Projections of Australia's population to 2051 - methods, results & concerns

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Summary

This paper describes methods used to give long-term projections of persons, dwellings and jobs for each statistical local area in Australia.

The methods are intended to systematically use the available data, be objective, and provide the behavioural models needed for stochastic projections.

The projections are based on statistical models fitted to data on immigrants, emigrants, employment patterns, migration between and within statistical divisions, land development and dwelling densities.

Two sets of projections are illustrated for each statistical division in Australia

- assuming long-term arrivals of 300,000 pa gives an estimated population of 25.54m in 2051, with 5.75m in Sydney
- assuming long-term arrivals increase at the long-term trend of 2.8% pa gives an estimated population of 43.68m, with 10.76m in Sydney.

Projection results with low migration assumptions

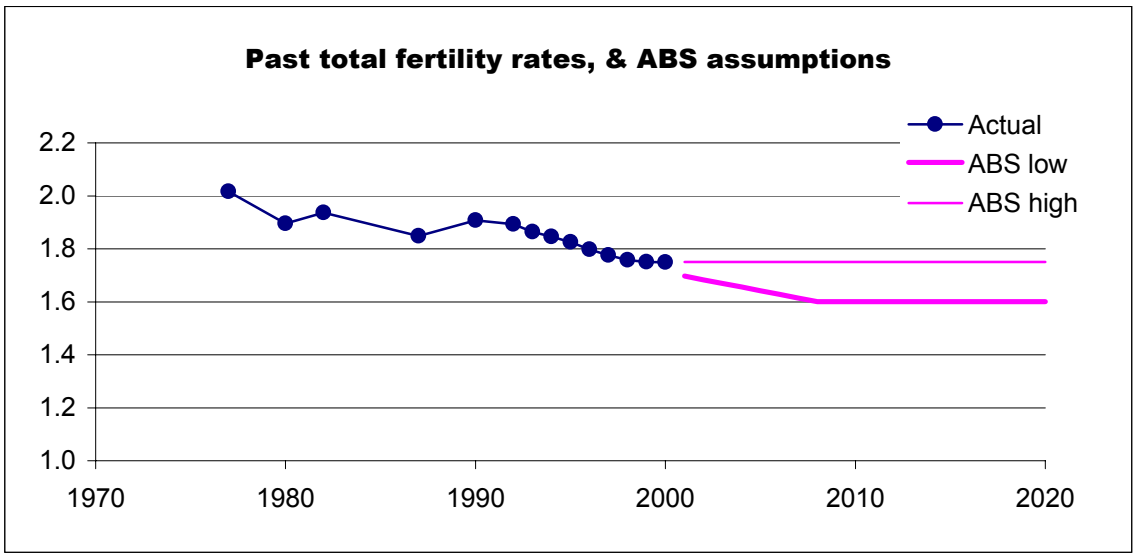
Area	Persons 2051 m	Persons growth	Dwellings 2051 m	Dwellings growth	Aged 65+ in 2051
Sydney	5.75	39%	2.45	56%	20.9%
Melbourne	4.68	34%	2.00	50%	21.2%
Brisbane	2.20	33%	0.94	52%	21.4%
Adelaide	1.36	23%	0.58	35%	21.9%
Perth	1.88	35%	0.80	53%	21.4%
Hobart	0.22	11%	0.10	25%	23.2%
Darwin	0.14	34%	0.06	63%	22.4%
Canberra	0.42	31%	0.18	52%	22.0%
Australia	25.54	31%	10.93	47%	21.5%

Projection results with high migration assumptions

Area	Persons 2051 m	Persons growth	Dwellings 2051 m	Dwellings growth	Aged 65+ in 2051
Sydney	10.76	159%	4.39	179%	14.7%
Melbourne	8.53	144%	3.49	163%	15.1%
Brisbane	3.79	129%	1.56	151%	15.6%
Adelaide	2.27	104%	0.94	117%	16.3%
Perth	3.26	133%	1.34	154%	15.5%
Hobart	0.31	57%	0.13	72%	18.6%
Darwin	0.21	93%	0.09	127%	17.5%
Canberra	0.68	110%	0.28	135%	16.2%
Australia	43.68	124%	17.94	142%	15.6%

Projection results for each statistical division to 2051 are in appendices A and B.

Fertility assumptions

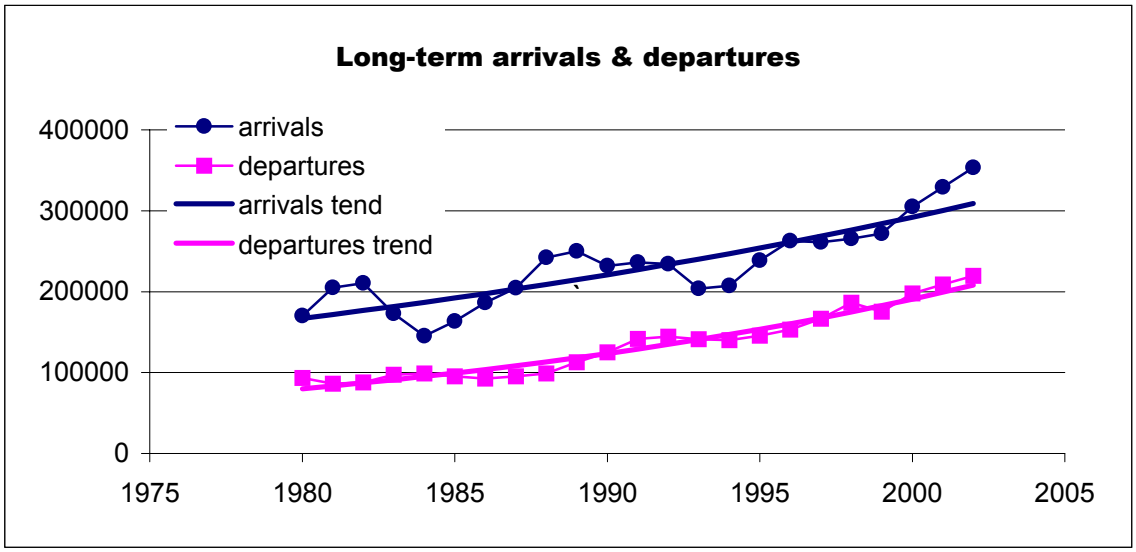


Past total fertility rates are from "Births Australia 2000", Australian Bureau of Statistics 31/10/01, and similar earlier publications. The low and high fertility assumptions are from "Population projections Australia 1999-2101", Australian Bureau of Statistics, 17/8/00, page 48. Projections were made using the ABS low fertility assumptions, even though recent experience has been close to their high assumptions.

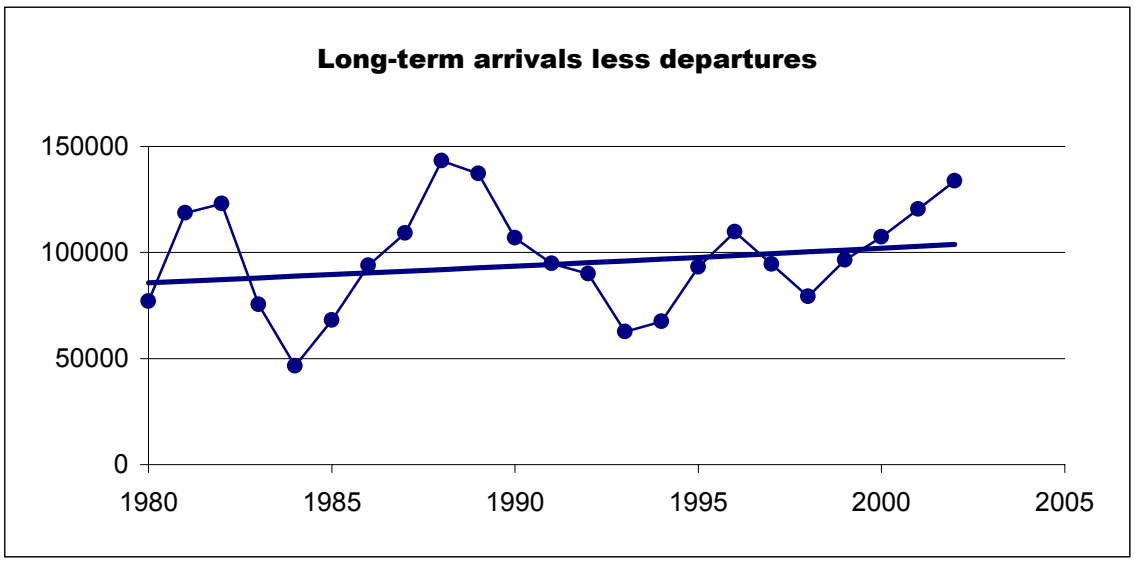
Mortality assumptions

Projections were made assuming the same improving mortality rates as used by ABS in "Population projections Australia 1999-2101".

Long-term arrivals and departures

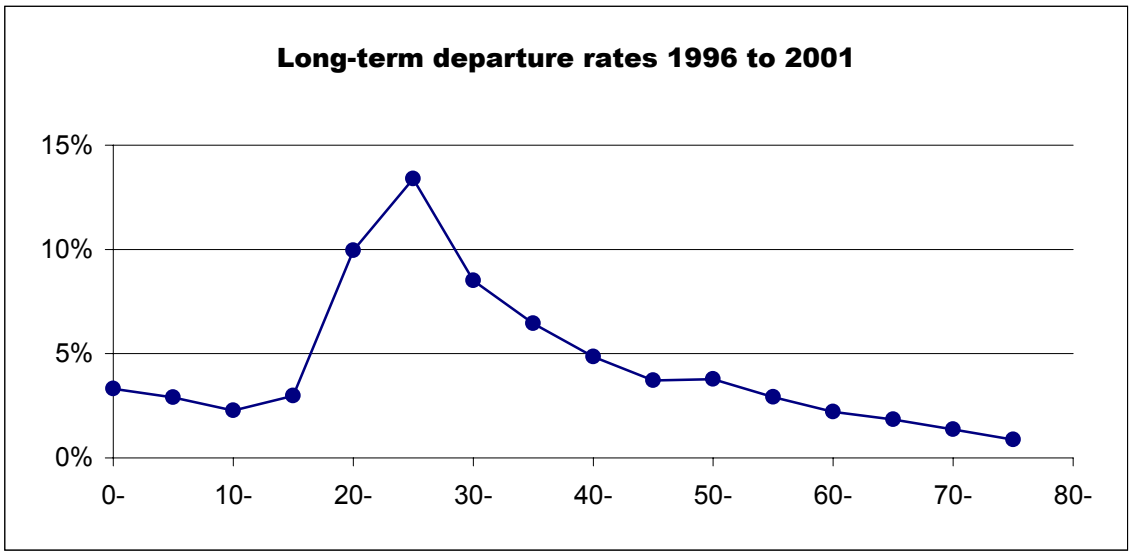


Long-term arrivals and departures from 79-80 to 99-00 are from "Migration Australia 1999-2000", Australian Bureau of Statistics, 15/3/01, page 26. Long-term arrivals and departures for 01-02 are from "Overseas arrivals and departures Australia Supplement April to June 2002", Australian Bureau of Statistics, 15/8/02, page 6. Figures for 01-02 are by interpolation from 99-00 and 01-02. Trend-lines fitted to the 23 years to 30/6/02 give a long-term growth rate of 2.8% pa for arrivals and 4.4% for departures.



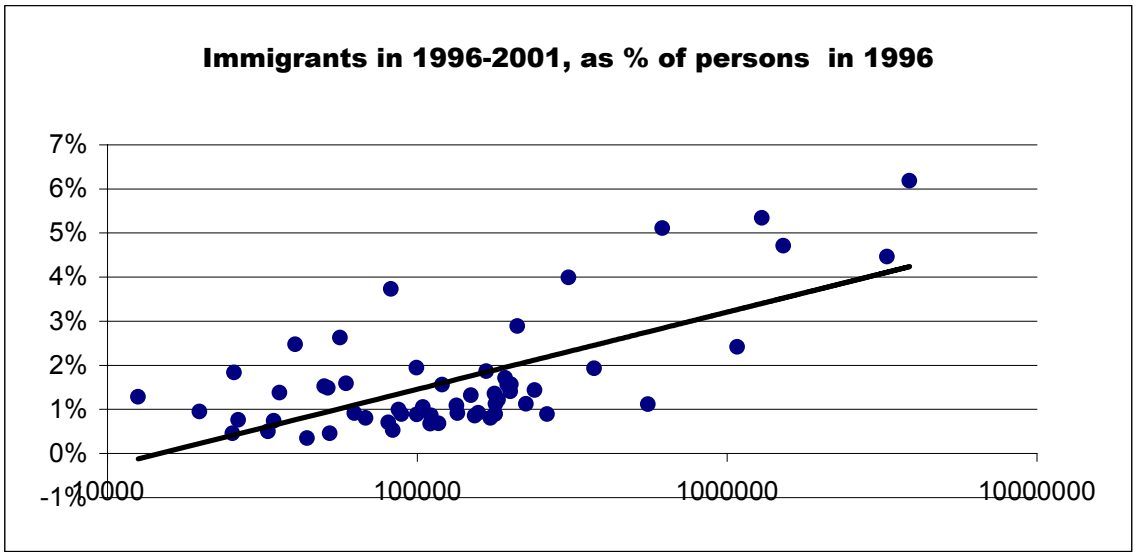
In 00-01 net long-term arrivals were 133,680, about 29% above the trend-line value of 103,830.

Long-term departure rates



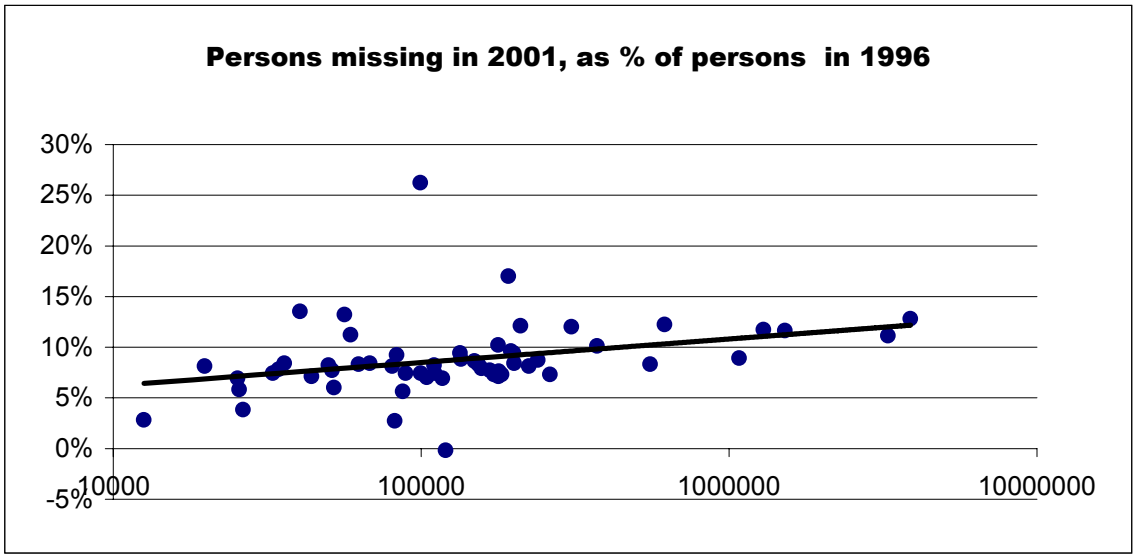
The above long-term departure rates were derived from the total numbers of departures in the 5 years to 30/6/01, the age-composition of the departures in 99-00, and the estimated resident population in June 1996. These long-term departure rates were assumed to continue until 2051. As the departure rates decline sharply after the 25-29 age band, an ageing population is likely to see the overall departure rate declining.

Immigrants 1996-2001 as % of 1996 population



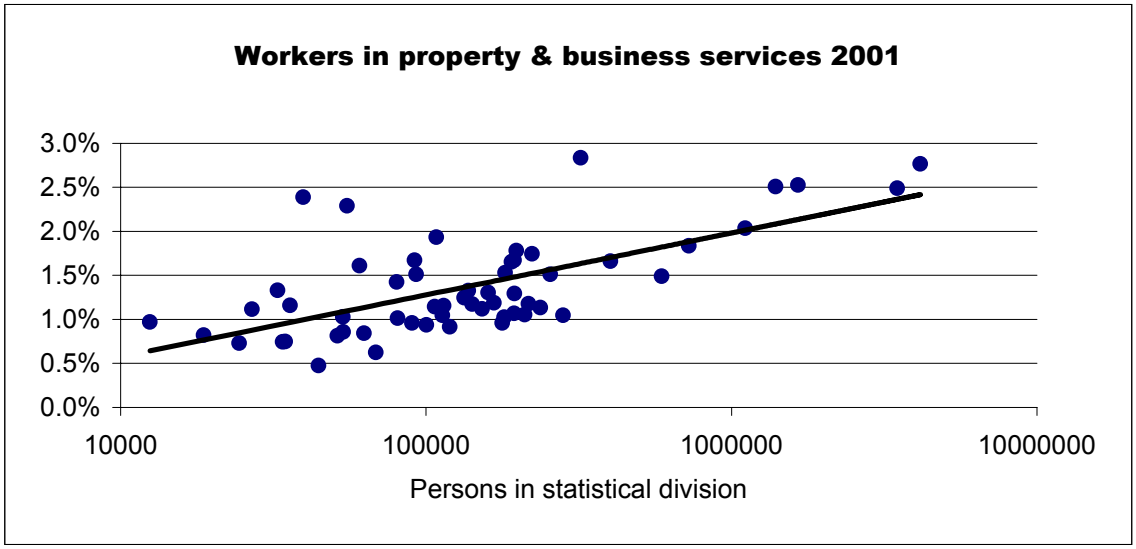
The above graph shows the numbers of persons at the 2001 census who described themselves as overseas at the 1996 census, as a percentage of the 1996 population, for each of the 57 statistical divisions. There were only 0.683m such persons, compared with about 1.433m of long-term arrivals in the 5 years to 30/6/01. The fitted line was used to share immigrants between statistical divisions, after adjusting it to give zero immigrants for a population of 10.000 persons.

Persons missing from 2001 census



The above graph shows the numbers of persons missing at the 2001 census from those of comparable ages at the 1996 census, after deducting estimated deaths, as a percentage of the 1996 population. There were only 1.892m such persons, compared with about 0.935m of long-term departures arrivals in the 5 years to 30/6/01. Persons not counted at the 2001 census, or not giving sufficient identification of their 1996 residence, may account for much of the difference. The fitted line was used to share departures between statistical divisions, after adjusting it to give zero departures for a population of 10.000 persons.

Employment patterns



Future numbers of jobs in each industry in Australia are exogenous assumptions, spread between statistical divisions using statistical models of the distribution of each industry. Statistical models of employment patterns were constructed for 13 industries, taking into account numbers of persons, age profiles and distance from a

capital city.

For example, the above graph shows the percentage of persons employed in property and business services, plotted against the number of persons in the SD. There is a clear trend for the percentage employed to increase with size, and this was allowed for in the statistical model for this industry. For 4 industries (agriculture, mining, accommodation and government) no statistical pattern was considered adequate, and each SD's share of workers in these industries was assumed to remain constant.

Assumed job numbers for Australia

Industry	Jobs 1947	Jobs 1976	Jobs 2001	Jobs 2051 Low migration	Jobs 2051 High migration
	m	m	m	m	m
Agriculture, forestry, fishing	0.537	0.434	0.330	0.263	0.452
Mining	0.059	0.078	0.074	0.074	0.074
Manufacturing	0.862	1.221	1.010	0.803	1.381
Electricity, gas, water supply	0.033	0.110	0.061	0.079	0.136
Construction	0.251	0.461	0.558	0.732	1.252
Wholesale trade	0.147	0.365	0.437	0.573	0.980
Retail trade	0.291	0.755	1.211	1.588	2.716
Accommodation, cafes, restaurants	0.152	0.173	0.410	0.882	1.501
Transport, storage	0.266	0.310	0.355	0.465	0.795
Communication services	0.053	0.119	0.148	0.195	0.333
Finance, insurance	0.059	0.220	0.312	0.409	0.700
Property, business services	0.021	0.228	0.920	1.206	2.063
Government admin, defence	0.154	0.348	0.368	0.482	0.824
Education	0.070	0.349	0.595	0.780	1.334
Health, community services	0.153	0.487	0.806	1.733	2.949
Cultural, recreational services	0.035	0.066	0.202	0.435	0.740
Personal, other services	0.057	0.064	0.301	0.646	1.100
Total	3.196	5.788	8.099	11.347	19.331

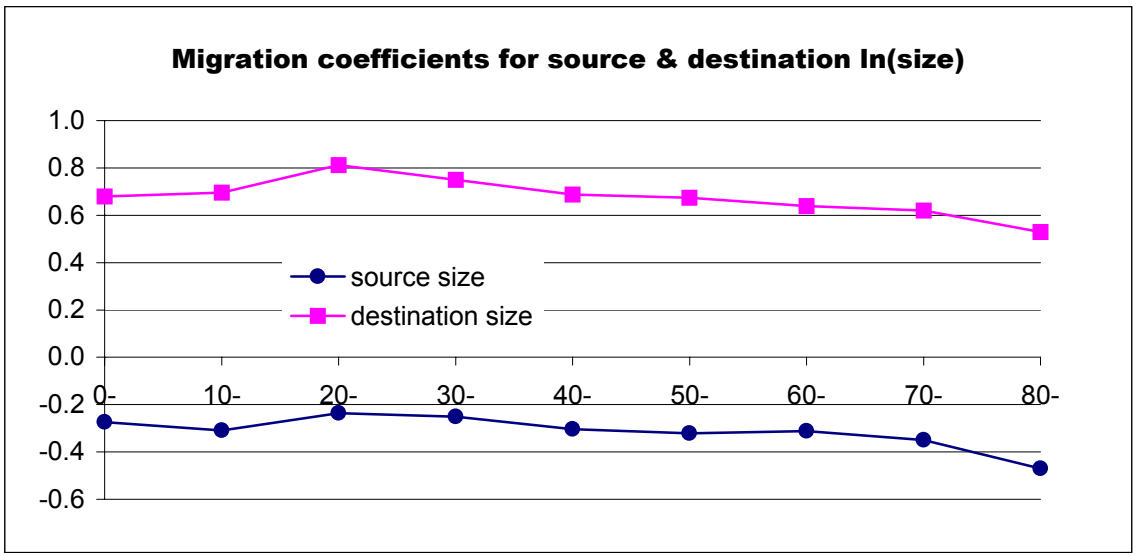
Job numbers for some of the 17 industries at the 1947 and 1976 censuses are estimates, as some of the industry classifications have changed. The main assumptions underlying the future job numbers were

- jobs in mining were assumed static
- jobs in agriculture, forestry, fishing manufacturing were assumed to grow at 1% pa less than population growth
- jobs in accommodation, cafes and restaurants, property and business services, cultural and recreational services and personal and other services were assumed to grow at 1% pa more than population growth

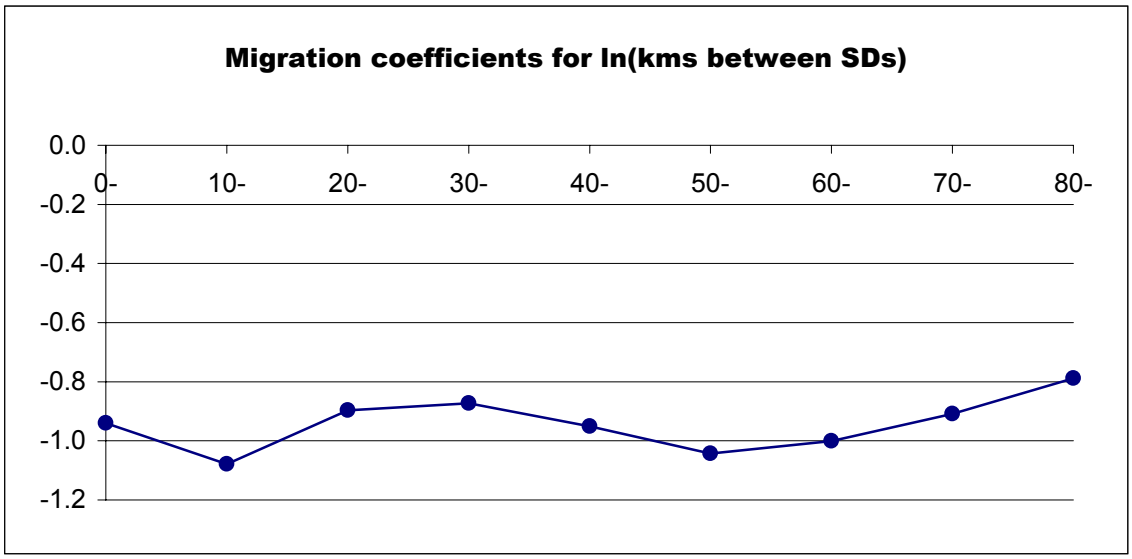
- jobs in all other industries were assumed to grow in line with population growth.

Probabilities of migration between SDs

Assumed probabilities of migration between each pair of SDs took into account distance and source and destination population, climate and employment rates at the start of each 5-year period. Separate estimates were made for each 10-year age group. Logistic regression were used to fit probabilities of migration between each possible pair of destinations, for each age group. The source data were statistical division of usual residence at the 1996 and 2001 censuses, compared with the reported statistical division 5 years before the census.

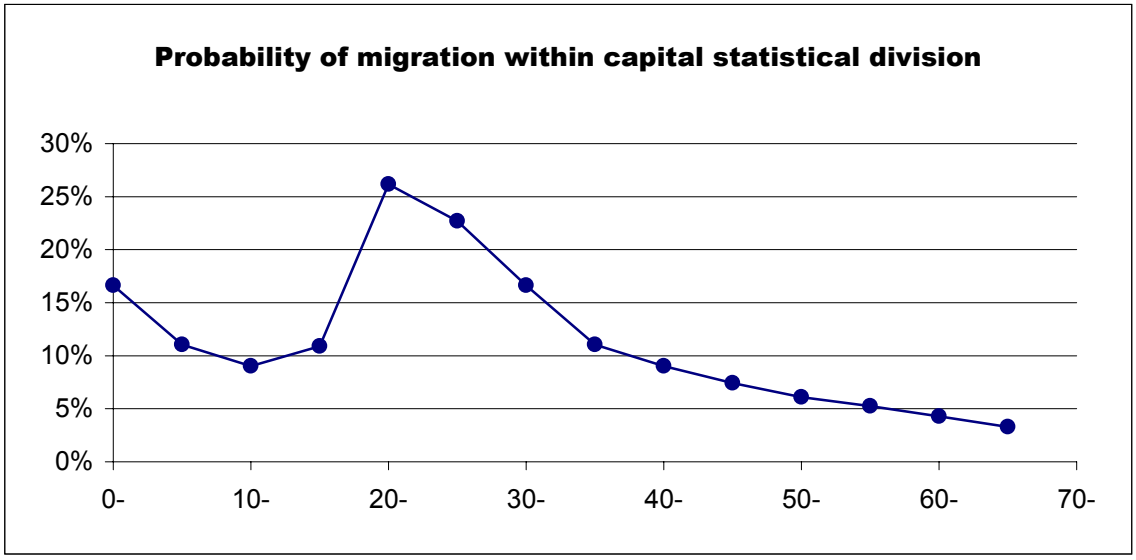


Persons aged 20-29 have the highest probabilities of moving to large destinations, and also the highest probabilities of leaving small destinations.



Although older persons have low probabilities of migrating between SDs, they are more likely to move longer distances if they do move.

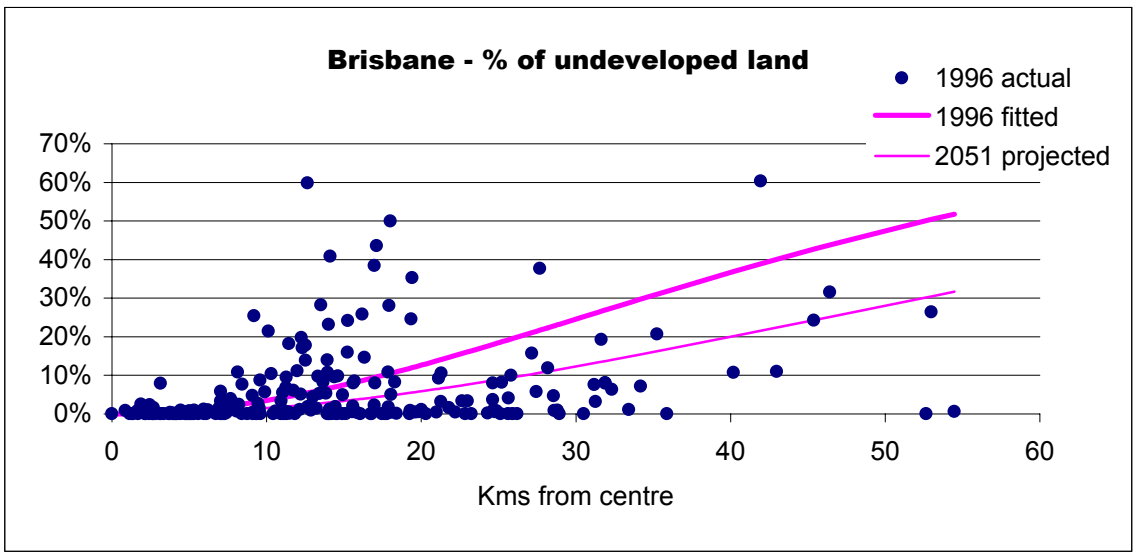
Probabilities of migration within SDs



The above probabilities were derived from table 14 of "Internal migration Australia 12 months ended 31/5/87", Australian Bureau of Statistics catalog no 3408.0. Persons aged 20-29 are most likely to move within capital city statistical divisions.

Assumed land development patterns

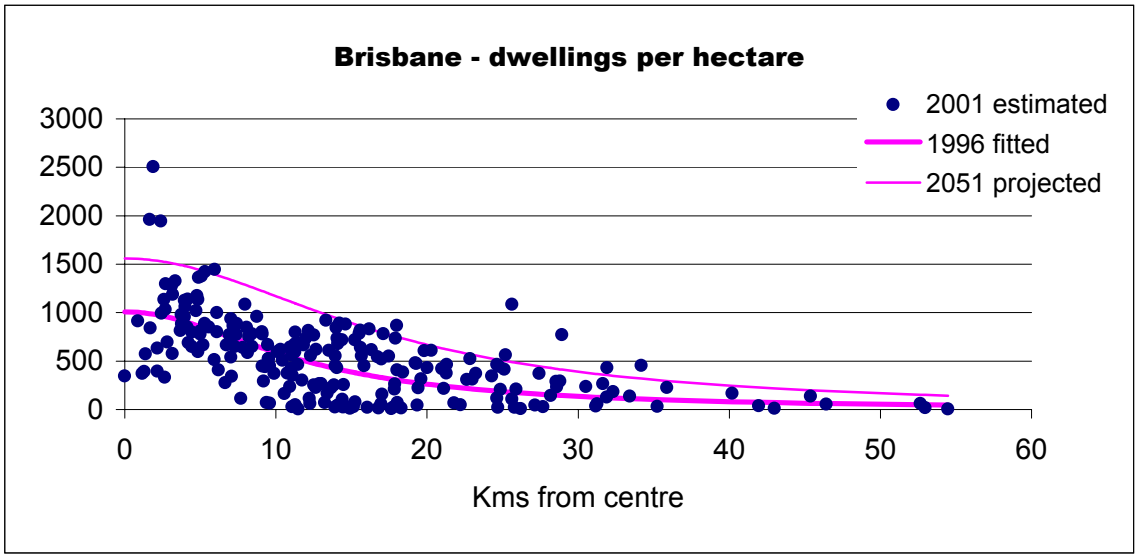
Movements within capital city statistical divisions are based on statistical models of the conversion of vacant land and of dwelling density increases.



For Sydney, Melbourne and Brisbane, estimates were made of the amount of undeveloped land within the SD, potentially available for housing. The data and a

fitted curve are shown above for all the SLAs in the Brisbane SD. Undeveloped land areas for Brisbane City SLAs are from Queensland Department of Communication & Information, Local Government, Planning & Sport (2000). Agricultural land was used as a measure of undeveloped land for other SLAs in the Brisbane SD. As shown by the thinner curve on the graph, the percentages of undeveloped land were assumed to gradually reduce to 2051. Areas were assumed to retain their deviations from the general pattern - for example, an area with a higher than average undeveloped proportion in 2001 was assumed to still be above average in 2051.

Assumed dwelling densities on developed land



The above graph shows dwellings per developed hectare for each SLA in the Brisbane SD. Dwellings in 2001 were estimated from 1996 values by assuming the rate of increase given by the 2000 population estimates in Department of Local Government and Planning (2001). The fitted curve has been assumed to increase in both height and spread, giving the largest percentage increase at the outskirts. As above, areas were assumed to retain their deviations from the general pattern. Projected dwelling densities were multiplied by projected areas of developed land to obtain projections of the numbers of dwellings in each capital city SLA. These projections were used as guides to the order in which SLAs will develop, for years where no state government projections were available.

State government projections

Where available, state government projections were used as a guide to the order in which SLAs will develop. For Victoria, projections of the population of each SLA to 2021 were available from Department of Infrastructure(2000). From these we derived estimates of the future numbers of dwellings, and used these as a guide to the order of development of each Victorian SLA until 2021. For Sydney, projections of increases in dwelling numbers to 2005 were available from Department of Urban Affairs and Planning (2001).

Future development of SLAs outside capital cities

For NSW and Queensland, no recent government projections were available for most SLAs outside the capital cities. For these areas, guides to the order of future development were obtained by assuming that dwelling numbers would grow at the SD growth rate in the last 5 years, plus a decreasing part of the difference between the SLA and SD growth rates in the last 5 years.

Movements of persons within SDs

Each SD is likely to have some persons migrating into it, and others moving within the SD. For capital city SDs, the SLAs these persons move to were modelled taking into account age and their likely ability to be able to afford dwellings in different areas. For other SDs, movers were allocated uniformly to the available dwellings.

Reliability of projections

The projections are based on probabilities of migration between SDs, and thus avoid the gross heterogeneity inherent in state migration data - see Cumpston & Sarjeant (1998). The statistical models are objectively fitted, and the interacting mechanisms make it difficult to intentionally bias the results. Critical discussion of these models would help give more confidence in the results. Our estimates for typical SDs are likely to be more reliable than for extreme SDs, particularly those in remote areas with small populations.

References

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