# Behavioral Responses to Health Innovations and the Consequences for Socioeconomic Outcomes

Mette Gørtz
University of Copenhagen
Department of Economics

CORS Conference
November 19, 2018

UNIVERSITY OF COPENHAGEN

# Health, innovations and inequality

Observations:

➢ Rising inequality in health over last decades

➢ Increasing gap in socioeconomic outcomes ➔

➢ Benefits of health technologies unequally distributed

Leading hypotheses:

➢ Richer and better-educated people are faster at adopting new technologies.

➢ Increasing pace of medical innovations disproportionally benefits the educated

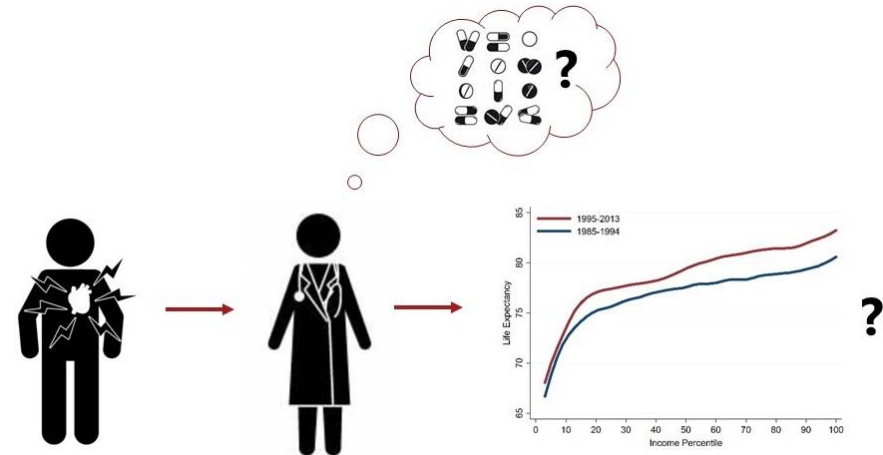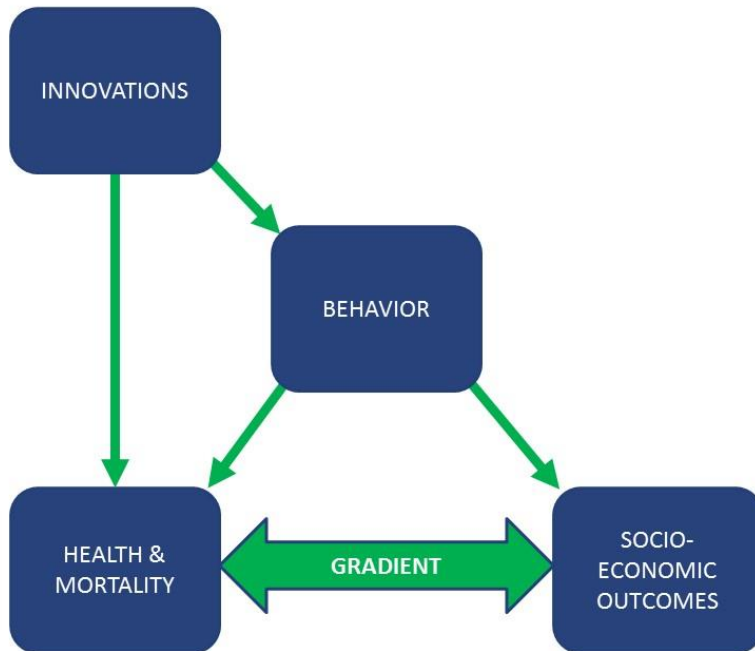➢ Widens the socioeconomic gap in health.

# Inequality in health and mortality

### Life expectancy for income groups
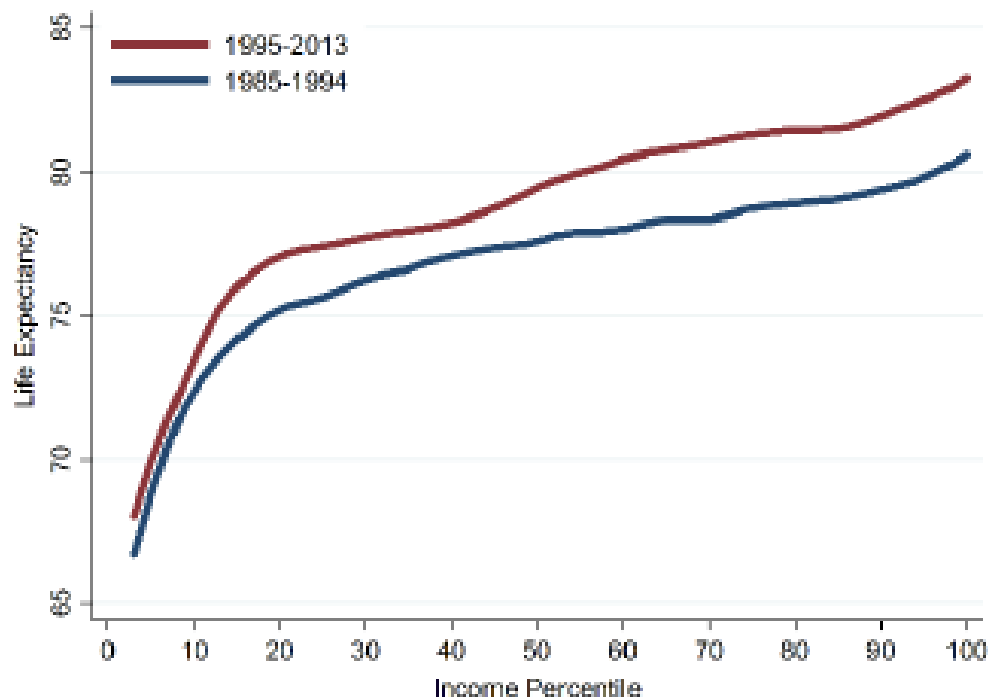


Source: Own calculations; Danish register data and Statistikbanken.dk

# Individual behavior and effectiveness of health innovations



## Important economic questions:
1. How do health innovations transmit into economic outcomes?
2. How do innovations and behavior shape the *gradient* in mortality?
3. Which mechanisms explain the education-health gradient?
➔ Answer these questions in large research project financed by the Novo Nordisk Foundation

# Data and methods

- Exploit the internationally unique Danish **register data**
  - Rich on health care use and socioeconomic information
  - Panel data 1980-today
- Collect **new survey data on behavior** of
  - **Patients**: personality traits determine how they adopt treatments
  - **Physicians**: physicians target treatment to different patients
  - Insights from new research field combining econ & psychology
- **Link** survey and register data: extraordinary possibility in DK
- Use state-of-the-art econometric methods
- Collaborations:
  - Region Zealand ➜ medical expertise
  - Ministry of Health ➜ policy expertise

# Socioeconomic gradient in mortality in an international perspective

**Chetty et al. (JAMA, 2016)**

Large literature relates socio-economic class to mortality and life expectancy (Case & Deaton *PNAS* 2015; Currie & Schwandt *Science* 2016; Chetty et al. *JAMA* 2016)
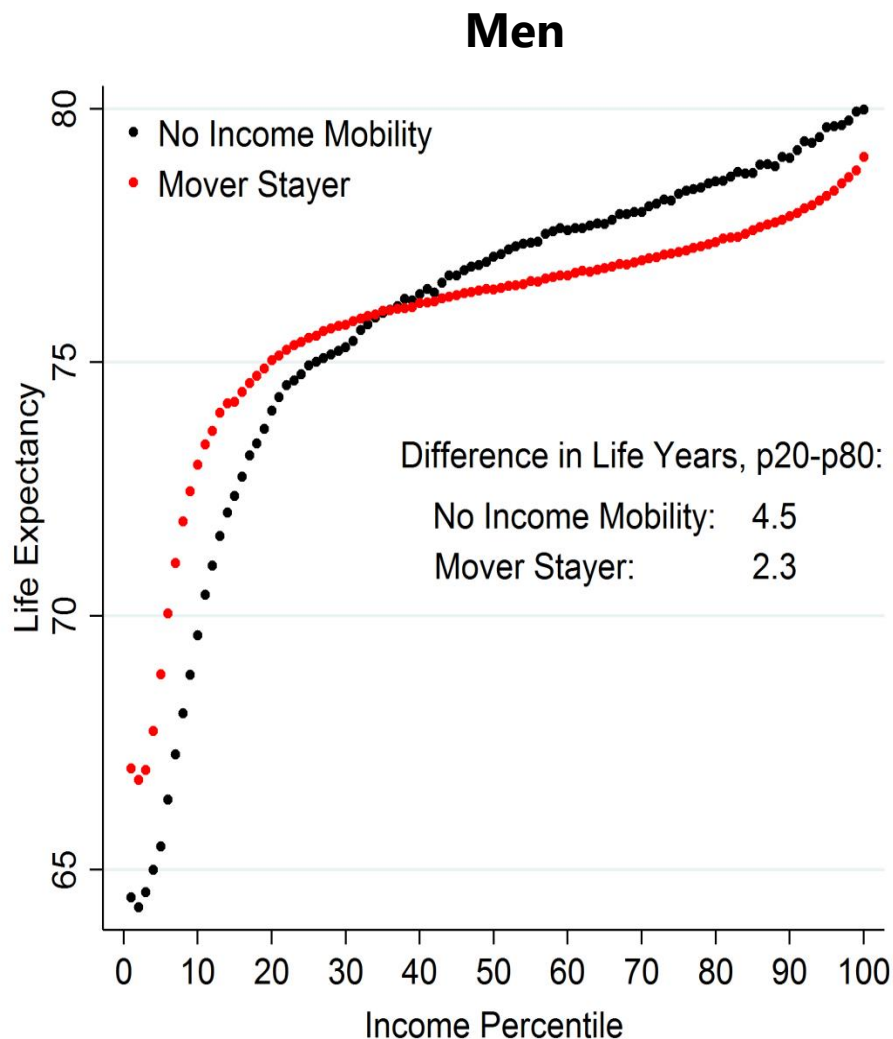
Large and increasing inequality in life expectancy

Important for inequality measurement and for social insurance policy (Auerbach et al. 2017)
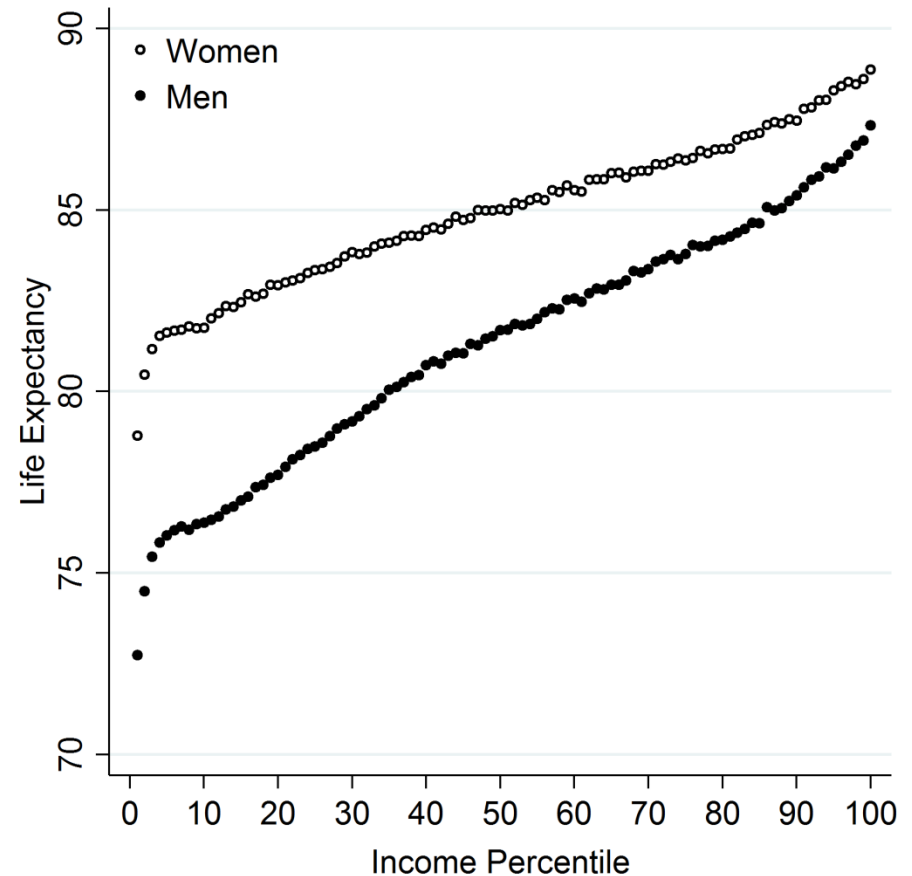
# Our contribution: accounting for mobility

**Men**



People in the top move down
People in the bottom move up

We propose and validate a method
to account for income mobility
in Life expectancy calculations
(Mover Stayer model)

Good news

Inequality in life expectancy only half
as big when accounting for mobility

Bad news

Inequality in life expectancy is still
rising

# Role of income mobility for the measurement of inequality in life expectancy

Claus Thustrup Kreiner[a,1], Torben Heien Nielsen[a], and Benjamin Ly Serena[a]

[a]Center for Economic Behavior and Inequality, Department of Economics, University of Copenhagen, 1353 Copenhagen, Denmark

This work proposes a method to compute the income gradient in period life expectancy that accounts for income mobility. Using income and mortality records of the Danish population over the period 1980–2013, we validate the method and provide estimates of the income gradient. The period life expectancy of individuals at a certain age, and belonging to a certain income class, is normally computed by using the mortality of older cohorts in the same income class. This approach does not take into account that a substantial fraction of the population moves away from their original income class, which leads to an upward bias in the estimation of the income gradient in life expectancy. For 40-y-olds in the bottom 5% of the income distribution, the risk of dying before age 60 is overestimated by 25%. For the top 5% income class, the risk of dying is underestimated by 20%. By incorporating a classic approach from the social mobility literature, we provide a method that predicts income mobility and future mortality simultaneously. With this method, the association between income and life expectancy is lower throughout the income distribution. Without accounting for income mobility, the estimated difference in life expectancy between persons in percentiles 20 and 80 in the income distribution is 4.6 y for males and 4.1 y for females, while it is only half as big when accounting for mobility. The estimated rise in life-expectancy inequality over time is also halved when accounting for income mobility.

life expectancy | mortality | inequality | income mobility

Life expectancy is strongly associated with income across societies and within societies (1–8). The relationship between income class and life expectancy within a society is important for evaluating equity and assessing the costs and benefits of public health and social security policies (9–14). It is well established that mortality is decreasing in income across individuals, and this relationship is used to estimate the association between income and life expectancy (6–8, 10, 15). An impressive recent study (7) provides nonparametric estimates of the association between income class and period life expectancy using tax return data for the US population and shows that those in the top of the income distribution at age 40 can expect to live nearly 15 y longer than those in the bottom of the distribution.

The calculation of period life expectancy for a given age group in a given year uses life tables with information about mortality of older cohorts to estimate future mortality. In an unchanging soci-

are constant. Some of the individuals originally in the top of the income distribution within their cohort will move down in the distribution, while individuals in the bottom of the distribution will tend to move up. Therefore, the method assigns too-high future mortality rates to low-income classes and too-low rates to high-income classes. This creates an upward bias in the estimation of the income gradient in period life expectancy (18).

To see the potential quantitative importance, consider the extreme case of perfect mobility, where income in 1 y is uncorrelated with income in preceding years. In this case, life expectancy of individuals alive 1 y from now is independent of their current income class, even when mortality rates vary strongly with income at each age. Estimates not accounting for income mobility would then point to a large income gradient in period life expectancy for these individuals, although the true gradient is zero.

Table 1 uses our data to illustrate the actual degree of income mobility in society and its importance for predicting future mortality of different income classes. Among 40-y-old males belonging to the bottom 5% of the income distribution, nearly half of those alive at age 50 (45% to be exact) have moved up in the income distribution (labeled movers), while the remaining half have stayed in the bottom part of the distribution (labeled stayers). Similarly, among individuals in the top 5% of the distribution, about half are movers, moving down in the income distribution, while the other half are stayers. This mobility across income classes is important for predictions of future mortality. During the subsequent 10 y, from age 50 to 60, we find that 29% of the stayers in the bottom part of the distribution die, but only 13.5% of the movers die. We observe the reverse pattern in the top of the distribution, where 3.5% of the stayers die, while 5% of the movers die. This example illustrates the potential for

## Significance

People in the bottom of the income distribution live shorter lives than those in the top. This is an important dimension of inequality in society. We demonstrate how forces of income mobility are important for conclusions about inequality in life expectancy. Some people escape poverty, and many people at the top of the distribution only have high incomes temporarily. Those moving out of an income class have very different mortality patterns than those staying. We provide a method that incorporates income mobility in calculations of life expectancy inequality. The good news is that the degree
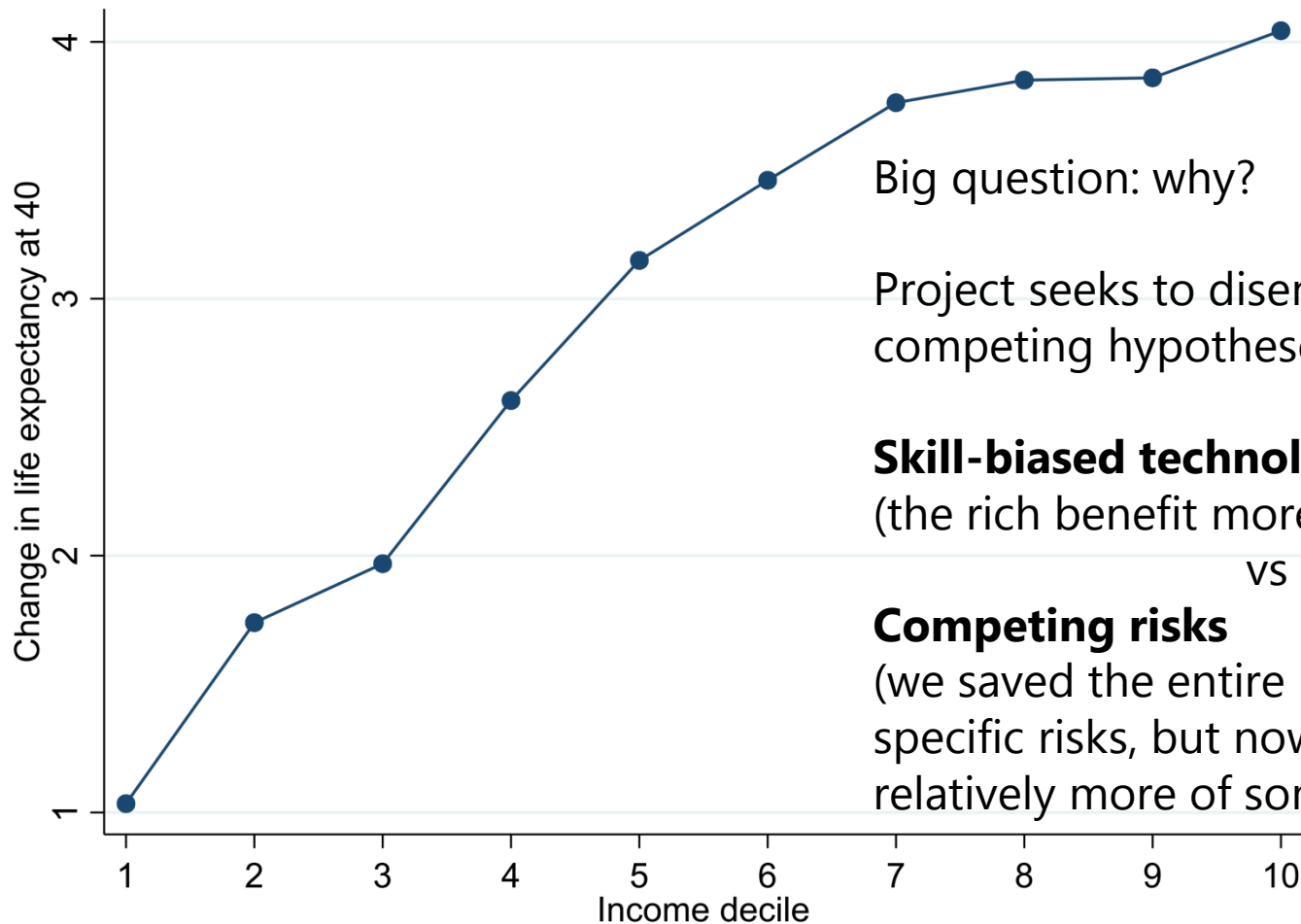
# Development in life-expectancy inequality

**Change in life expectancy 83-94 → 95-13**
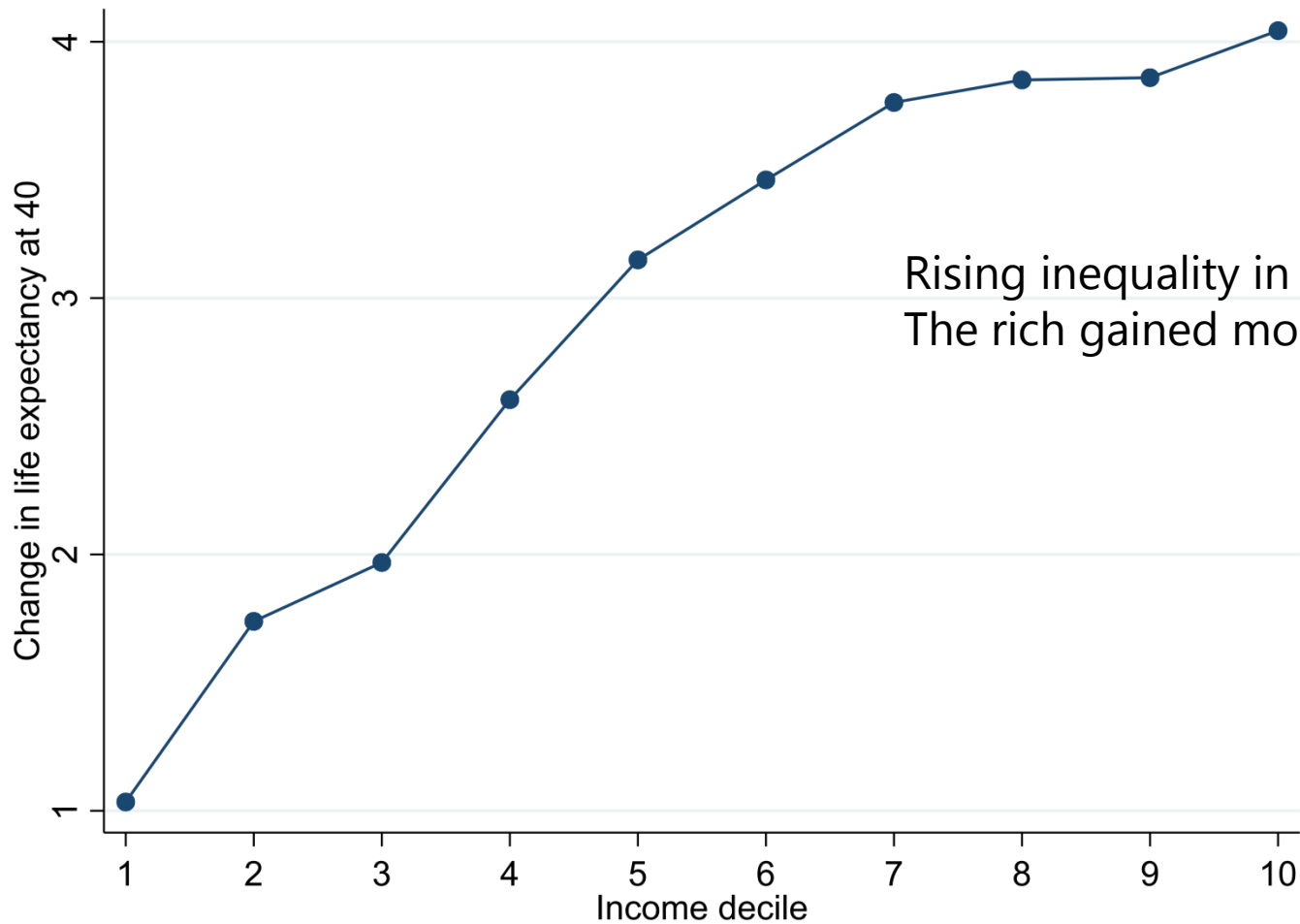


Rising inequality in LE:
The rich gained more life years

# Development in life-expectancy inequality

**Change in life expectancy 83-94 → 95-13**

Big question: why?

Project seeks to disengtangle two competing hypotheses:

**Skill-biased technology**
(the rich benefit more from new technologies)

vs

**Competing risks**
(we saved the entire population from specific risks, but now the poor die relatively more of something else)

*Chart y-axis: Change in life expectancy at 40; x-axis: Income decile*

# Role of behavior and skills

➢ Innovations improved public health over decades

➢ Essential that innovations are **adopted** by users in order to be effective - "trickle down"

➢ Individual **behavior**

  ➢ ...affects how patients and physicians adopt new health technologies

  ➢ ...ultimately determines how **effective** new treatments are

➢ **Individuals respond differently** to new treatments -

  ➢ Socioeconomic factors account for substantial part of variation in effectiveness of treatments

# Mechanisms: Patient/physician behavior

Possible explanations for **high education = healthier:**

1. Education ➔ better decision-making (use innovations)
2. Healthier people obtain more education
3. Some people are **both more educated and healthier**.

➢ One example of characteristics: socio-emotional skills

- Self-control
- Sense of control over life = "translate knowledge into action"
- Anxiety, stress, depression
- Motivation, grit = "get out and choose best"

- **Socio-emotional skills** drive *both* economic & health behaviors ➔ are they behind gradient? **Disagreement** in literature.

- How much does health effect of education decrease with controls?

  - No change in Cutler and Lleras-Muney (2010), rather cognition=IQ!
  - Strong support for skills in Conti et al. (2010).
  - Conti & Hansman (2013) show that which skills are used matters!

# Mechanisms: Patient/physician behavior

**To test which socio-emotional skills** mediate link from education/income to successful innovation adoption:

- Observe health outcomes in administrative registers +
- **Supplement** register data with **patient survey**
  - ➢ Personality measures, well-established instruments
  - ➢ Information-gathering behaviour
  - ➢ Engagement with treatment options

# Survey 1: General Population

➢ Sample: ages 18-75
- Over-sample ages 45-75 – bc young are healthy
- Country-wide; tradeoff dense coverage to various conditions
- Identify siblings – tradeoff representative vs family effects

➢ Invite via e-boks, remunerate participation

➢ Self-assessed personality traits such as
- Conscientiousness
- Extraversion (sociability)
- Risk preference

➢ Merge to administrative registers (unique!)

➢ Study:
  ➢ Skills as mediators of health-income/education gradient
  ➢ Identify treatment differences for same condition by skills

# Survey 2: Effects of family health shocks

➢ Challenge in previous set-up:

- Observing skills in adulthood: they are potentially result of education/income and health shocks.
- Difficult to infer **causal effects**

➢ Suggested supplemental study:
**How much** do socio-emotional **traits change** in response to health shocks in the family?

- Existing small literature disagrees.
- We will exploit existing survey data from the Trivselsundersoegelse/Well-being study on school children, 3 annual waves
- Supplement with over-sample of previous study on 18-20 year-olds to extend time frame.

# Mechanisms: Physician's role

- Physicians are important for variation in care (Finkelstein et al. 2014, Laird & Nielsen 2017)

- How do physicians form their beliefs and practices?

- Patient/physician interaction. Do physicians anticipate differential patient compliance?
  - Collect paired survey data from physicians
  - Study treatment choices together with perceived patient skill

- Physician beliefs formed by technology diffusion.
  - knowledge spillovers from mobility of physicians (regions/institutions)
  - random allocation of 20,000 newly educated doctors across regions
  - Link to register data since 1984 for practice styles and careers

# Health innovations and economic outcomes

- **Research question:** How do health innovations transmit into economic outcomes?

- **Idea:** New treatments alter patients' life expectancy and expectations for the future

- ➔ We ask how innovations in health affect *individual economic decisions* regarding employment, investment and savings.

# Health innovations and economic outcomes

**Investigate selected innovations, focusing on:**

1. The arrival of new treatments of HIV virus in the mid-1990's

2. Innovations in the surveillance and treatment of diabetes

 • Both diseases hit individuals at a rather young age and require considerable patient self-management (Goldman & Smith 2002; Smith & Goldman 2010; Maitra 2010).

• 3. HPV vaccine (innovation and "exnovation")

Heterogeneity in responses: Analyze differential responses across age, gender, income and education groups.

# Introduction of HIV treatment in mid-90'es

Previous studies:

- Introduction of Antiretroviral (ART) medicine in 90'es in Malawi: Effects on savings and investment. Baranov & Kohler 2018, *AEJ Applied*.

- Introduction of HAART in the US: Effects on domestic violence and illicit drug use. Papageorge et al. 2018.

Our study will:

- Use Danish register data: Look at effects on savings, investment, education, family formation

- Include data from Danish HIV cohort: Allows us to estimate progression of disease

# HPV virus take-up

HPV vaccine uptake over time for birth cohorts 1997-2003
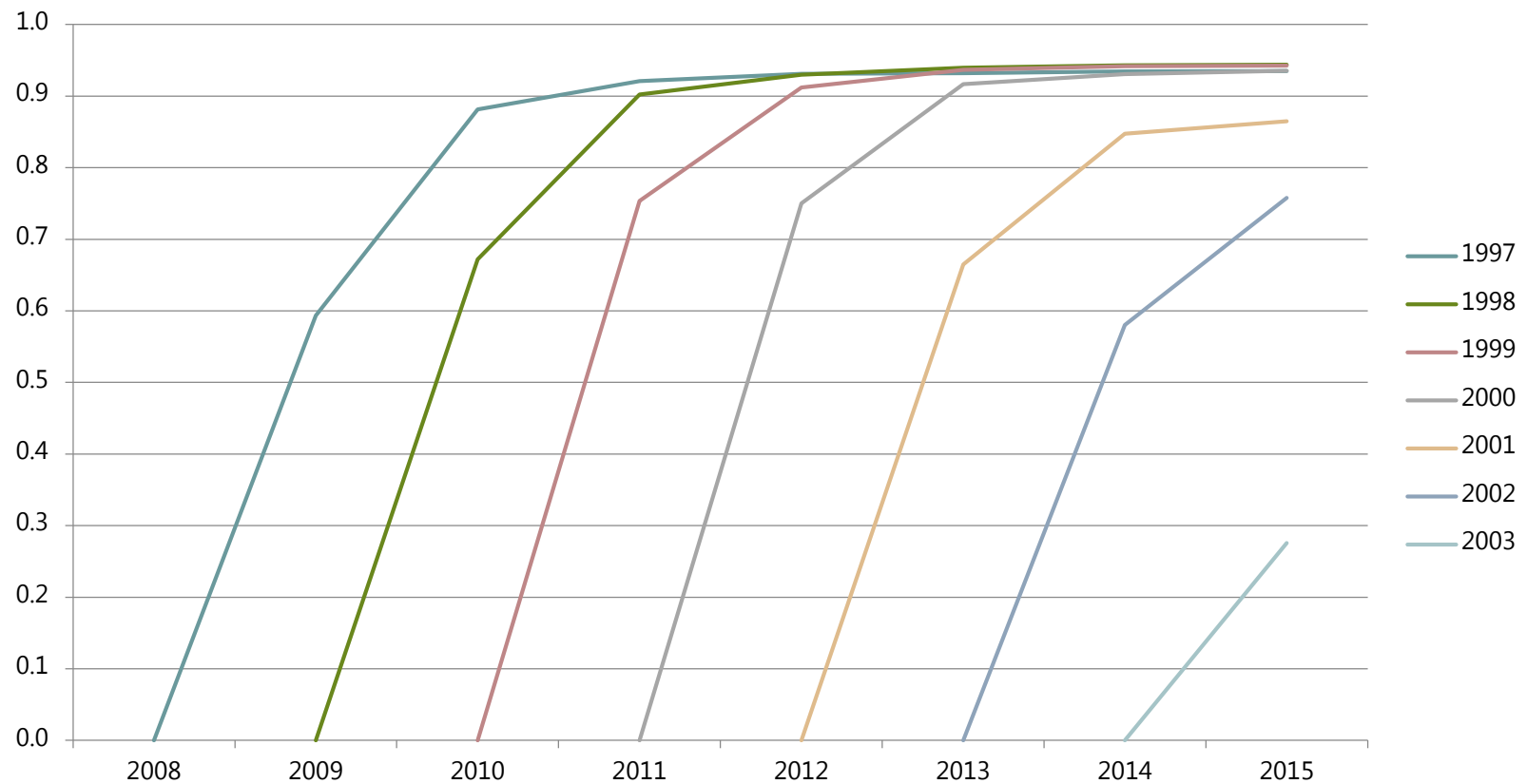
# Conclusion

- Socio-economic gradient in health and mortality has been increasing over last decades

- Innovations, behaviors & skills, health, education and income linked

- Our project aims at disentangling these links, using register data combined with surveys

- Project runs 2018-2021