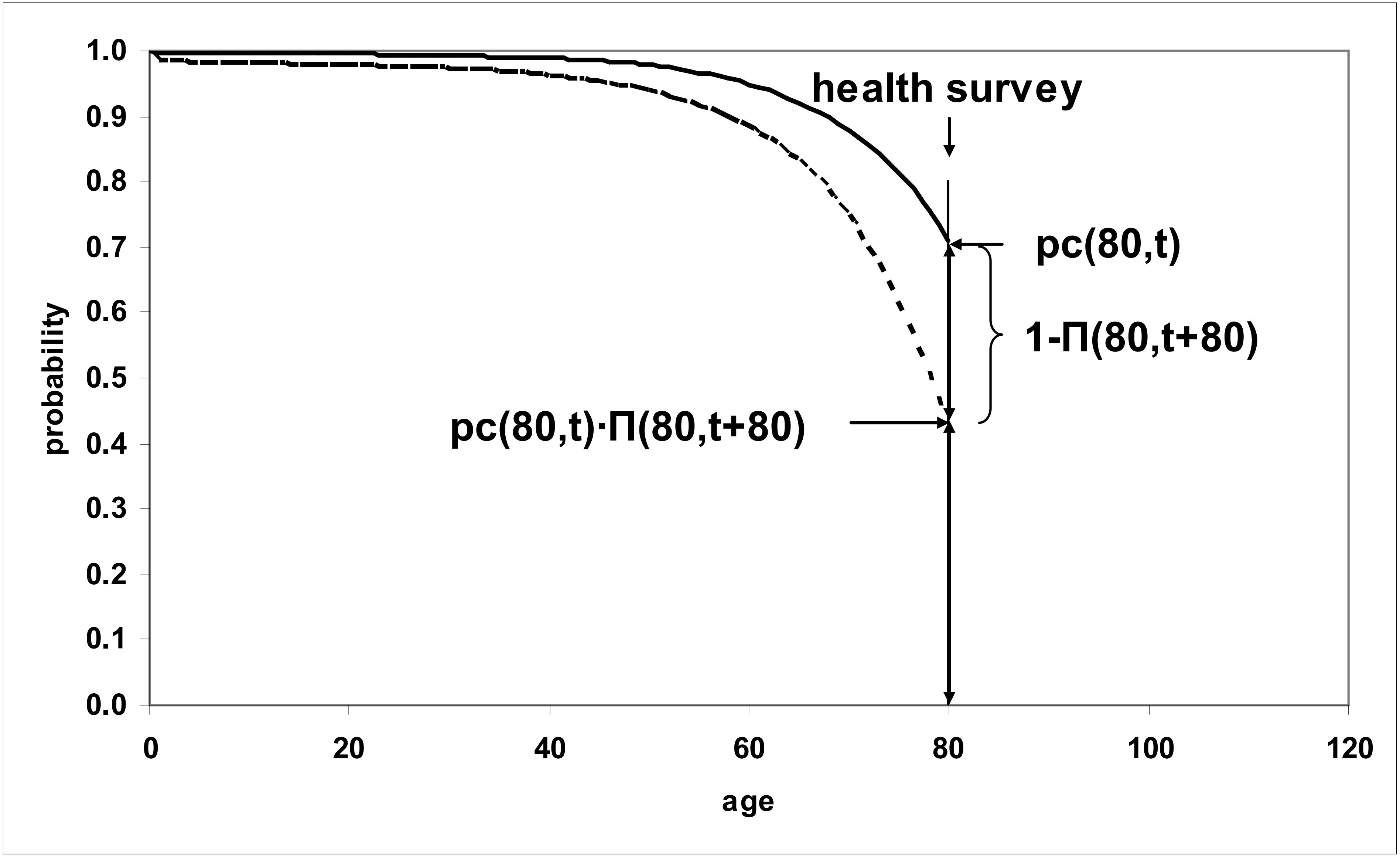
Compression vs. expansion of morbidity in relative terms

- Evolution of $p_c(x,t)$ vs. $p_c(x,t)\cdot\Pi(x,t+x)$ in relative terms
- $[p_c(x,t) - p_c(x,t)\cdot\Pi(x,t+x)] / p_c(x,t)$
  $= 1- \Pi(x,t+x)$
- Look for increases vs. decreases in:
  - $1- \Pi(x,t+x)$
- No need for mortality information



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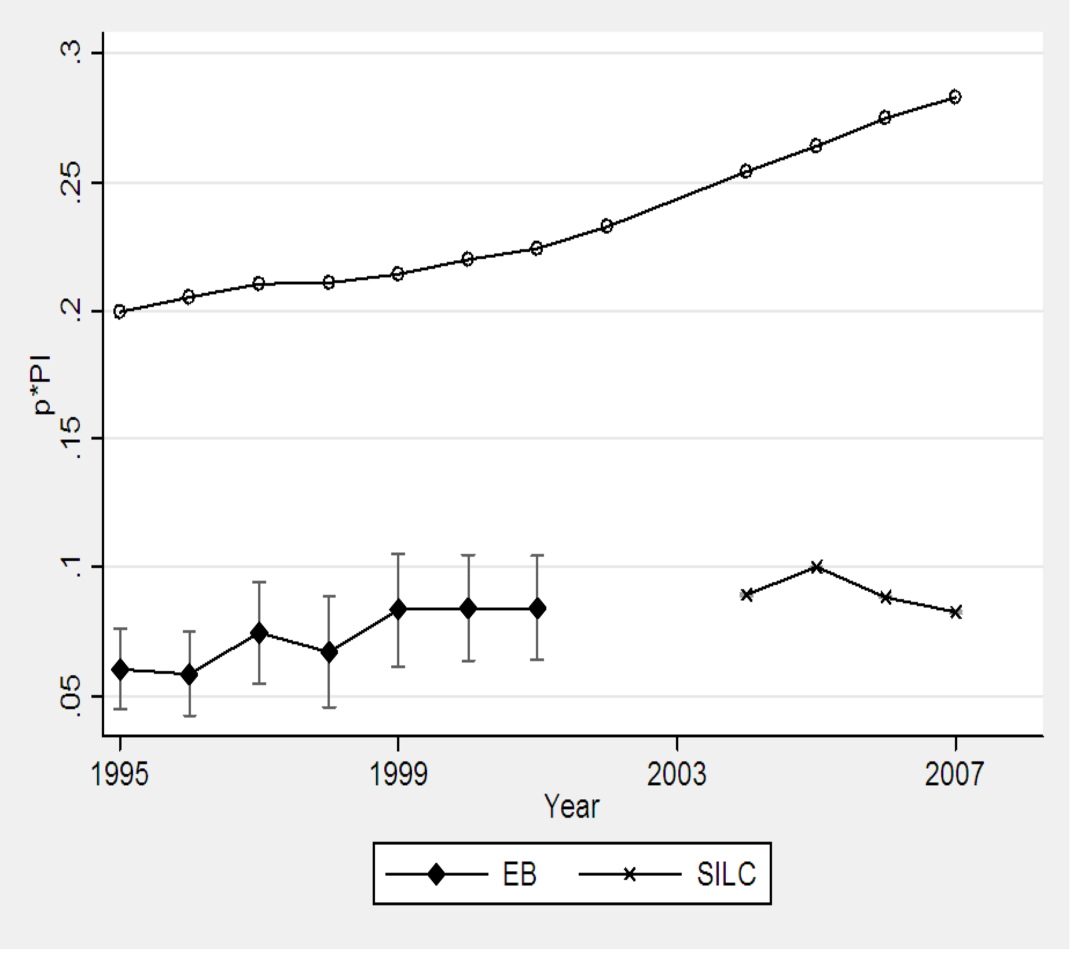
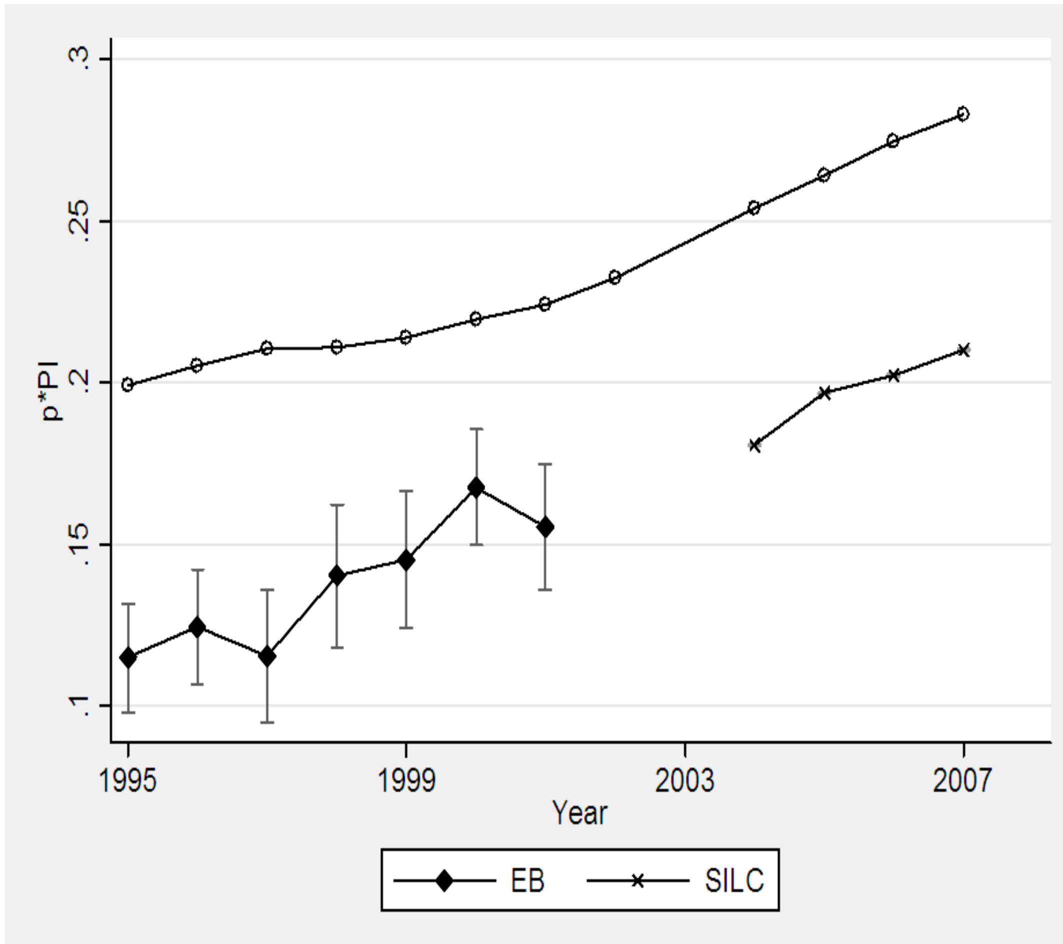
Empirical application

- Human mortality database for cohort survival probabilities
- EHEMU database for proportions of healthy individuals
- Surveys: ECHP, SILC
- Two definitions of “unhealthy” based on activity limitation question:
  - Limited or severely limited
  - Severely limited only
- Calculation of 95% confidence intervals for healthy survival probabilities using binomial framework
- France, males, survival up to age 80

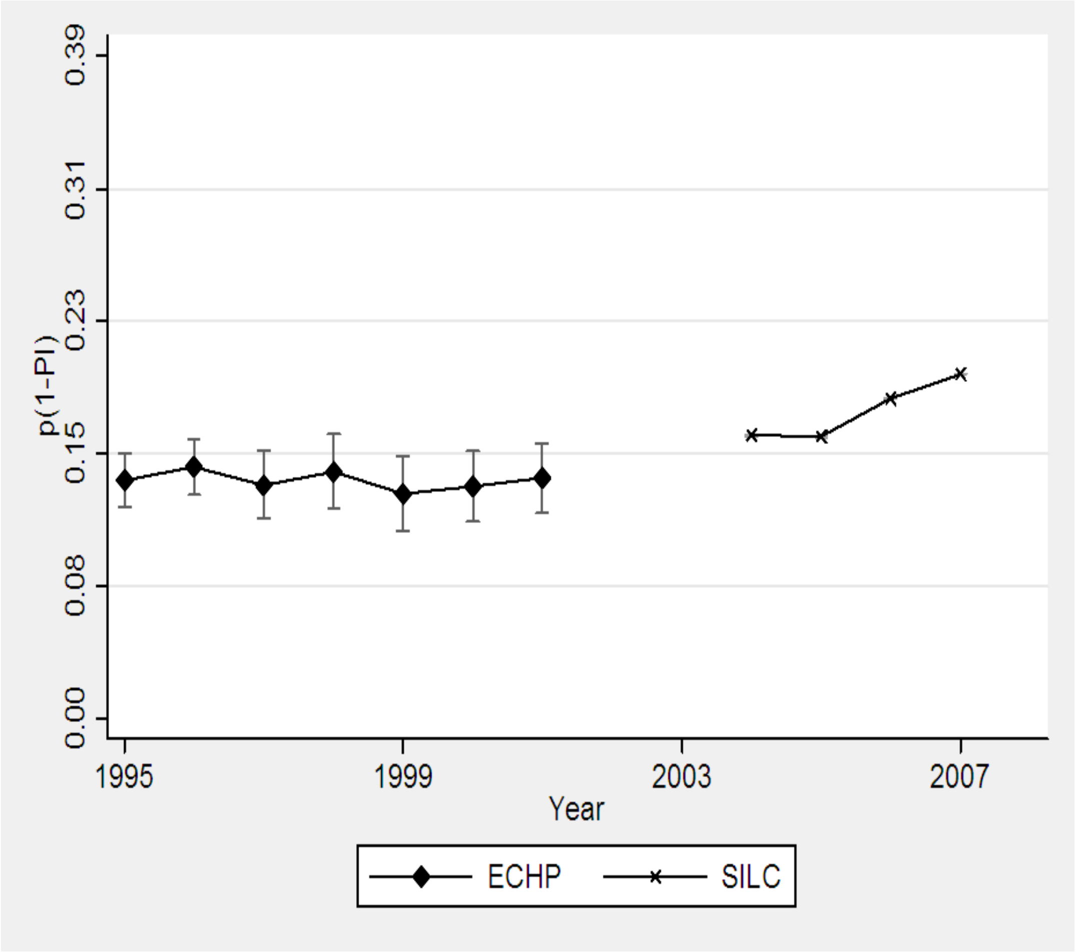
France, Males, Age 80
Limited or severely limited



France, Males, Age 80
Severely limited



France, Males, Age 80
Limited or severely limited



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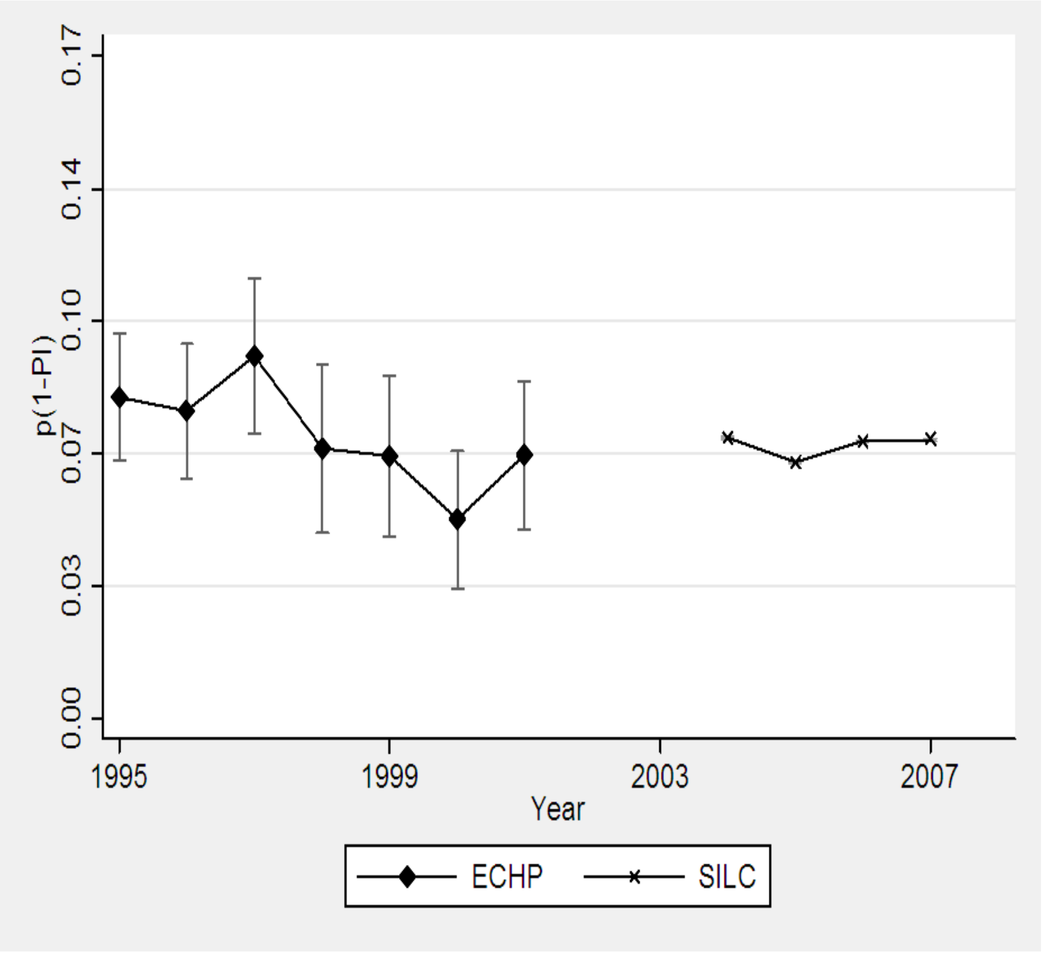

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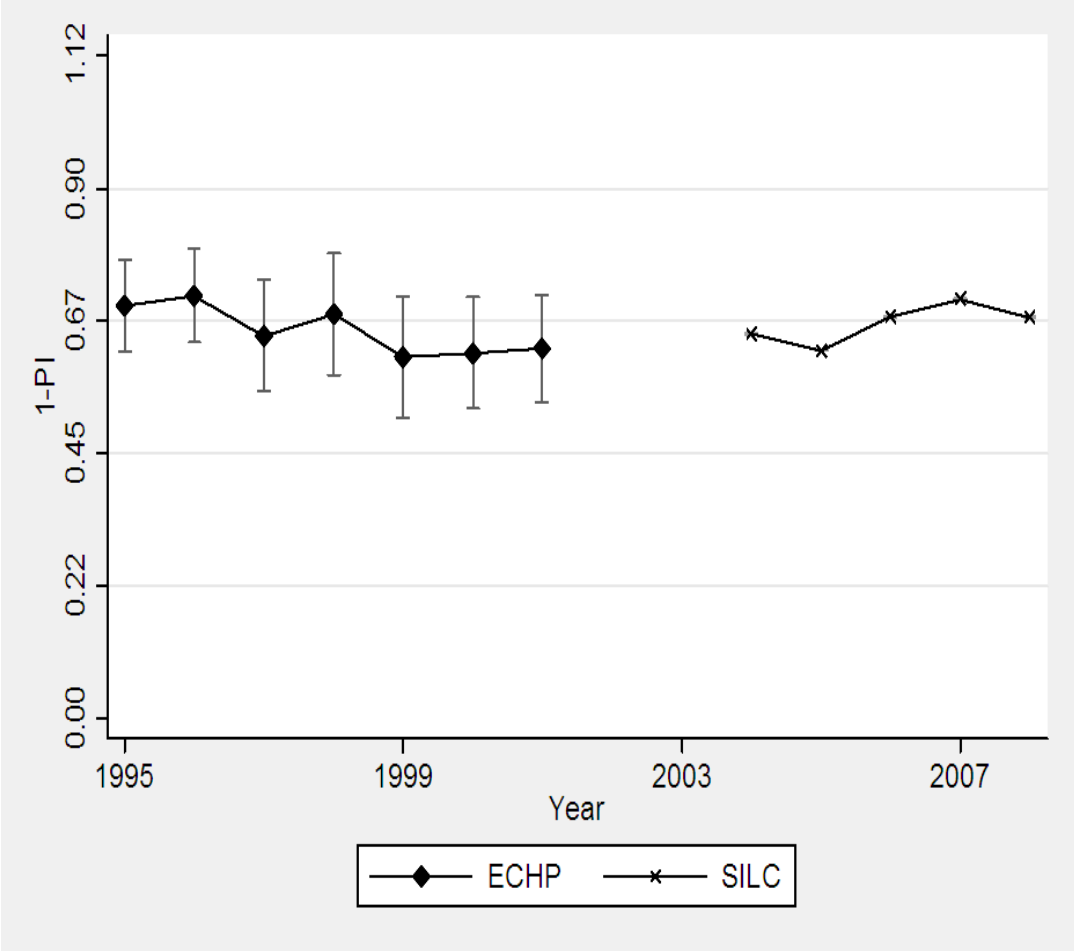

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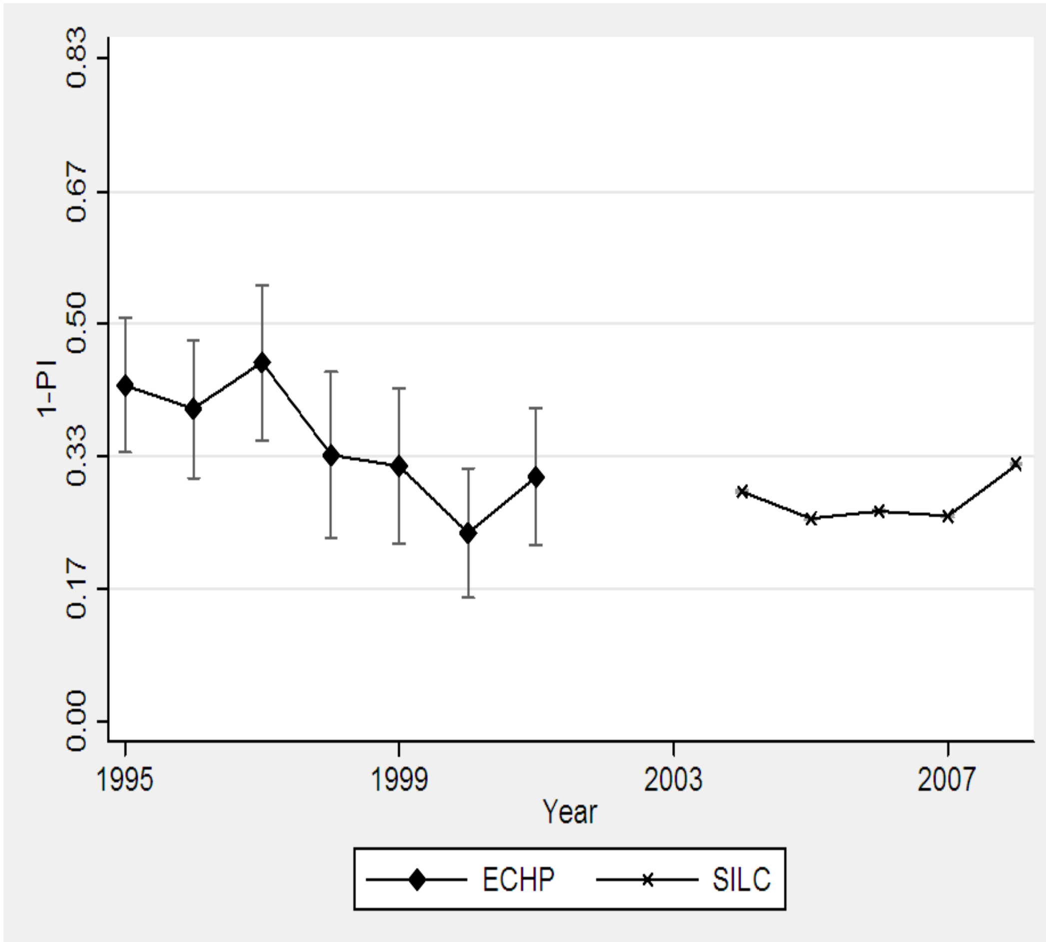

Healthy survival vs. health expectancies

- Survival probabilities and probabilities of healthy survival are useful indicators in their own right
- Expansion vs. compression of morbidity typically examined in terms of health expectancies
- Strong relationship between $p_c(x,t)$ and life expectancies; likely to hold as well for healthy survival vs. health expectancies

Conclusion

Advantages:

- Use of widely available data in a theoretically consistent fashion
- Based on actual experience of cohorts
- With good health survey data, should provide unambiguous picture of trends in mortality and disability

Conclusion

Issues:

- Need to look separately at different age groups – no global estimate such as life expectancy
- Refers to the past dynamics of mortality and morbidity
- Results only as good as the health survey data

Next steps

- Systematic examination of countries, health surveys and health outcomes
- Merging of countries in order to reduce sampling error in $\Pi(x,t+x)$
- Comparison with period health expectancy trajectories