

Identifying causal factors of the components of population change to population ageing at a sub-national level using Tasmania, Australia as a case study

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Population ageing

- A 'major concern' by over half the Governments worldwide
- The 'most important population issue for the ensuing two decades' by world leading demographers
- The third stage in the demographic transition, population ageing results from a situation in which both fertility and mortality are initially high to one in which they are both low
- An unprecedented, pervasive, enduring and irreversible global phenomenon affecting all levels of community which will eventually lead to depopulation without intervention
- Demographic Transition Theory fails to consider the role of migration in demographic change as well as the political, economic and social influences on each of the components of population change and their combined impact on a population's age structure.
- Response: diverse national level policy focussing on population growth, raising statutory retirement ages, reforming pension systems, introducing pro-natal policies and increasing immigration and to lesser degree, spatial (re)distribution

Population ageing: sub-national level

- National level research on population ageing has the potential to conceal disparity in the rate and causes of population ageing across sub-national jurisdictions which could have serious policy implications.
- Scant, but emerging, research in relation to population ageing at a sub-national level and its associated implications
- Marked differences exist between regions in terms of the number, proportion and rate of ageing as well as the cause of ageing
- There appears little evidence of established methods to examine the contribution of the various components of population change to population ageing

Approach

Extend the Preston Model based on stable population theory

Model aims to identify, and attribute, the cause and extent of population ageing to the various components of population change; fertility, mortality, migration, and in this case, interstate migration.

- That births have a rejuvenating effect on the mean age of a population given that age at birth (zero) is less than the mean age of the population
- That deaths, if the mean age of deaths is greater than the mean age of the population, have a rejuvenating effect on the age structure of a population
- That migration can have either a rejuvenating or ageing effect on the change in the mean age of a population depending on the mean age of inward migrants and outward migrants.
- The extent of rejuvenation or ageing is then further influenced by the volume of each component of population change, expressed as a proportion of the total population at risk, i.e. the crude rate of each.

Adapted Preston Model

$$\begin{aligned} \frac{dA_p}{dt} = & \\ & 1 - \\ & bA_p - \\ & d(A_D - A_P) - \\ & [oi(A_P - A_{oi}) + oo(A_{oo} - A_P)] \\ - & \\ & [ii(A_P - A_{ii}) - io(A_{io} - A_P)] \end{aligned}$$

$\frac{dA_p}{dt}$ is the derivative of the mean age of a population at a point in time

b is the crude birth rate

A_p is the mean age of the population

d is the crude death rate

A_D is the mean age at death

oi is the overseas in-migration rate

A_{oi} is the mean age of overseas in-migrants

oo is the overseas out-migration rate

A_{oo} is the mean age of overseas out-migrants,

Ii is the interstate in-migration rate

A_{ii} is the mean age of interstate in-migrants

Io is the interstate out-migration rate and

A_{io} is the mean age of interstate out-migrants

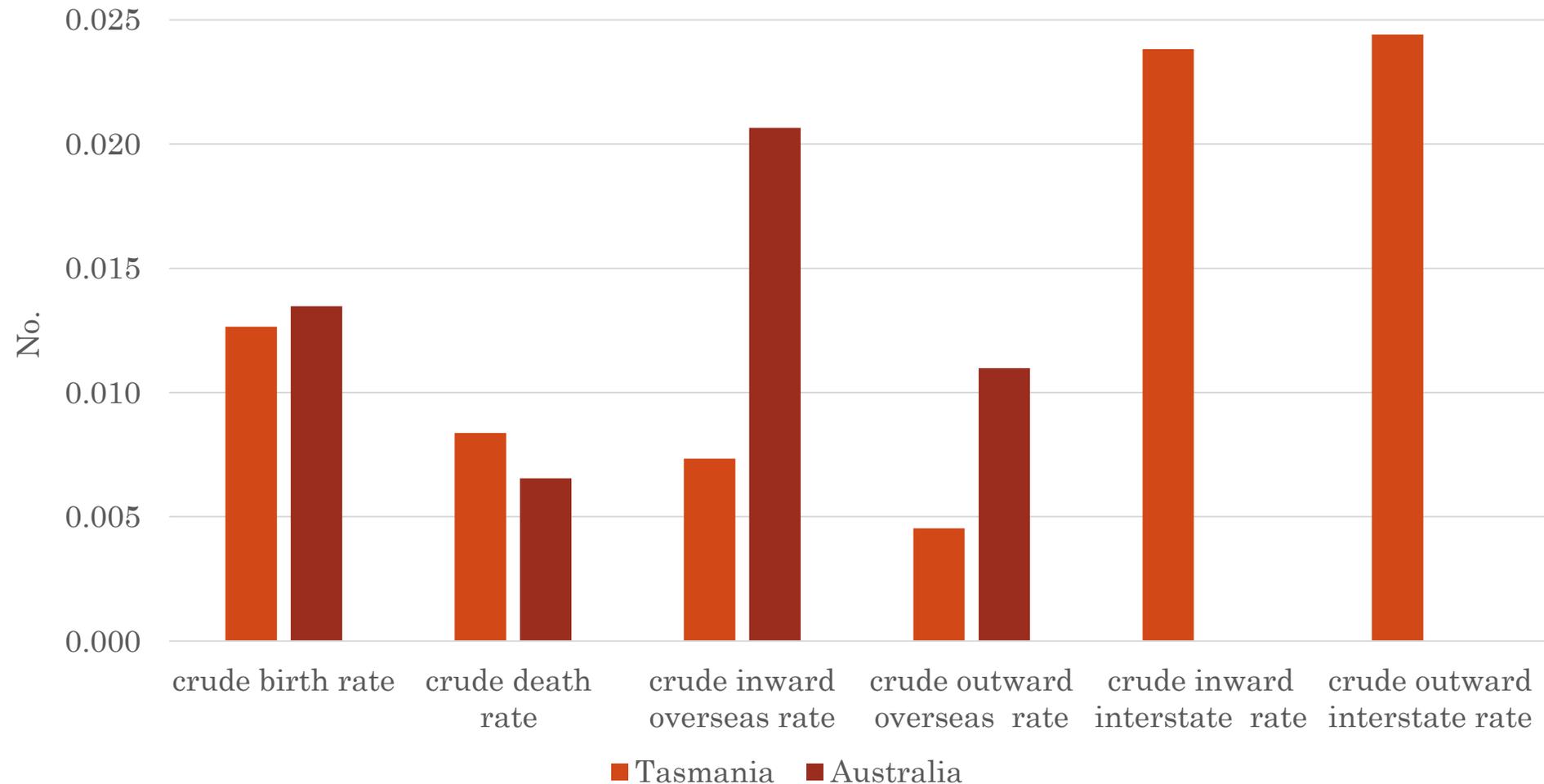
Components of population change: average mean age and crude rates, Australia and Tasmania, 2004 to 2014

	Australia	Tasmania
mean age (A_p)	37.4	39.0
mean age at death (A_D)	75.7	75.9
crude birth rate (b)	0.013	0.013
crude death rate (d)	0.007	0.008
mean age of in interstate migration (A_{II})	n/a	33.2
mean age of out interstate migration (A_{io})	n/a	30.6
crude interstate arrival rate (ii)	n/a	0.024
crude interstate departure rate (io)	n/a	0.024
mean age of out overseas migration (A_{oo})	30.9	28.5
mean age of in overseas migration (A_{oi})	27.9	32.4
crude overseas arrival rate (oi)	0.021	0.007
crude overseas departure rate (oo)	0.011	0.005

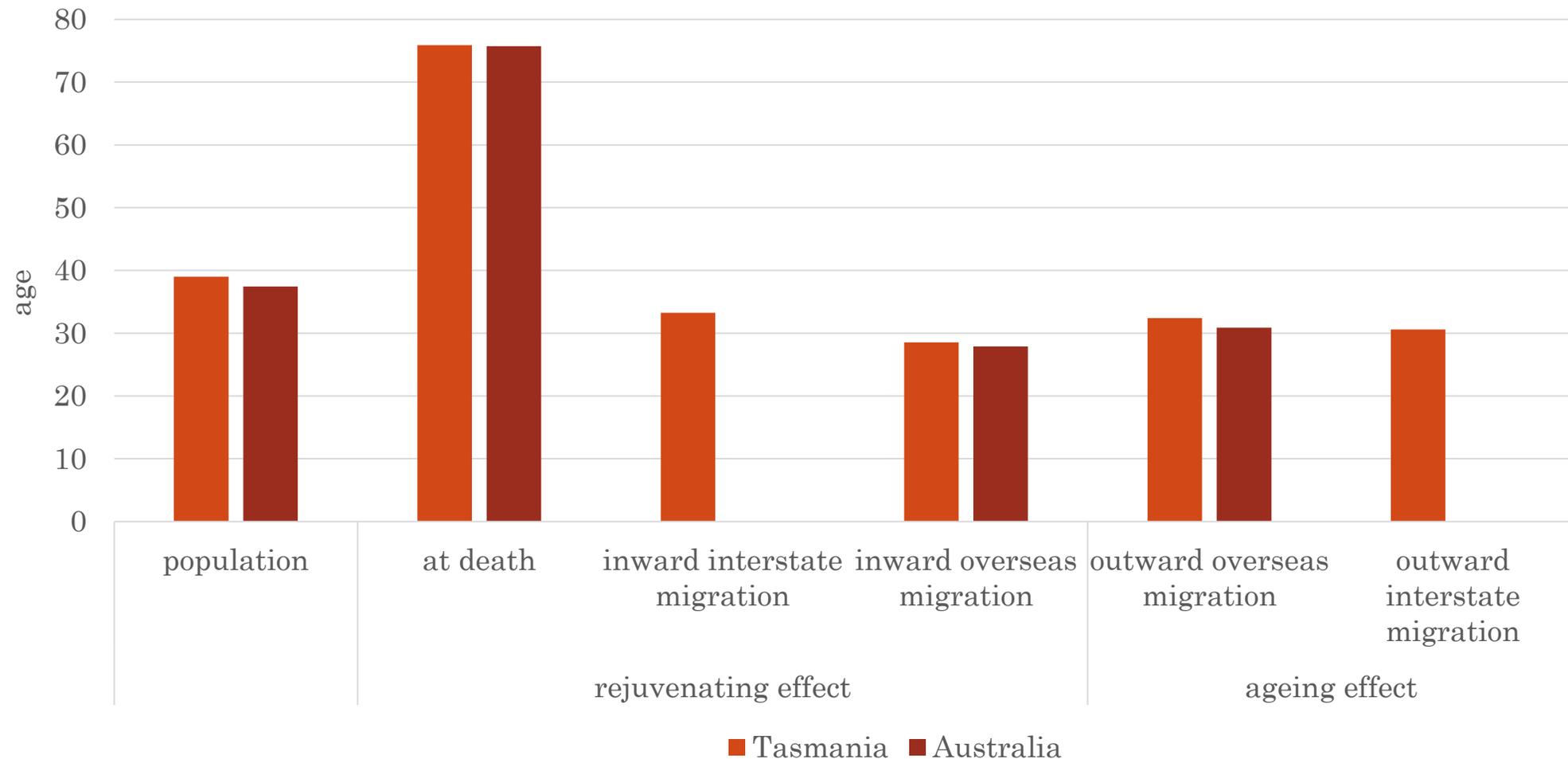
Effects on population change by component, average, Australia and Tasmania, 2004 to 2014

	Australia	Tasmania
effect of fertility	0.504	0.493
effect of mortality	0.205	0.309
effect of interstate arrivals	n/a	0.137
effect of interstate departures	n/a	-0.204
net effect of interstate migration	n/a	-0.067
effect of overseas arrivals	0.179	0.077
effect of overseas departures	-0.072	-0.030
net effect from overseas migration	0.125	0.047
rejuvenating effect	0.880	0.781

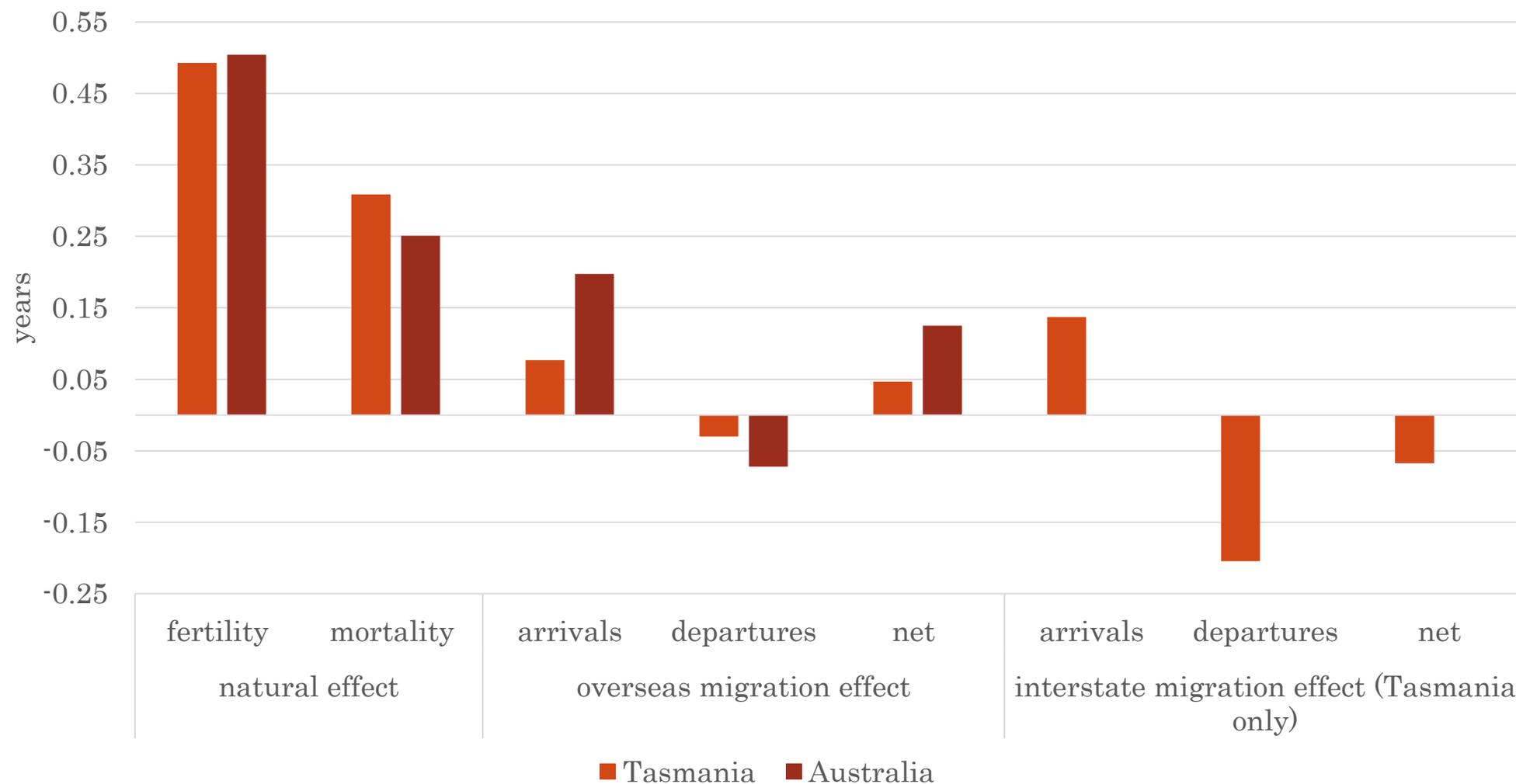
Crude rates, annual average, Tasmania and Australia, 2004 to 2014



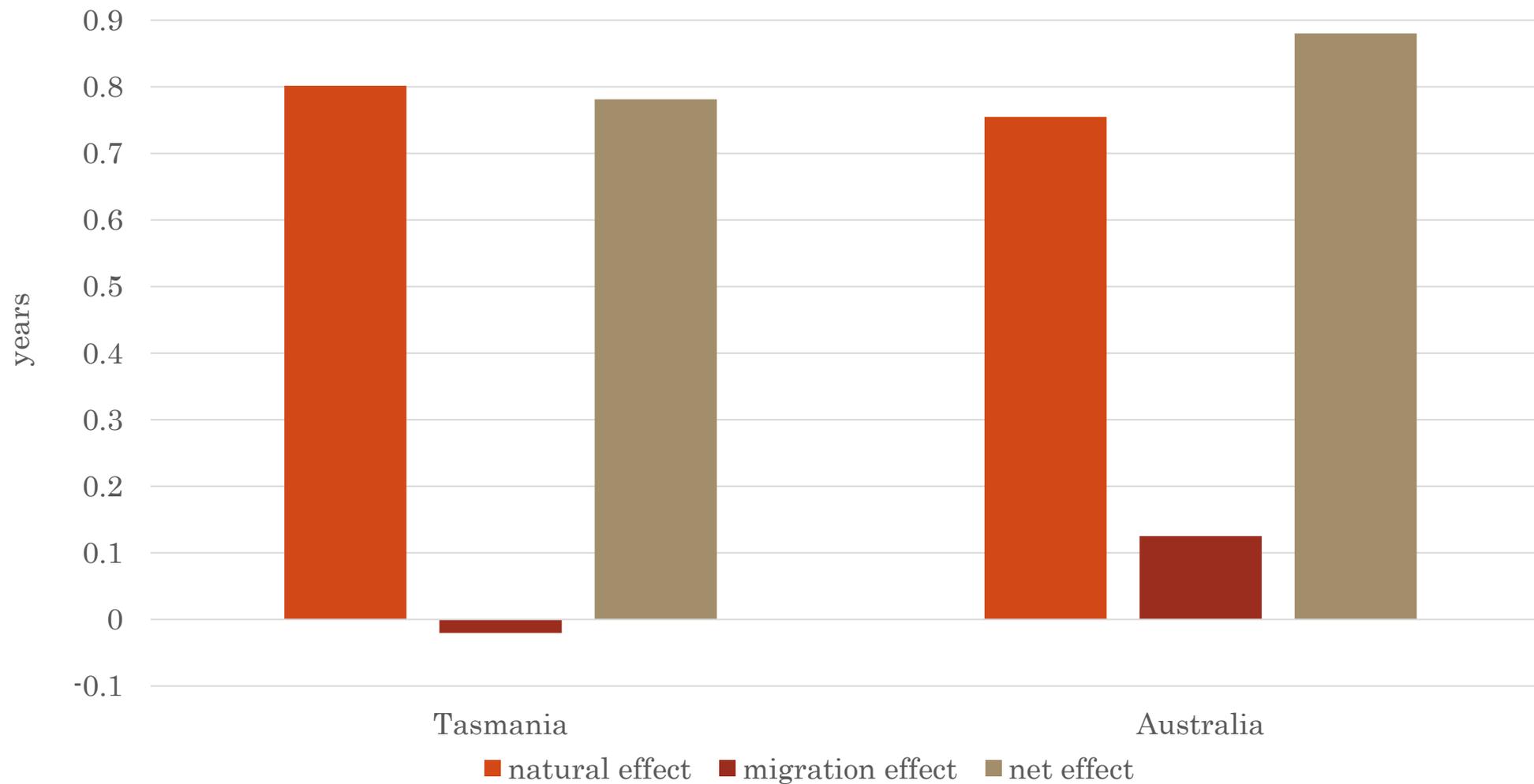
Mean age, annual average, Tasmania and Australia, 2004 to 2014



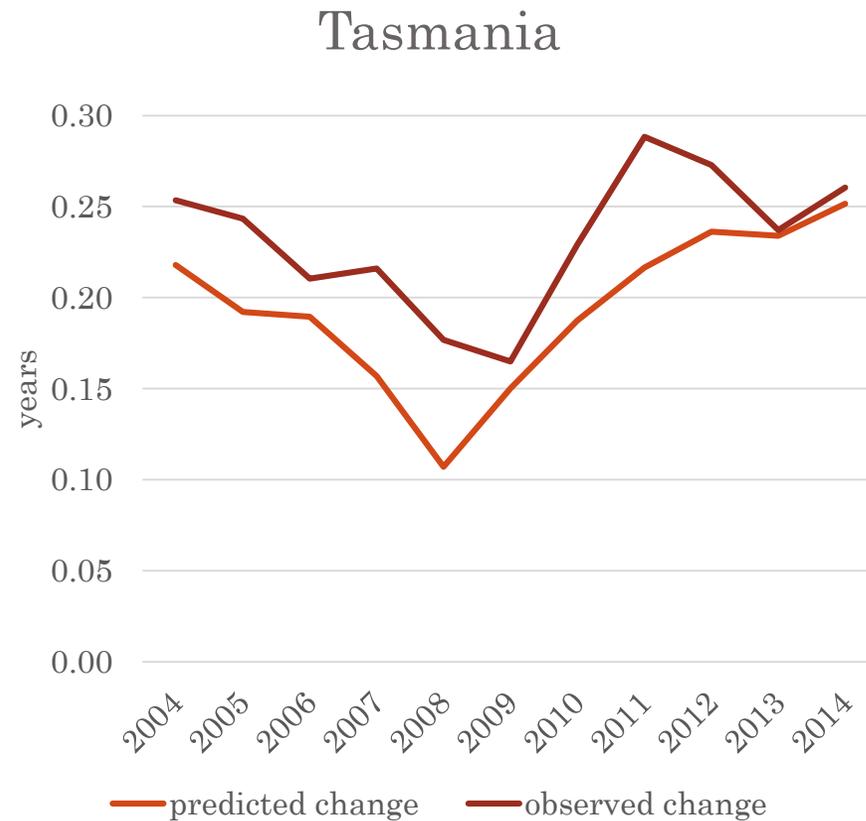
Effects on mean age of population, annual average, Tasmania and Australia, 2004 to 2014



Net effect on mean age of population, annual average, Tasmania and Australia, 2004 to 2014



Change in mean age, predicted and observed, 2004 to 2014



Conclusion

- Findings confirm that population ageing is occurring for both Australia and Tasmania, however, at differing rates and for differing reasons
- Provides evidence that policy intervention can effectively influence the rate of population ageing and, ultimately, a population's age structure.
- In Australia's case, the process of ageing is consistent with demographic transition theory of declining, and below-replacement level, fertility rates and increasing life expectancy.
- The rate of ageing has slowed due to the age profiles of inward and outward overseas migration
- In Tasmania's case, while also consistent with the demographic transition theory, the change in the mean age of the population and thus, the rate of population ageing, is exacerbated by the volume and age of interstate migrants
- The recent baby boom in Australia, evident from an increase in the crude birth rate from 2005 to 2009, has also contributed to slowing the rate of population ageing.

Why is this useful?

- Greater, detailed understanding of the contribution of the components of population change to demographic change at a sub-national level
 - Population ageing
 - Population growth
- Enables long term trend analysis (subject to data availability)
- Inform population projection models at a sub-national level
- Contribute to fit-for-purpose policy development with local context
- Identify demand for investment in infrastructure, services and amenities at the local level
- Provide ongoing assessment and evaluation of policy initiatives to identify their effectiveness, or not, over time.

Questions

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Data sources:

Australian Bureau of Statistics; Australian
Demographic Statistics, Cat. No. 3101.0;
Migration, Australia, Cat. No. 3412.0;
Births, Australia, Cat. No. 3301.0; Deaths,
Australia, Cat. No. 3302.0, various years,
author calculations