Journal of Health Economics 30 (2011) 1113–1123

Contents lists available at ScienceDirect

Journal of Health Economics

journal homepage: www.elsevier.com/locate/econbase

Accounting for the dead in the longitudinal analysis of income-related health inequalities

Dennis Petrie[a,*], Paul Allanson[a], Ulf-G. Gerdtham[b,c,d]

[a] Economics Studies, School of Business, University of Dundee, Perth Road, Dundee DD1 4HN, Scotland, United Kingdom
[b] Department of Economics, Lund University, Sweden
[c] Health Economics & Management, Institute of Economic Research, Lund University, Sweden
[d] Centre for Primary Health Care Research, Lund University, Sweden

ARTICLE INFO

Article history:
Received 2 February 2011
Received in revised form 30 June 2011
Accepted 7 July 2011
Available online 18 July 2011

JEL classification:
D39
D63
I18j

Keywords:
Mortality
Income-related health inequality
Mobility analysis
Longitudinal data
Inverse probability weights (IPWs)

ABSTRACT

This paper develops an accounting framework to consider the effect of deaths on the longitudinal analysis of income-related health inequalities. Ignoring deaths or using Inverse Probability Weights (IPWs) to re-weight the sample for mortality-related attrition can produce misleading results. Incorporating deaths into the longitudinal analysis of income-related health inequalities provides a more complete picture in terms of the evaluation of health changes in respect to socioeconomic status. We illustrate our work by investigating health mobility from 1999 till 2004 using the British Household Panel Survey (BHPS). We show that for Scottish males explicitly accounting for the dead rather than using IPWs to account for mortality-related attrition changes the direction of the relationship between relative health changes and initial income position, from negative to positive, while for other groups it significantly increases the strength of the positive relationship. Incorporating the dead may be vital in the longitudinal analysis of health inequalities.

1. Introduction

A strong cross-sectional relationship between individuals' socioeconomic status and health has been documented in numerous studies (Benzeval and Judge, 2001; Deaton, 2003). Significant income-related inequalities in health have persisted, and even increased, in some western countries over the last decade in spite of considerable improvements in average health status (Van Doorslaer and Koolman, 2004; Kunst et al., 2005). Thus, reducing socioeconomic inequalities in health has become a key policy objective for many European governments (Mackenbach and Bakker, 2002; Strategic Review of Health Inequalities in England Post 2010, 2010). As with any policy objective, it is important to be able to evaluate progress and understand reasons for progress in order to inform future policy (Exworthy et al., 2006).

Often the longitudinal analysis of income-related health inequalities focuses on how the cross-sectional relationship, between income (or some other socioeconomic status indicator) and the morbidity of those currently alive, evolves over time (Lahelma et al., 2002; Gravelle and Sutton, 2003; Kunst et al., 2005). However, in order to evaluate the performance of policies in reducing income-related health inequalities, a measurement framework is needed which simultaneously examines changes in inequality associated with both morbidity changes and mortality (Khang et al., 2004).

The main measure of income-related health inequality within the health economics literature is the concentration index (Wagstaff and Van Doorslaer, 2000). This captures the extent to which good health in any period is concentrated among the rich compared to the poor and is equal to twice the covariance between health and income rank normalised by average health.

Changes in the concentration index (*CI*) over time have been analysed in the manner of Gravelle and Sutton (2003) using repeated cross-sections, but this does not consider the impact of individuals dying and dropping out of the population between cross-sectional surveys. The changes in cross-sectional income-related health inequality are usually calculated based only on a sample of those in the population at each point in time. Holding all else equal, if the poor are more likely to die than the rich then

* Corresponding author. Tel.: +44 01382 386164; fax: +44 01382 384691.
E-mail address: d.j.petrie@dundee.ac.uk (D. Petrie).

0167-6296/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.jhealeco.2011.07.004

this will result in an improvement in the cross-sectional *CI* of those alive in the final period, given that the health of the poor is usually worse on average than the rich, even though such an outcome is likely to be viewed as a policy failure rather than a success.

The longitudinal analyses of the *CI* have also been conducted using both balanced and unbalanced panel data on individuals where the dead are either excluded from the analysis in all periods or included only in periods where they are alive.[1] One recent longitudinal study, Allanson et al. (2010), tracks the performance of individuals over time by decomposing the change in the *CI* into "income-related health mobility", which measures the effect of the relationship between health changes and the initial income rank of the individuals on the change in the *CI*, and "health-related income mobility", which measures the effect of the relationship between income rank changes and the final health of the individuals on the change in the *CI*.[2] While this allows one to follow the performance of individuals over the period it again does not capture the impact of individuals who are alive in the initial period but dead by the final period, as it uses a balanced sample of only those alive in both periods. Taking mortality into account is important for the evaluation of policies which tackle health inequalities since a failure to do so would ignore perhaps the most important of all health outcomes. In our empirical example, we find that between 1999 and 2004 health changes due to mortality made up over one-third of all absolute health changes in Great Britain.

One option used to deal with attrition in analysing the dynamics of health is to re-weight the sample using inverse probability weights (IPWs) (Contoyannis et al., 2004; Jones et al., 2006; Lorgelly and Lindley, 2008; Van Kippersluis et al., 2009). This involves placing extra weight on those individuals within the final sample who appear to have the same initial characteristics as those who drop out of the sample. However, in the current context, it seems unreasonable to assume that there are some individuals who stay within the sample (stay alive) who could represent the longitudinal experience of those that die, given that death is the most extreme health outcome possible.[3] In particular, if those that die between the initial and final period were in general sicker in the initial period, then by construction the sick in the initial period that survive obviously had a better longitudinal experience in terms of their health. Therefore, simply placing more weight on the performance of these individuals would bias the result. In our empirical example we show that for Scottish males explicitly accounting for the dead rather than using IPWs to account for mortality-related attrition changes the direction of the relationship between relative health changes and initial income position, from negative to positive, while for other population groups it significantly increases the strength of the positive relationship.

This paper aims to provide a unified framework for the longitudinal analysis of changes in income-related health inequality due to both morbidity changes and mortality, based on the assumption that the dead are assigned a health state of zero.[4] First, we provide an overview of the longitudinal methods employed by Allanson et al. (2010). Second, we extend these methods to explicitly account for the impacts of mortality on income-related health inequalities. The paper then uses data from the BHPS (British Household Panel Survey) to perform a forward looking evaluation of the extent to which relative health changes from 1999 to 2004 in England & Wales and in Scotland were progressive in the sense that they have favoured the initially poor. It compares the results when mortality is assumed to be just another form of attrition and adjusted for using IPWs to when mortality is explicitly taken account of in the decomposition analysis. Finally, the paper compares the performance of England & Wales versus Scotland in tackling income-related health inequalities over this period.

2. Decomposition methodology

2.1. Review of Allanson et al. (2010)

The approach is based on the simple observation that any change in income-related health inequality over time must arise from some combination of changes in health outcomes and income ranks. By decomposing the change in *CI* between two periods, an index of income-related health mobility is provided that captures the effect on short run income-related health inequality of differences in relative morbidity changes between individuals with different levels of initial income. Thus, the measure addresses the question of whether the pattern of morbidity changes is biased in favour of those with initially high or low incomes, providing a natural counterpart to measures of income-related health inequality that address the issue of whether those with better health tend to be the rich or poor. In addition, a health-related income mobility index that captures the effect of the reshuffling of individuals within the income distribution on cross-sectional income-related health inequalities is obtained.

The change in the short run *CI* between any initial (or start) period s and any final period f of only those alive in both periods is decomposed into two parts[5]:

$$\begin{aligned} CI_{ff}^{A} - CI_{ss}^{A} &= \frac{2}{\bar{h}_f^A}\mathrm{cov}(h_{if}^A, R_{if}^A) - \frac{2}{\bar{h}_s^A}\mathrm{cov}(h_{is}^A, R_{is}^A) \\ &= \left(\frac{2}{\bar{h}_f^A}\mathrm{cov}(h_{if}^A, R_{if}^A) - \frac{2}{\bar{h}_f^A}\mathrm{cov}(h_{if}^A, R_{is}^A)\right) \\ &\quad + \left(\frac{2}{\bar{h}_f^A}\mathrm{cov}(h_{if}^A, R_{is}^A) - \frac{2}{\bar{h}_s^A}\mathrm{cov}(h_{is}^A, R_{is}^A)\right) \\ &= (CI_{ff}^{A} - CI_{fs}^{A}) + (CI_{fs}^{A} - CI_{ss}^{A}) = M_R^A - M_H^A, \end{aligned} \tag{1}$$

where CI_{ss}^{A} and CI_{ff}^{A} are the *CI*'s in periods s and f respectively of those individuals who are alive (A) in the final period, and CI_{fs}^{A} is the *CI* obtained when health outcomes in the final period are ranked by income in the initial period; $\bar{h}_f^A$ is the average final health of all those who survive to the final period; $\bar{h}_s^A$ is the average initial health of all those who survive to the final period; h_{if}^A is the final health of individual i who survives to the final period; h_{is}^A is the initial health

[1] In most cases individuals who die during the period are excluded from the sample when a longitudinal perspective is taken as in Wildman (2003), Jones and Lopez Nicolas (2004) and Allanson et al. (2010). Islam et al. (2010) compare the results from an unbalanced sample with a balanced sample while investigating the extent to which income-related health inequalities change as the population ages.

[2] Note that in Allanson et al. (2010) we also outline an alternative decomposition which measures "income-related health mobility" and "health-related income mobility" from a different perspective. In this alternative perspective income-related health mobility represents the relationship between final income rank and health changes over the period as opposed to the relationship between initial income rank and health changes which is the focus in the current paper.

[3] Jones et al. (2006) do note that non-response associated with idiosyncratic morbidity shocks are likely problematic and that their Hausman test is unlikely to pick up this type of bias.

[4] We also show in our empirical example that, even when taking a more conservative assumption regarding the weight of mortality, using IPWs can create significant bias.

[5] Note that CI_{xy} refers to the *CI* relating to health from period x and income rank from period y.