Modelling the Links Between Socioeconomic Status and Health in Australia: a Dynamic Microsimulation Approach

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August 2005

A thesis submitted for the degree of Doctor of Philosophy of
the Australian National University,
National Centre for Epidemiology and Population Health

Except where otherwise acknowledged in the text, this thesis represents my own original work.

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Acknowledgements

The author wishes to thank Professor Niels Becker - 'Chair' of the PhD supervisory panel - for his unwavering commitment to this thesis over the five long years it took to complete; for the overall guidance he provided to the project; for his valuable contributions to our joint paper to be published in *Public Health* (Chapter 5); and to the methodologies used to model health state transitions (Chapter 8). The author is also grateful to Professor Ann Harding, Director, National Centre for Social and Economic Modelling (NATSEM) for making DYNAMOD available for this thesis. The helpful comments on an earlier draft of this thesis by Professors Niels Becker and Ann Harding, and by Dr Simon Kelly of NATSEM are gratefully acknowledged. Finally, help from David Pederson of the University of Canberra on the use of the SAS language for statistical analyses, and from Richard Percival and Dr Simon Kelly of NATSEM with C programming and the understanding of the technical details essential for running and modifying DYNAMOD, were much appreciated.

Abstract

This thesis concerns the modelling of individuals' health over the life course, within the framework set by the now substantial international literature on the relationship between socioeconomic status and health. The focus is on people with long term illnesses and related disabilities, on inequalities in health by socioeconomic status (SES) and on the impact of health on employment.

The main tool of analysis is a dynamic microsimulation model of the Australian population which tracks the demographic, socioeconomic and financial characteristics of individuals and their families over the life course. Its original form, developed at the National Centre for Socioeconomic Modelling, University of Canberra, is based on a one per cent representative sample of the Australian population (around 150,000 individuals), with a series of life course events simulated for individuals and their families up to 2050 - such as births, deaths, migration, taxes, education, labour force participation, earned income, wealth accumulation and government transfers. The model is written in the C programming language and was initially used on a UNIX system. The dramatic increases in the speed and memory size of PCs over the past five years has led to a PC version now being available.

Despite their relatively short existence and long development phases, dynamic microsimulation models are now used in many developed countries – for example, the USA, UK, Canada, France, Sweden, Norway and Italy. In recognition of their ability to analyse distributional and financial issues in considerably greater depth than what is possible with traditional methods, their use by government for policy analysis is rapidly increasing.

In this thesis two new modules were added to the original Australian dynamic microsimulation model – namely: a Health_SES module and a Health State Transitions module. The former makes the study of health inequalities across socioeconomic groups possible. The latter provides a link between health status and the ability of individuals to carry out every day activities as the severity of their ill-health increases with age. A major advantage of adding these new modules to an existing main model is that it allows much more comprehensive studies over the life courses of individuals than the alternative would allow – that is the building of two stand-alone models developed exclusively for 'health-SES' and 'health state transition' types of applications.

The main data sources used to construct the two new modules were an extract from the Australian Institute of Health and Welfare's Mortality database covering the 1995-97 period, and the Australian Bureau of Statistic's 1998 survey of Disability, Ageing and Carers. The analysis of the mortality data was handled using EXCEL, and that of the much larger Disability survey unit record dataset - over 40,000 individuals and 100s of variables – using the SAS programming language.

While most of the methodologies used in constructing the new modules are in line with what became the norm for dynamic microsimulation model development, the thesis contains several innovations. The main ones are: a quantitative assessment of the suitability of different types of SES indicators for studies of health inequalities; the modelling of the progression of people's health from illness-free status to mild and severe disability; the development of a methodology for estimating health state transition probabilities from cross-sectional data (in the absence of longitudinal data); and the linking of health status to individual's ability to stay in the labour force.

As with most models, there are a number of limitations. These are discussed in the thesis, together with areas of possible future improvements.

The thesis also presents two novel and topical – though at this stage illustrative – applications of the enhanced dynamic microsimulation model. The first simulates the impact of a narrowing in health inequalities in Australia as health is lifted nationally to the level currently enjoyed by the most affluent 20% of the population. The findings are that, if such a policy change were implemented, close to half a million fewer Australians would be disabled, around 180,000 life years would be saved, health care costs would be around A$1 billion lower per year and the government could save close to A$700 million on the Disability Support Pension.

The second application quantifies the likely impacts of longer working lives in future, which may arise from changes such as: more favourable labour market conditions; government incentives to remain in the labour force longer (eg the lifting of the pension age); and general improvements in health. This application estimates the probability that Australians aged 65-70 would work more than 15 hours per week, had such changes eventuated. The decision to retire is modelled as a function of each individual's own health, socioeconomic status, age, sex and family composition. The impacts are simulated in a world in which current patterns of health by age, sex and SES remain unchanged over time – the Base case; and a world replicating the narrower health inequalities scenario of the first application. Under the Base case an additional 450,000 persons aged 65-70 years were estimated to remain in the workforce - with the related earnings totalling up to $20 billion in 1998 ($35 billion in 2018) and savings by government on the age pension of around $2 billion ($4 billion in 2018). Under the narrower health inequalities scenario the numbers working, their earnings and the related savings on the age pension were estimated to be around 7% higher.

Much of the original research carried out for this thesis has appeared, or is yet to appear, in refereed publications.

Contents

List of Figures and Tables

Definitions

Age pension age	refers to the age, set by legislation, after which Australians may be eligible for government support through the age pension. During our study period the age pension age was 65 years for men and 60 years for women.
Core activities	Communication, mobility and self care (ABS 1999c, p.66)
Core activity restriction	Four levels based on whether 'needs help', 'has difficulty', or 'uses aids/equipment' with a core activity task. *Profound*: unable to do or always needs help. *Severe*: sometimes needs help. *Moderate*: needs no help but has difficulty. *Mild*: needs no help/has no difficulty, but uses aids/equipment (ABS 1999c, p.66).
Dependent	Children under 16 years of age, and full-time dependent students up to 25 years of age
Disability	A limitation, restriction or impairment, which has lasted, or is likely to last, for at least six months and restricts every day activities (ABS 1999c, pp.66-7)
Enhanced model	The DYNAMOD model as at August 2004, with elements of the Health_SES and Health state transition module incorporated.
Family	ABS (2003, Appendix 1) defines 'income unit' as adults and dependent children within a household whose income is shared. The concept is close to that of a family. In this thesis 'family' is generally used as a proxy for 'income unit'.
Long term health condition/illness	A long term health condition is a disease or disorder, including damage from accidents or injuries, which has lasted, or is likely to last, for six months or more (ABS 2000, p.3)
Equivalent family income (or wealth)	Gross annual family cash income (or wealth), 'needs-adjusted' to account for differences in family size.
The health states modelled	'No illness or disability': has neither long term health condition nor disability; 'Long term illness': has long term health illness or condition but no disability; 'Disabled_severe retriction': has disability and is profoundly, severely or moderately restricted in core activities; 'Disabled_mild restriction': has disability and is either not restricted or mildly restricted in core activities.

Symbols (used in section 4.4)

$l^a_{x,y}$ number in able–bodied population aged x within SES quintile y

$l^d_{x,y}$ number in disabled population aged x within SES quintile y

$q^a_{x,y}$ mortality rates for the able–bodied population aged x within SES quintile y

$q^d_{x,y}$ mortality rates for the disabled population aged x within SES quintile y

$q_{x,y}$ mortality rates for the general population aged x within SES quintile y

$p_{x,y}$ prevalence of disability at age x within SES quintile y

$\theta_e(x_1 x_2, y)$ number of deaths due to external causes between ages x_1 and x_2 within SES quintile y

$\theta(x_1 x_2, y)$ total number of deaths between ages x_1 and x_2 in SES quintile y

$R_{x,y}$ number of recoveries from disability aged x within SES quintile y

$D_{x,y}$ number of people becoming disabled aged x within SES quintile y

$E_{x,y}$ initial number exposed to risk for the entire population at age x within SES quintile y

$r_{x,y}$ rate of decrement among the disabled due to recovery at age x, in SES quintile y

$d_{x,y}$ rate of decrement due to people becoming disabled at age x within SES quintile y

$\theta^a_{x,y}$ number of deaths in the able–bodied population at age x within SES quintile y

$\theta^d_{x,y}$ number of deaths in the disabled population aged x within SES quintile y

$\delta(x, y, i)$ percentage change in the total mortality rate in the i^{th} year at age x within SES quintile y

NOTE: the above variables were also a function of sex and time. However, in the notation these variables were omitted for sake of simplicity of presentation.

Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
Disability survey	Disability, Ageing and Carers surveys by the ABS
NHS	National Health Survey conducted by the ABS.
SES	Socioeconomic status