

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

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

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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

Acknowledgements.....	iii
Abstract.....	iv
CONTENTS	VII
Definitions	xv
Symbols (used in section 4.4).....	xvi
Abbreviations.....	xvii
CHAPTER 1 OVERVIEW	1
1.1 Introduction.....	1
1.1.1 Background.....	1
1.1.2 Aims of thesis	3
1.2 Reasons for choosing dynamic microsimulation.....	4
1.2.1 Background.....	4
1.2.2 Reasons for choosing dynamic microsimulation.....	7
1.3 New modules as part of an existing model versus a stand-alone model.....	9
1.4 The dynamic microsimulation model chosen	10
1.5 Steps involved in adding new modules to DYNAMOD.....	13
1.5.1 Key elements of the enhanced model	14
1.5.2 The main steps	16
1.5.3 The programming effort	17
1.6 Questions the enhanced model may address.....	19
1.7 Outline of thesis	20
PART 1: DEVELOPMENT OF THE HEALTH_SES AND HEALTH STATE TRANSITION MODULES	22
CHAPTER 2 RELEVANT FINDINGS FROM THE LITERATURE.....	23
2.1 Mortality based studies of the health-SES links	23
2.2 Intergenerational effects	25
2.3 Labour market effects	26

2.4	Causality	27
2.5	Life course approach.....	29
2.6	Other countries' dynamic microsimulation models.....	30
2.7	Discussion.....	35
CHAPTER 3 CHOICE OF DATA SOURCES		36
3.1	Data requirements	36
3.2	The data sources considered	36
3.3	Suitability of the health and disability surveys.....	39
3.4	The data sources chosen	42
CHAPTER 4 METHODOLOGY USED IN DEVELOPING THE HEALTH_SES MODULE 44		
4.1	Overview of the development of the Health_SES module	45
4.2	Indicators of health status	48
4.2.1	<i>Mortality</i>	48
4.2.2	<i>Disability</i>	49
4.3	Key factors affecting family income	50
4.4	Estimating disability and mortality rates by SES	53
4.4.1	<i>Equations for computing mortality rates: able-bodied and disabled</i>	54
4.4.2	<i>Equations linking disability and mortality by SES</i>	55
4.4.3	<i>Equations for deriving future mortality rates</i>	58
4.5	Conclusion	62
CHAPTER 5 COMPARING GEOGRAPHIC-AREA-BASED AND INDIVIDUAL- BASED SES INDICATORS		63
5.1	Aims of analyses.....	64
5.2	Indicators of health and socioeconomic status	65
5.3	Do the three types of SES measures produce similar estimates of health inequalities?	67
5.4	Are some SES indicators better predictors of a person being disabled than others? 67	
5.5	Results.....	68
5.5.1	<i>Inequalities in health by SEIFA – Objective (a)</i>	68
5.5.2	<i>Comparing the predictive ability by type of SES indicator – Objective (b)</i>	72

5.6	Discussion	73
5.7	Conclusions and possible future improvements	74
5.7.1	<i>Conclusions</i>	76
5.7.2	<i>Possible future improvements</i>	76
5.8	Choosing the SES indicators for DYNAMOD	77
CHAPTER 6 PREPARING THE INPUT DATA ON MORTALITY AND DISABILITY BY AGE, SEX AND SOCIOECONOMIC STATUS		79
6.1	Introduction	79
6.2	Mortality rates	80
6.2.1	<i>By SES quintiles</i>	80
6.2.2	<i>Over time</i>	82
6.3	Disability prevalence	84
6.4	Disability decrement rates	85
CHAPTER 7 MODELLING SOCIOECONOMIC STATUS FOR THE BASE DATASET AND THE PROJECTION YEARS		86
7.1	Modelling socioeconomic status in the Base dataset	86
7.2	Modelling socioeconomic status in the simulation years	87
CHAPTER 8 MODELLING HEALTH STATE TRANSITIONS		90
8.1	The available data	91
8.2	The health states modelled	93
8.3	Methodology for estimating health transition probabilities	93
8.3.1	<i>Assumptions</i>	93
8.3.2	<i>Computing health transition probabilities</i>	94
8.4	Implementation in the model	98
8.4.1	<i>Input data</i>	98
8.4.2	<i>Implementation in the Base dataset</i>	98
CHAPTER 9 VALIDATION		99
9.1	Disability in the original model	100
9.2	Disability in the enhanced model	101
CHAPTER 10 LIMITATIONS		105
10.1	Alignment procedures	105

10.1.1	<i>Alignment procedures in the literature</i>	106
10.1.2	<i>Alignment processes used in DYNAMOD</i>	108
10.2	Stochastic variations in model outputs	110
10.3	Sensitivity testing.....	111
10.4	Multiple-module validation	112
PART 2: APPLICATIONS OF THE ENHANCED MODEL.....		113
CHAPTER 11 NARROWER HEALTH INEQUALITIES		114
11.1	Description of scenario and assumptions.....	114
11.2	Impact on the number of deaths.....	115
11.3	Impact on numbers disabled and on health care and disability pension expenditures 118	
11.4	Discussion.....	123
11.4.1	<i>Comparisons with findings from earlier studies</i>	124
11.4.2	<i>Possible future improvements</i>	125
CHAPTER 12 HEALTH AND THE ABILITY OF OLDER AUSTRALIANS TO STAY IN THE LABOUR FORCE		127
12.1	Recent policy initiatives and future directions	127
12.2	Aims	129
12.3	Modelling the employment status of 65-70 year olds.....	129
12.3.1	<i>Data and methodology</i>	130
12.3.2	<i>Choice of variables in explaining work patterns</i>	130
12.3.3	<i>Logistic regression for the probability of working</i>	132
12.3.4	<i>Imputing of 'work' status in the main model</i>	134
12.3.5	<i>Validation</i>	135
12.4	Description of the Base case and Scenario simulations.....	135
12.5	Results: health and employment of 45-54 year olds versus 65-70 year olds.....	136
12.6	Results: predicted population of 65-70 year olds and the proportion working ...	139
12.7	Results: earnings of 65-70 Year Olds.....	141
12.8	Results: expenditures on the age pension for 65-70 year olds.....	144
12.9	Results: comparing the Base case and Scenario results.....	146
12.10	Discussion.....	147

PART 3: OVERALL CONCLUSIONS	150
CHAPTER 13 CONCLUSIONS AND POSSIBLE FUTURE DEVELOPMENTS 151	
13.1 Conclusions.....	151
13.1.1 PART 1: Modelling the links between health and socioeconomic status	151
13.1.2 PART 2: Applications of the enhanced model	155
13.2 Possible future developments	156
REFERENCES.....	160
REFERENCES.....	160
APPENDICES	174
A1 DESCRIPTION OF DYNAMOD - ORIGINAL VERSION AND THE WEALTH MODULE	175
A1.1 Original version	175
A1.2 The Wealth module.....	184
A2 POSSIBLE DATA SOURCES.....	186
A2.1 National Health Surveys (1977, 1983, 1989 and 1995).....	186
A2.2 Australian Longitudinal Study of Ageing (ALSA).....	188
A2.3 Disability surveys	189
A2.4 Mortality statistics.....	192
A2.4.1 Causes of deaths (ABS).....	192
A2.4.2 Mortality by age sex and socioeconomic status	192
A3 SOCIO-ECONOMIC INDEXES FOR AREAS (SEIFA).....	194
A4 CHANGES IN MORTALITY PATTERNS BY AGE AND SEX, 1990-92 TO 1995-97	196
A5 CHANGES IN DISABILITY PREVALENCE BY AGE AND SEX, 1993 AND 1998 200	
A6 DERIVING INCOME-BASED SES INDICATORS FROM THE 1998 DISABILITY SURVEY	202
A6.1 Creating the basic SAS dataset	203

A6.2	Deriving family income and computing income quintiles.....	205
A6.3	Example of SAS code: deriving income-based SES indicators.....	206
A7	DEMOGRAPHIC, HEALTH, EMPLOYMENT AND RESIDENTIAL CHARACTERISTICS OF AUSTRALIANS, 1998.....	209
A7.1	Introduction.....	209
A7.2	Disability by age and sex	209
A7.3	The disabled population by income	211
A7.4	The disabled population by labour force status and institutionalisation.....	212
A7.5	Duration of main disabling condition and patterns of comorbidities	213
A8	THE MODIFIED OECD EQUIVALENCE SCALE.....	216
A9	HEALTH AS A REASON FOR NOT LOOKING FOR WORK.....	217
A10	AGE STANDARDISATION ACROSS SES QUINTILES	219
A11	STANDARD ERRORS AND STATISTICAL SIGNIFICANCE	221
A12	EXAMPLE OF C CODE – COMPUTING AND IMPUTING SOCIO- ECONOMIC STATUS	222

List of Figures and Tables

Figure 1: Elements of the enhanced version of DYNAMOD	15
Figure 2: Probability of Australians aged 25–65 years dying, by sex and quintile of socioeconomic disadvantage, 1995–97	24
Figure 3: Spenders on prescribed drugs, per cent of the population by age group, 1993-94 and 1998-99	40
Figure 4: Proportion of population disabled and/or with long-term-illness, 1998	41
Figure 5: The links modelled between mortality and disability, by SES	46
Table 1: Multiple regressions of ‘equivalent family income quintile’ for persons aged 20 years or over, 1998	51
Figure 6: Proportion disabled by age and type of SES indicator*	69
Figure 7: Proportion disabled by type of SES indicator,* 1998	70
Table 2: Differences in the proportion disabled by age and type of socioeconomic status indicator, 1998	71
Table 3: Logistic regressions – SES indicators as predictors of disability	72
Figure 8: Age distribution within SES quintiles, Disability Survey, 1998	75
Figure 9: Mortality rates, external causes, males age, SEIFA quintiles, 1995-7	81
Figure 10: Mortality rates for men, non-external causes (ie the disabled population), by single years of age, 1990-92 and 1995-97	83
Figure 11: Disability prevalence, males, by age, 1993 and 1998	84
Figure 12: Per cent of the population by age and health status, 1998	92
Table 4: Matrix algebra equations for transition probabilities - general notation	95
Table 5: Matrix algebra equations for transition probabilities - assuming that people’s health can only deteriorate	95
Table 6: Example of a transition probability matrix: Quintile 1 Males moving from the 45-54 age group to the 55-64 age group	97
Figure 13: Age specific disability rates in the 1993 ABS survey and in DYNAMOD for 1986 and 1998	101
Figure 14: Proportion of disabled in the Australian population by health states, ABS survey and DYNAMOD, 1998	102
Figure 15: Age-specific fertility rates: simulated average for 1994 to 1998 and ABS actual figures for 1996	109
Table 7: Number of deaths by age, 1998 and 2018	117
Table 8: Number of disabled by age, 1998 and 2018	119
Figure 16: Proportion disabled in the population, Base case and Scenario, 1998 and 2018	119
Figure 17: Proportion disabled by health state, Base case and Scenario, 1998 and 2018	120
Figure 18: Expenditure on selected diseases* in 2000-01	121
Table 9 –Health expenditures* on the disabled by age, 1998 and 2018	122
Table 10: Logistic regressions, 45-54 year olds, variables influencing whether ‘working’, ^ 1998 133	133
Figure 19: Distribution of the 45-54 and 65-70 populations by health state, ABS Survey and DYNAMOD, Base case, 1998	137
Figure 20: Per cent of 45-54 and 65-70 populations ‘working’ by health state,* ABS survey and DYNAMOD, Base case, 1998	138

Table 11: Persons* aged 65-70 years by health status, Base case and Scenario, 1998 and 2018	140
Table 12: Number of 65-70 year olds working more than 15 hours per week, Base case and Scenario, 1998 and 2018	141
Table 13: Mean weekly cash incomes of 45-54 year olds who worked more than 15 hours per week and whose main source of income was from wages and salaries, by health state (1998 dollars)	142
Table 14: Annual earnings* of 65 to 70 year olds, Base case and Scenario, 1998 and 2018 (1998 dollars)	143
Table 15: Assumptions made when estimating age pension expenditures on 65-70 year olds, Base case and Scenario, 1998 and 2018	145
Table 16: Potential savings on the age pension of 65 to 70 year olds if their employment patterns* were similar to that of 45 to 54 year olds in 1998, 1998 and 2018 (1998 dollars)	146
Table A1.1: Program structure – original version of DYNAMOD	177
Table A1.2: List of key DYNAMOD variables	181
Figure A4.2: Mortality rates, non-external causes (ie the disabled population), by age and sex, 1990-92 and 1995-97	198
Figure A4.3: Mortality rates, all causes by age and SEIFA quintiles, 1995-7	199
Figure A5.1: Disability rates by age and sex, 1993 and 1998	200
Figure A7.2.1: Proportion of Males by age group and disability level, 1998	210
Figure A7.2.2: Proportion of Females by age group and disability level, 1998	210
Figure A7.3.1: Proportion of population disabled (mild and severe), by equivalent income quintile, 1998	211
Table A7.4.1: Proportion of persons aged 15 years or more by health and labour force status, 1998 (per cent)	212
Table A7.4.2: Proportion of total population in private dwellings and institutions, 1998 (per cent)	213
Figure A7.5.2: Proportion of population with one, two ...nine conditions, 1998	215
Table A9.1: Main reason as to why not looking for work, by age, 1998	217

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. <i>Profound</i> : unable to do or always needs help. <i>Severe</i> : sometimes needs help. <i>Moderate</i> : needs no help but has difficulty. <i>Mild</i> : 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	<p>‘No illness or disability’: has neither long term health condition nor disability;</p> <p>‘Long term illness’: has long term health illness or condition but no disability;</p> <p>‘Disabled_severe restriction’: has disability and is profoundly, severely or moderately restricted in core activities;</p> <p>‘Disabled_mild restriction’: has disability and is either not restricted or mildly restricted in core activities.</p>

Symbols (used in section 4.4)

$l_{x,y}^a$	number in able-bodied population aged x within SES quintile y
$l_{x,y}^d$	number in disabled population aged x within SES quintile y
$q_{x,y}^a$	mortality rates for the able-bodied population aged x within SES quintile y
$q_{x,y}^d$	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
$\theta_e(x_1x_2, y)$	number of deaths due to external causes between ages x_1 and x_2 within SES quintile y
$\theta(x_1x_2, y)$	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
$\theta_{x,y}^a$	number of deaths in the able-bodied population at age x within SES quintile y
$\theta_{x,y}^d$	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
