

Using a micro simulation model to project family and kinship networks in Britain

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Introduction

Main demographic trends of **first demographic transition** in now-developed societies:

- fertility declined from a level of about five children per woman in 19th century to 'below-replacement level fertility' today
- mortality has declined with e_0 around 1900 of about 40 years but double that today
- populations have aged with proportions aged 65 & over now often approaching 20%.

Introduction (contd.)

Main demographic trends of **second demographic transition** in now-developed societies:

- substantial reductions in nuptiality
- increases in:
 - non-marital cohabitation
 - divorce
 - the proportion of births outside marriage.

Impacts on:

- those directly involved
- national population structure
- families and kin

A complete kinship network within a single framework, permitting analysis of the key family & kin networks of older people:

- in a cross-national European survey, 49% of family carers of cared-for elderly people were children & 22% were spouses/partners (EUROFAMCARE consortium, 2006).
- divorced fathers have less contact with their adult children than fathers who did not divorce; for mothers the effects of divorce is small (de Graaf & Fokkema, 2007)
- grandparental role is important: 75% of relationships were 'highly' or 'very highly' emotionally close in Germany (Sticker, 1991)

Kinship and family the background

- Kinship distribution at a time point is determined solely by the fertility, mortality, nuptiality, divorce and cohabitation experienced by the population for many decades earlier
- The contemporary pattern of kinship is strongly influenced by recent trends, especially where step-kin are considered
- Little information available in Britain (or elsewhere) on kinship in large nationally-representative data sources.

Micro-simulation model based on individual-level rules

- We start with known or assumed population characteristics, and then simulate individual demographic events.
- This produces a set of individual records, with a statistical pattern of individual demographic events similar to what would be observed in a real population.

Special aspects of demographic kinship modelling

- Not contemporary survey oriented
- Conceptually more complex than e.g. household modelling (or policy microsimulation)
- Requires new methods of analysis.

The question to be addressed:

- What changes in family and kin constellations have occurred over the period since 1950 and what are key features of future family and kinship networks in Britain up to 2050

Method: demographic microsimulation using the Berkeley SOCSIM model

- an initial population of size 40,000 with the population distribution of England in 1751 subject to appropriate rates of fertility, mortality and nuptiality (including divorce) for the period since 1751 (cohabitation from 1950)
- the population in 1751 comprises unrelated individuals, but, over time, a full set of kinship links is constructed as the individuals marry and procreate

SOCSIM demographic microsimulation model

- initial population subject to appropriate rates of fertility, mortality and nuptiality, these individuals age month by month; some will marry (or cohabit) with each other, give birth, divorce or remarry, and finally they die
- Monte Carlo method
- model builds up kinship links for an initial population of unrelated and never-married people

Marriage in SOCSIM

- the model is closed so that partners have to be found within the existing simulation population
- the model includes a prohibition on incest between siblings and parents and children
- in recent decades, cohabitation which has become increasingly important, is also included
- any kinship relationship through blood or marriage may be traced through living and/or dead kin.

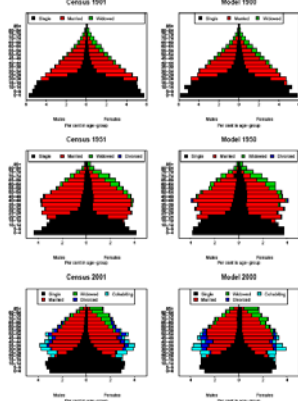
Main assumptions: summary

Decade	TFR	Life expectancy at birth (e_0)		Average age at first marriage		Births outside marriage (%)
		Males	Females	Males	Females	
1950-60	2.4	68.1	73.6	24.8	23.2	5.5
2000-10	1.8	80.0	85	30.2	27.9	42.0
2010-20	1.9	83.5	86.5	30.3	28.4	39.8
2020-30	1.9	86.2	89.8	30.4	28.8	40.4
2030-40	1.9	85.5	87.7	30.5	28.6	40.6
2040-50	1.9	88.5	89.1	30.4	28.7	40.2

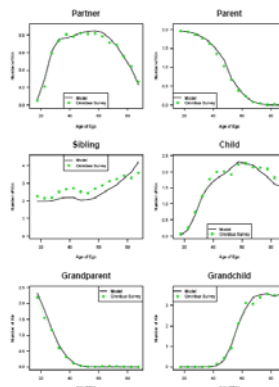
Method: demographic microsimulation using the Berkeley SOCSIM model

- The population is ‘censored’ at selected years between 1950 and 2000 to produce the populations that would have been alive at those dates. Thus comparisons are made of the same population at three different points of time.
- For each type of kinship relationship, the relevant egos and their kin were identified
- The size of living populations analysed:
 - 1950 329 thousand
 - 2000 377 thousand
 - 2050 394 thousand.

Comparison of England & Wales Census and model data



Average number of living kin: comparison of survey and model data

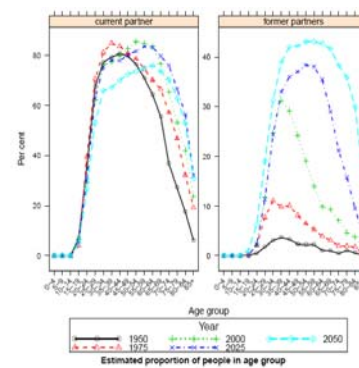


Grundy E, M Murphy, and N Shelton (1999) Looking beyond the household: inter-generational perspectives on living kin and contacts with kin in Great Britain. *Population Trends* 97: 19-27

Principal trends in family and kin structures: Partners

- In the North Western European marriage pattern, historically marriage was relatively late and high proportions never married
- marriage rates were particularly low in the 1920s and 1930s
- in the period from 1945 to about 1970 many countries experienced an unprecedented marriage boom
- recently, a substantial decline in marriage
- cohabitation has increased, but insufficient to offset the decline in marriage.

Proportion with current and former partners



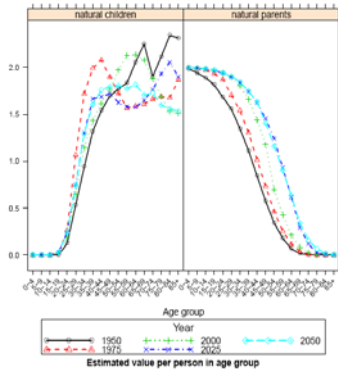
Principal results of family and kin structures: Partners

- highest proportions currently in a partnership, marital or cohabiting, are found among those in their mid-30s in 1975 (and around 60 in 2000) - those born in the 1940s are likely to be the most advantaged in terms of having a living partner
- for those at e.g. age of 55 in 2050, under the assumption of largely constant partnership behaviour in the Twenty-First Century, the proportions in a partnership would be about 15 percentage points lower, with about one third not being in a partnership at that age.
- at older ages the patterns are different with the highest proportions in a partnership are likely to be found in 2050
- the existence of living *former* partners following cohabitation breakdown or divorce will increase

Principal trends in family and kin structures: Children & Parents

- fertility rates were particularly low in the 1920s and 1930s
- in the period from 1945 to about 1970 many countries experienced a fertility boom
- recently, a substantial decline in fertility, but increase in extra-marital (mainly cohabiting union) childbearing
- re-partnering has become more common, with effects on 'incomplete families'

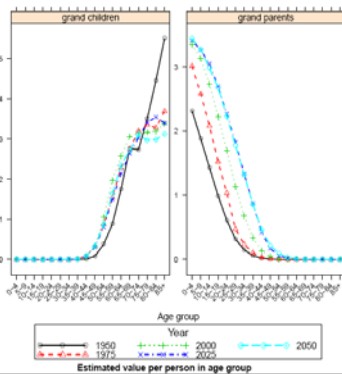
Average number of living children and parents



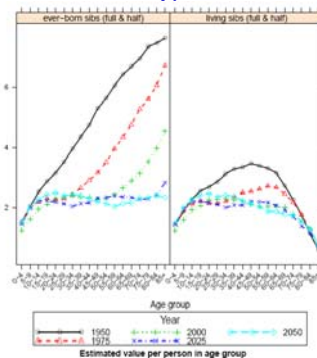
Principal results of family and kin structures: Parents & children

- trends for living children and parents are different
 - the peak number of living children, 2.4, for older people in 1950 and for those aged around 55 in 2000
 - the proportion aged 60 with a living child could be one fifth lower in 2050 than the peak value around 2000.
- in the next 50 years, those of late working age will be much more likely to have parents alive than people today ('care gap')
 - age when half had lost both parents: early 40s in 1950 but 60 in 2050.
 - the median age for having at least one living parent increased as nearly much in the last 25 years - from 49 to 55 years - as in the previous century - from about 43 to 49 years
- there is an ageing of generational relations: age after which people more likely to have a living child than a living parent
 - 1950 below age 40
 - 2000 about age 45
 - 2050 about age 50

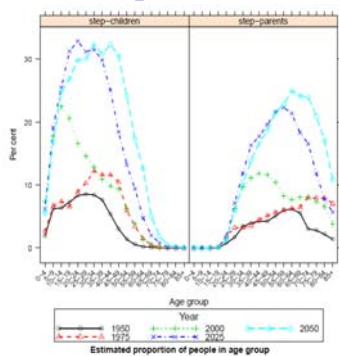
Average number of living grand children and grand parents (complete)



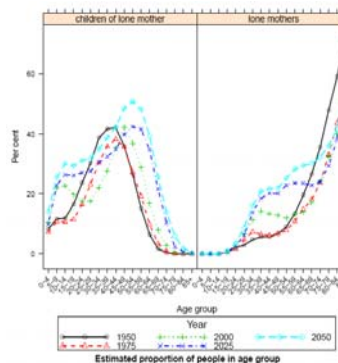
Average number of ever-born and living sibs



Proportion with step-children & step-parents



Proportion with lone mothers and lone children



Conclusions and implications

- emerging patterns will lead to many more 'incomplete' kin relationships than in the past, such as step families
- kin relations are likely to become more 'vertical' than 'horizontal'
- the ageing of populations will have an independent and sometimes reinforcing impact on kin relations in that there will be an ageing of generation relationships

Conclusions and implications (contd.)

- Micro-simulation provides a useful integrated approach to elucidating the full range of family and kinship ties

Additional References

- Grundy E, M Murphy, and N Shelton (1999) Looking beyond the household: inter-generational perspectives on living kin and contacts with kin in Great Britain. *Population Trends* 97:19-27.
- Grundy, E., and Murphy, M. (2006) Marital status and family support for the oldest-old in Great Britain. Pp. 415-436 in J-M Robine et al (eds.) *Human Longevity: Individual Life Duration and the Growth of the Oldest-Old Population*. Dordrecht: Springer.
- Hammel EA, C Mason, and KW Wachter (1990) *SOCSIM II, a sociodemographic microsimulation program, rev. 1.0, operating manual: Graduate Group in Demography Working Paper No. 29*. Berkeley, California, University of California, Institute of International Studies, Program in Population Research.
- Hammel, E.A. 'Demographic dynamics and kinship in anthropological populations', *Proceedings of the National Academy of Sciences* **102**, (2005), 2248-53.
- Kalogirou S. and M Murphy, 'Marital status of people aged 75 and over in nine EU countries in the period 2000-2030', *European Journal of Ageing* **3**, 2 (2006), 74-81.
- Murphy M (2003) Bringing behaviour back into micro-simulation: Feedback mechanisms in demographic models. Pp 159-174 in Francesco Billari and Alexia Prskawetz (eds.) *Agent-Based Computational Demography: Using Simulation to Improve our Understanding of Demographic Behaviour*. Heidelberg: Physica-Verlag.
- Murphy M (2004) Tracing very long-term kinship networks using SOCSIM. *Demographic Research* **10**: 171-195.
- Murphy M (2006) The role of assortative mating on population growth in contemporary developed societies. Pp 61-84 in Billari F, Fent T, Fuernkrantz-Prskawetz A, Scheffran J (eds.) *Agent-based Modelling in Demography, Economics and Environmental Sciences*. Physica Verlag, Heidelberg.
- Murphy M, and D Wang (1999) Forecasting British families into the 21st century. Pp 100-137 in S McRae (ed) *Changing Britain: Families and Households in the 1990s*. Oxford: Oxford University Press.
- Murphy M, P Martikainen, and S Penneç (2006) Demographic change and the supply of potential family supporters in Britain, Finland and France in the period 1911-2050. *European Journal of Population* **22**(3): 219-40
- Van Imhoff E and Post W (1998) Microsimulation methods for population projection. *Population: An English Selection, special issue New Methodological Approaches in the Social Sciences*, 97-138.

Thank you