Final Report

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The structural drivers of homelessness in Australia 2001–11

Final Report 2 of 2

authored by

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ACRONYMS

ABS	Australian Bureau of Statistics
AHURI	Australian Housing and Urban Research Institute Limited
AIHW	Australian Institute of Health and Welfare
ARIA	Accessibility/Remoteness Index of Australia
ASGS	Australian Statistical Geography Standard
BoM	Bureau of Meteorology
CHSA	Commonwealth State Housing Agreement
CD	Collection District (a unit of measurement under the previous ABS geographical system)
NAHA	National Affordable Housing Agreement
NPAH	National Partnership Agreement of Homelessness
NT	Northern Territory
OLS	Ordinary Least Squares
SA3	Statistical Area Level 3 under the ASGS
SA2	Statistical Area Level 2 under the ASGS
SA4	Statistical Area Level 4 under the ASGS
SAAP	Supported Accommodation Assistance Program
SHS	Specialist Homeless Services
SHSC	Specialist Homeless Services Collection
TSP	Times Series Profile dataset
VIF	Variance Inflation Factors

EXECUTIVE SUMMARY

Background and aims

What role do structural factors play in shaping the rate and distribution of homelessness across Australia? This second and final report, from a project addressing this broad question, builds on our earlier analysis of the spatial dynamics of homelessness from 2001 to 2011. It examines the role of housing and labour markets, household income, income inequality, climate and demographic profiles in shaping the spatial distribution of homelessness across Australia.

Interest in the role of structural versus individual level drivers of homelessness has been longstanding in the homelessness research and policy fields. Some have argued that homelessness is caused by structural factors such as weak labour markets and tight housing markets (Neale 1997), while others have emphasised individual factors such as mental illness, a history of contact with institutions, or poor decision-making as the key causes (Neale 1997). More recently a loose consensus has emerged where homelessness is understood to be caused by the *interaction* of individual risk factors *and* adverse structural conditions (Fitzpatrick & Christian 2006; Lee et al. 2010; Pleace 2000; O'Flaherty 2004). But despite the prevalence of this view, there is a lack of evidence to support such a claim, and in Australia there is almost no quantitative evidence. This project aimed to address this evidence gap.

In this report we address the following research questions:

1. What role do housing market factors play in shaping the rate of homelessness across Australia over time? If housing markets play a role in shaping the rate of homelessness, is it because:
   - → there is a shortage of low-cost rental properties for those on low incomes (the housing shortage hypothesis)? And
   - → people experiencing homelessness or who are vulnerable to homelessness gravitate to areas where there is more affordable housing (the sorting hypothesis)?
2. What role do household income and labour market factors play in shaping the rate of homelessness across Australia and over time (the poverty hypothesis)?
3. How do these processes affect Indigenous and lone-person households?

Research approach

The empirical work interrogates a panel data base comprising 328 local regions over three census collections (2001, 2006 and 2011). Estimates of homelessness in these local regions have been drawn from the ABS revised census counts in 2001, 2006 and 2011. Demographic profiles, housing and labour market factors, climate and income inequality data were derived from multiple sources, including: the Time Series Profile dataset from the ABS; climate data from the Bureau of Meteorology (BoM); housing affordability, availability and suitability (special request) from the ABS Census of Population and Housing; and the ABS remoteness structure and concordances.

We first conducted a descriptive analysis examining the bivariate relationship between a range of previously untested structural indicators and rates of homelessness to get a sense of the importance of each structural variable on its own, and to inform variable selection for the modelling work. However, these descriptive analyses did not account for the effect of other potentially important or confounding factors. To address this, we undertook panel modelling, which gives a clearer picture of the importance of

each variable in determining variations in rates of homelessness—once we have controlled for the relative importance of other factors. In line with our empirical approach, we first present the key findings from our descriptive analysis, followed by our modelling results.

Key findings from the descriptive analysis

The role of the housing market: examining possible sorting and shortage effects

First and foremost we found that the relationship between homelessness rates and the housing market is neither simple nor straightforward.

Building on Batterham's (2012) and Wood et al.'s (2014) findings of higher homeless rates in regions with lower median rents, we hypothesised that people experiencing homelessness may gravitate to areas with cheaper and more abundant private rental housing (sorting effect), but that these regions still have a shortfall relative to demand (shortage effect), and so their homelessness cannot be resolved.

However, we found no evidence in support of a shortage effect. In fact we found the opposite. Descriptive analysis showed that areas with higher homelessness tended to have a larger supply of affordable housing relative to demand from low-income households.

In terms of suitability, we found an acute shortage of affordable one-bedroom private rental dwellings relative to demand, while larger dwelling sizes (two or more bedrooms) seemed to be adequately supplied. However, we also found that the shortage of affordable one-bedroom dwellings was more severe in areas with lower rates of homelessness. This is consistent with our findings in relation to the supply of affordable private rental dwellings.

There was also no evidence of a sorting effect we were unable to directly test the sorting hypothesis as we could not identify moves made by the homeless from aggregate data. However, the dynamic patterns in the changing spatial distribution of homelessness reveal that homelessness rates tended to fall in areas where affordable housing was relatively healthy, and rose where it was relatively scarce. All else equal, we might expect the opposite pattern if a strong sorting effect were present.

Characteristics of regions with high rates of homelessness

Our earlier report documented the relationship between a limited range of potential structural indicators and rates of homelessness. In short, we found higher rates of homelessness in regions with lower rents, more public housing, lower rent to income ratios, higher unemployment and a larger share of Indigenous persons.

Our expanded descriptive analysis found that regions with higher rates of homelessness tended to have a warmer and less variable climate, a greater proportion of younger persons (aged 15–34) as well as never-married populations, a relatively large Indigenous population, and a disproportionately high share of rental (particularly social) housing. They also have poor rates of employment (especially part-time), higher rates of unemployment, relatively more unequal distributions of household income and larger numbers of workers in labourer occupations than is typical across Australian regions.

Three socio-economic characteristics were evident in regions with elevated levels of homelessness—weak labour markets, concentrations of poverty (as proxied by the share of public housing and unskilled labourers) and income inequality. High rates of unemployment and concentrations of poverty, along with related social problems, are

typically correlated with weak housing market conditions and an abundant supply of affordable rental housing.

Characteristics of areas with rising rates of homelessness

In our earlier report we found that areas with the highest rates of homelessness in 2001 tend to experience a decline in rates over the 2001–11 decade, while those areas where homelessness was low in 2001 were more likely to experience an increase. Consistent with this, the characteristics of regions with rising rates of homelessness were quite different to those with high rates of homelessness.

Regions with rising rates of homelessness over the decade tended to have a higher percentage of dwellings owned with a mortgage, more people who have never married, lower winter temperatures, and greater variability between summer and winter months. They were also more likely to have a shortage of affordable rental housing.

Results from panel modelling

The importance of demographic profiles

Demographic factors proved to be the best predictors of variations in rates of homelessness. Regions with higher shares of males, Indigenous persons and sole parents had elevated rates of homelessness. The population share of Indigenous persons was especially important in regional Australia. There was weaker evidence in support of the idea that a younger demographic profile is associated with homelessness, and what evidence there is suggests that this is an urban phenomenon.

Type of housing

There is some evidence that regions with a larger supply of flats, units and apartments have higher rates of homelessness. The type of housing stock is probably important because of the association with demographic variables—persons aged 15–34, a group more vulnerable to homelessness, may be more likely to be living in flats, units or apartments than other age groups. Overcrowding is also more likely to feature in flats and apartments, and this is the most important component of the homelessness figures.

Higher income inequality

We also found evidence that regions with higher income inequality have higher rates of homelessness. The relationship is likely to be a directly causal one: regions with relatively unequal income distributions have a larger pool of very low-income households, which increases the competition for low-cost housing.

Change in homeless rates across the decade

In our first report, general ABS figures suggested that homelessness rates had fluctuated across the decade. However, our modelling work suggests an underlying decline in homelessness across Australia over the decade once structural factors are accounted for.

Further analysis focusing only on urban regions demonstrated an underlying decline in the first half of the decade between 2001 and 2006, and a subsequent increase back to 2001 levels in the second half of the decade.

Interstate and territory differences

We also found considerable differences in adjusted rates of homelessness between states and territories. We take these variables to indicate unobserved or unknown structural factors that vary across state and territory boundaries due to institutional arrangements. For the national sample of regions, New South Wales had lower rates of homelessness than most states and territories, once we accounted for a range of structural factors (i.e. demographic profiles, income inequality etc.). The Northern Territory adjusted rates were particularly high in relation to New South Wales. In the urban only sample of regions, many of these interstate and interterritory differentials disappeared. However, in Victoria, adjusted rates of homelessness were higher and it is conspicuous in both national and urban-only samples.

Puzzling findings in relation to the supply of affordable rental housing and labour markets

We had expected that, all things being equal, homelessness would be higher in areas with a smaller supply of affordable private rental housing for those on low incomes. However, modelling results suggested that the supply of affordable housing was unrelated to rates of homelessness. While there is some indication that relatively healthy supplies of social housing are associated with lower rates of homelessness, the evidence is less than compelling.

We also found that weak labour markets (higher unemployment) were associated with lower per capita rates of homelessness, a puzzling finding, since we might expect job losses and limited job opportunities to precipitate homelessness.

These key housing and labour market findings were evident even when we experimented with alternative measures.

Making sense of our findings

We think that supplies of affordable housing in regions could be important, but their effects are masked by the interrelationships between housing and labour markets.

If regions with higher unemployment and lower incomes have lower rents—because these are areas that are typically less desirable places to live—they will have a more abundant supply of affordable private rental housing. Given the low incomes of the residents of these regions, there will be a larger pool of people ‘at-risk’ of homelessness; but a small fraction of the ‘at risk’ group become homeless because of the relatively abundant supply of affordable private rental housing.

In contrast, regions with lower unemployment and higher incomes tend to have higher rents, less affordable private rental housing and a smaller ‘at-risk’ population. However, because of a shortage of affordable private rental housing, a higher proportion of the at-risk group become homeless. The relationship between low unemployment, higher incomes and higher rents masks the role of housing and labour market factors in precipitating homelessness.

The mobility of 'at risk' groups has potentially important consequences for national rates of homelessness. If the mobile 'at risk' group gravitate to regions with stronger labour markets, the threat of homelessness can be greater given the shortage of affordable housing options in these regions. These patterns of mobility could then lift national rates of homelessness (all else being equal).

Policy implications

This is the first Australian research project to investigate the spatial dynamics of homelessness and the first to use quantitative techniques to investigate the structural

drivers of homelessness nationally and over time. This work represents only the beginning of stream of such research in the homelessness field and there is significant work to be done in this space. While it is difficult to make specific recommendations for policy-makers, there are some potential policy implications from both our findings and our explanation of the relationship between housing markets, labour markets and the risk of homelessness.

Given the strength of our demographic findings in both the modelling work and the descriptives, it may be worth considering targeting homeless services, and policy interventions more generally, to disadvantaged regions with more males, sole parents, Indigenous and young people. The enormous geographical variation in rates of homelessness across the nation that we documented in our first report means that appropriate targeting of policy resources is a key policy challenge.

Further, policy focused on addressing Indigenous homelessness should focus on regional areas, and those areas where the Indigenous population make up the largest share of the population—remote and very remote areas of Australia.

If our ideas about the relationship between housing markets, labour markets and risk of homelessness are correct, there are some important implications for policy. Concentrations of affordable housing in areas with weak labour markets risks trapping residents in a cycle of poverty and creating/accentuating concentrations of disadvantage. It is important for policy-makers to think not just about increasing the supply of affordable rental housing—but also ensuring that this housing is located in regions with stronger labour markets. If many of those 'at risk' of homelessness gravitate towards regions with stronger labour markets but more expensive housing, they could become more vulnerable unless steps are taken to retain and add to supplies of affordable housing.

Future research

Our results, and the interpretations we have offered, are tentative. There are a number of important avenues for future research that need to be developed in order to meet critically important gaps in the evidence base.

The geographical mobility of the homeless and 'at risk' population

The mobility of the homeless and 'at risk' populations is a key factor that could be influencing our results. Little is known about the geography of the moves made by persons before, during and after they experience homelessness. The homeless estimates we have are simply point prevalence rates. They tell us where homeless people are at a point in time—not where they first became homeless. Further, these homeless estimates are very unlikely to contain the same individuals across the three census counts. Data from the ABS General Social Survey shows that, for their most recent period of homelessness, only 22 per cent of persons had been without somewhere to live for six months or more (ABS 2010a). A full investigation of the role that mobility might play in relation to homelessness and both housing markets and labour markets requires longitudinal micro-data that identifies the location of individuals when they become homeless and tracks their subsequent moves, along with information about the characteristics of these areas. This is the subject of planned future research.

Additional structural drivers

There were some additional structural indicators suggested by the international literature which we did not incorporate as the data was unavailable at the desired spatial unit of measurement within our timeframes. These include the incidence of

mental health, drug and alcohol issues, as well as the service capacity to address these issues in a region, rates of family violence and child protection notifications, health problems, and the incidence of disability in a region's population. Given the highly targeted nature of public housing in Australia, it is likely that persons who have experienced family violence, have ongoing significant health issues, disabilities, problematic drug and alcohol use, and mental health issues will be disproportionately represented in public housing. Perhaps the amount of social housing in a region should be interpreted as a proxy measure for the importance of these groups in a region's population, and this overwhelms their impact as a source of affordable rental housing. However, the capacity of the health, mental health and disability service systems to respond in a region and its relationship to homelessness is unknown and warrants further investigation.

Investigating lags

In the literature review presented in our first report, we discussed the theoretical contribution of Glomm and John (2002). Their argument rests on the existence of hysteresis effects; a worsening in housing affordability (or unemployment) tips some vulnerable people into homelessness. There are adverse feedback effects on health, through to unemployment that makes future escapes from homelessness less likely, even if the initial deterioration in housing affordability which precipitated the homelessness is reversed. This line of reasoning should motivate future research that explores the presence of lags and the possibility of scarring effects—that is, the relationship between housing market (and labour market) conditions in a region in one period and rates of homelessness in that region in future time periods.

Different spatial units

It is possible that our findings are in part an artefact of the spatial unit we have chosen. A significant part of the reason we selected the SA3 spatial unit was that we wanted to investigate the role that composition of the homeless population might play in regional differences, and this was the smallest spatial unit at which data was available by operational group. However, housing market research is usually carried out at the SA2 (formerly SLA level) level while labour market research employs SA4s (formerly SD level) as the preferred spatial unit. Future research should experiment with data at the SA2 level to explore housing market drivers in particular.

Teasing out the importance of individual vs structural level drivers

Our findings in relation to demographics suggest that some individuals or households may be more 'at risk' of homelessness than others. Research is currently under way (see Johnson et al. 2015) to examine the way that structural factors, such as those investigated in the present study, and individual risk factors, such as age, gender, ethnicity, income, education, health, psychological distress and substance use, interact to bring about homelessness. This will shed further light on the role that housing and labour markets play in the homeless story in Australia. By combining panel microdata (*Journeys Home*) with measures of structural factors, this research will be able to explore how these interactions affect whether those 'at risk' groups are actually tipped into homelessness

1 INTRODUCTION

This is the second and final report from a study investigating the structural drivers of homelessness in Australia over the decade 2001–11. Our first report presents findings on the spatial dynamics of homelessness over this decade, documenting where homelessness is high and low in Australia, where it has increased and decreased, and its high spatial concentration. In addition to describing the spatial distribution of homelessness across Australia, the first report also presents findings on the impact of service location and the composition of the homeless population on these dynamics over time. Finally, it presents findings of a limited descriptive investigation of the relationship between housing and labour market characteristics, household income, other household characteristics and rates of homelessness across Australia.

This Final Report builds on the initial report in two ways. First, it includes some extensions to the initial geographical analysis, including descriptive investigation of a suite of previously unexamined structural variables, such as the supply of affordable private rental housing, climate and income inequality and their relationship to homelessness. Second, it presents findings from panel modelling that explores the role that these structural variables play in shaping the spatial dynamics of homelessness across Australia.

1.1 Context and background

1.1.1 Policy

Since the mid-1980s, homelessness has been recognised as an issue worthy of discrete policy and programmatic intervention in Australia, in both legislation and five successive joint commonwealth-state funding agreements (Coleman & Fopp 2014; Snaddon 2008; Roseman 2006). From 2008 Australian homelessness policy has been guided by a Federal Government white paper on Homelessness, *The road home: a national approach to reducing homelessness* (Commonwealth of Australia, 2008). Developed by the then Labor Government, *The Road Home* provides an overarching national strategy to inform the development of state and territory responses to homelessness. It outlines a three-pronged approach to address homelessness focusing on early intervention and prevention, improving and expanding services, and the provision of specialist care for those experiencing chronic homelessness. It includes a series of key targets to address these areas and aims to halve overall homelessness by 2020.

The Road Home is supported by the National Affordable Housing Agreement (NAHA) and a series of associated National Partnership Agreements between state and federal governments—especially the National Partnership Agreement on Homelessness (NPAH) (Gronda & Costello 2011). The NPAH, which replaced the earlier Commonwealth–State Supported Accommodation Assistance Program 1-V agreements, provides the vehicle for joint federal and state and territory funding for homelessness and articulates some key deliverables for state and territory governments. Each state and territory government developed an implementation plan in line with this agreement. While this included some common programmatic responses, especially those directed at rough sleepers, each state and territory has discretion to implement their own targeted responses to homelessness.

The National Partnership Agreement on Homelessness initially spanned five years from 2009–14. A Prime Ministerial Council on homelessness was established to monitor progress and achievements of the NPAH. Following the Australian federal election in late 2013, the new Liberal/National party coalition government extended the NPAH until June 2015, but with reduced funding and the abolition of the Prime

Ministerial Council. The direction of homelessness policy at the federal level and the status of the NPAH remains unclear beyond 2015.

1.1.2 Individual vs structural causes of homelessness

Historically, there has been a lack of large-scale research into homelessness in Australia, largely due to the relatively small number of homelessness researchers and the limited availability of both data and funding opportunities. As a result, the field has been characterised by a plethora of small-scale qualitative studies documenting particular sub-populations or client groups, describing their experiences and evaluating programs and interventions (e.g. Kolar 2004; Baker et al. 2011; Kelly 2004; Mendes et al. 2010; Rayner et al. 2005; Grace et al. 2006; Johnson et al. 2012).

Over the last decade, however, both governments and philanthropic trusts have increasingly invested in homelessness research resulting in an expansion of the research field, including longitudinal studies such as *Journeys Home* (Scutella et al. 2012), Project I (Mallett et al. 2010), and *Home first* (Kolar 2004), and the emergence of large-scale service evaluations (e.g. Rayner, Batterham & Whiltshire 2005; Grace et al. 2006; Johnson et al. 2015). While much of this research has been descriptive, it has often referenced a key international debate about the role of structural versus individual causes of homelessness.

Some researchers have argued that homelessness is caused by structural factors such as weak labour markets and tight housing markets, while others have emphasised individual factors such as mental illness, a history of contact with institutions or poor decision-making as the key causes (Neale 1997). More recently a consensus has emerged whereby homelessness is understood to be caused by the interaction of individual risk factors and adverse structural conditions (Fitzpatrick & Christian 2006; Lee et al. 2010; Pleace 2000; O'Flaherty 2004). This view is reflected in the key homelessness policy instruments, and also in the advocacy work of the specialist homelessness sector. But despite its prevalence, there is a lack of population level evidence to support this view. While numerous studies have argued that an increased supply of affordable housing is critical to addressing homelessness, the relationships between homelessness and housing markets have not been formally modelled. Instead, available evidence is largely based on case studies (see, e.g. Westmore & Mallett 2011).

This evidence gap is due in part to a lack of data on homelessness—specifically a lack of data that enumerates the homeless population consistently over time across the country. Researchers Chamberlain and McKenzie (2008) pioneered an enumeration methodology based on the Australian Census of Population and Housing, however, they continued to refine and develop their methodology following each census collection, precluding comparison between years. Nevertheless, their analysis of the 1996, 2001 and 2006 censuses provided the only enumeration of homelessness in Australia. Following the release of *The Road Home*, the Australian Bureau of Statistics (ABS) undertook a comprehensive review of Chamberlain and McKenzie's methodology with the aim of producing homeless estimates at multiple geographical levels consistently over time. As part of this review the ABS also developed a statistical definition of homelessness for the first time—which can be used across multiple ABS collections.

At our request, the ABS brought forward its plans to re-release these new homeless estimates for earlier census periods (2001, 2006 and 2011) and across small geographical units. This development has enabled the current project to be undertaken. Through analysis of a newly constructed panel dataset incorporating

these new homeless estimates, we begin to address this significant gap in the Australian homeless evidence base.

While little work has been conducted in Australia, a number of studies from the US and one from Scotland have directly investigated the links between housing markets (and labour markets) and homelessness. These studies have typically been cross-sectional in nature (see, e.g. Bohanon 1991; Elliott & Krivo 1991; Honig & Filer 1993; Lee et al. 2003; Florida et al. 2012), though there are two panel studies (see Quigley & Raphael, 2001; Kemp et al. 2001). Both cross-sectional and panel studies examined whether variations in the incidence of homelessness across cities or areas is related to differences in housing markets, labour markets or other factors.

This international literature has informed the only Australian study in this space—Batterham (2012). Using Victorian homeless estimates from the 2006 census, this study examined whether variations in the incidence of homelessness were related to housing market, labour market, service availability or demographic factors. This was the first Australian study to empirically explore the relationships between structural drivers and aggregate rates of homelessness.

Building on Batterham (2012) and the international literature, this project brings together the new homelessness estimates along with data from the census and other sources to enable the investigation of possible structural drivers of homelessness across Australia—for the first time. The first report from this project has provided important evidence on homelessness 'hotspots' in the geography of homelessness, and how that geography has changed over time. A summary of key findings from our first report now follows.

1.2 Key findings from report 1

Report one examined the spatial dynamics of homelessness in Australia from 2001–11. It specifically addressed the following key research questions:

- Where is homelessness high and where is it low?
- Where is homelessness rising or falling?
- Is homelessness becoming more or less spatially concentrated?
- Are there changes in the composition of the homeless population?
- Are homelessness services well located to intervene in areas with high and rising rates of homelessness?
- And finally, are changes in the geography of homelessness associated with changes in housing and labour market conditions, household income or other household characteristics?

The empirical work for this first report used a panel dataset comprising 328 regions across Australia. Homeless estimates for each region were drawn from the revised census counts in 2001, 2006 and 2011. Indicators of structural drivers for housing market, labour market, and demographics were sourced from the Time Series Profile dataset drawn from the Australian Bureau of Statistics Census of Population and Housing. Measures of service capacity were derived from the Specialist Homelessness Service Collection from the Australian Institute of Health and Welfare (AIHW).

The national picture of homelessness

Over the decade from 2001–11, homeless rates fluctuated across the country. In 2001, the national rate was 50.8 persons per 10 000, but this declined by 6 per cent to

45.2 over the five-year period to 2006. Homeless rates then rebounded to almost their 2001 levels in 2011 (48.9) perhaps reflecting the effects of the Global Financial Crisis.

Looking across the states and territories, the Northern Territory clearly stood-out with a homelessness rate 15 times the national average in 2011. While homeless rates were higher than the national average in both Western Australian and Queensland in 2001, they experienced a decline across the decade, with rates below the national average in 2011. Tasmania's homeless rates remained the lowest for all states and territories across the decade. Rates of homelessness in Victoria and New South Wales followed the national pattern, while homelessness in the Australian Capital Territory experienced a sharp increase between 2006–11.

While the homelessness rate indicates the risk of homelessness in a region, the national share of homelessness in each region tells us where most homelessness is located. On this measure, New South Wales accounted for over a quarter of all homelessness in 2011 (or 1 in 4 homeless persons), with its share of national homelessness increasing over the decade 2001–11. Victoria was second accounting for 22 per cent (1 in 5) of all national homelessness in 2011. Its share also increased over the decade. While the rate of homelessness was substantially higher in the Northern Territory, the smaller population in this territory means that its national share is lower than the more populous south eastern states at 14.7 per cent, or less than 1 in 7. The Northern Territory's share of national homelessness also declined over the decade.

Where is homelessness high and where is it low?

Rates of homelessness were higher in remote rural and regional areas, and in small pockets in some of Australia's major cities. We found that the entire Northern Territory, and the northernmost parts of Western Australia and Queensland were identified as homeless hotspots in 2011. Additionally, of the 20 hotspot regions identified, around half (9 out of 20) of these regions were located in inner-city areas or pockets in growth corridors of state capitals. Areas with relatively low rates of homelessness were generally located on the coastal fringe and in urban areas.

Where is homelessness rising or falling in Australia?

We calculated the percentage change in the rate of homelessness in order to examine changes in homelessness across areas over the decade 2001–11. On mapping this indicator we found that those areas that had higher homelessness in 2001 experienced a drop in homelessness, whereas those areas that had lower homelessness tended to experience an increase in homelessness over the decade.

Is homelessness becoming more or less spatially concentrated in Australia?

Homelessness is highly spatially concentrated. Using concentration ratios we found that 42 per cent of all people experiencing homelessness at a point in time could be found in just 10 per cent of the regions we examined. However, while homelessness is highly spatially concentrated it has becoming less so over time. Using measures of sigma and beta convergence we confirmed the pattern evident in our mapping. Convergence in homelessness rates has occurred because homelessness has been declining in areas where it has been relatively high, but increasing where it has been relatively low.

Are homeless services well placed to intervene?

Through descriptive decile and correlation analysis we found that there is higher service capacity in areas with higher rates of homelessness. Despite this finding, there was also evidence of a mismatch between the distribution of homelessness and

service capacity. In 2011, the top 10 per cent of areas in terms of national share of homelessness accounted for 42 per cent of all homelessness, but their share of Specialist Homelessness Service accommodation capacity was lower at 34 per cent. This mismatch was worse at the beginning of the decade (2001) when almost half (46%) of all homelessness was found in the top 10 per cent of regions, but those same regions accounted for only one-quarter (24%) of the nation's supported accommodation capacity. While there was improvement in the matching of resources to demand over the decade, a clear mismatch remains evident in the 2011 data. A key concern for policy-makers and service providers alike is that an inadequate supply of bed spaces may be compounded by their misallocation.

Do homeless services act as a magnet attracting homelessness to a region?

There was no evidence to suggest that services act as a 'magnet' attracting homeless persons to an area. If the magnet hypothesis were true then regions with a better service support capacity would subsequently experience relative increases in rates of homelessness. In fact, the opposite was found. Those regions with less homelessness service capacity per head of population in 2001 were more likely to experience growth in their rate of homelessness across the decade, while those areas with greater service capacity at the start of the decade were less likely to experience growth over the period.

What role does the changing composition of the homeless play in explaining homeless hotspots?

Results from a shift-share analysis revealed that the composition of the homeless population (six operational groups are used by the ABS[1]) explained little of the differences in homeless rates across regions. Instead, our analysis suggested that differences across regions must be due to the characteristics of regions. These characteristics could include labour and housing market conditions, demographics or some other regionally specific feature.

What does our preliminary analysis tell us about the importance of structural factors in explaining homelessness in Australia?

Preliminary analysis using decile level descriptives and correlations demonstrated that structural factors do seem to be important in understanding spatial variations in aggregate rates of homelessness—but not always in expected ways. For example, we found that regions with lower rents, more public housing, smaller rent to income ratios, higher unemployment and a larger share of Indigenous persons were more vulnerable to homelessness.

When looking at changes in the rate of homelessness across the decade, only one indicator appeared to be important—the percentage of public housing in an area. Regions with relatively high shares of public housing in 2001 tended to experience increases in homelessness, while those with relatively small shares tended to experience falling homelessness rates.

1.3 Building on our existing literature review

Our initial report (Wood et al. 2014) includes a comprehensive literature review providing key contextual information about homelessness in Australia, as well as a review of relevant national and international research. It reports on Australian housing

[1] The six operational groups are: Persons who are in improvised dwellings, tents or sleepers out; Persons in supported accommodation for the homeless; Persons staying temporarily with other households; persons staying in boarding houses; Persons in other temporary lodging; and Persons living in 'severely' overcrowded dwellings.

market research which highlights affordability problems for low-income households, and identifies possible trends that may impact on aggregate rates of homelessness. Evidence on the relationship between homelessness and the labour market in Australia is also reviewed and two key ways that the labour market may impact on aggregate rates of homelessness are identified. The review also examined the international evidence, documenting a number of cross-sectional and panel studies that have directly investigated the relationships between structural drivers and homelessness. Key theoretical literature was summarised along with methodological approaches and insights.

Without repeating the literature review given in our first report, we include here a summary of the structural drivers investigated in the international literature (see Table 1 below). This is important as we have expanded the suite of structural variables from our first report, and the expansion is informed by this literature, and the data that was available given time constraints. The scope of the literature reviewed for this table has expanded beyond cross-sectional and panel studies to also include studies that aimed to predict homelessness, or its likelihood, based on characteristics of the homeless population and local areas.

Across the literature, the structural drivers investigated include: housing markets; labour markets; demographics (which are in most cases control variables); Income, poverty and inequality; deinstitutionalisation; government payments/income support; crime; climate; and availability of homeless services. For this report, we have included additional housing market indicators—in particular the supply of affordable housing, additional labour market indicators, expanded demographics and also income inequality and climate indicators.

Table 1: Types of structural variables and data items from the international literature

Structural driver	Data items/indicators used	Studies
Housing market	Rental vacancy rates Median rents Rent to income ratio Lowest quality housing available Relative price of substandard housing Homeownership rate Public housing Affordable housing units Availability of subsidised housing Subsidised housing targeted to very poor Presence of rent control Price of undeveloped land The lowest rent needed to occupy a rental unit Vacancy rate of low-cost housing Rents at 10th percentile of all apartments Vacancy rate at 10th percentile of apartments Per cent of renter occupied units renting at $150 or below Housing density (occupants per room) Vacant local authority stock New builds completed by social landlords Private rental sector housing	Quigley & Raphael (2001); Early (1999); Lee, Price-Spratlen & Kanan (2003); Fertig & Reingold (2008); Early & Olsen (2002); Early (2005); Quigley, Raphael & Smolensky (2001); Honig & Filer (1993); Elliot & Krivo (1991); Bohanon (1991); Florida, Mellander & Witte (2012); Kemp, Lynch & MacKay (2001)

Structural driver	Data items/indicators used	Studies
	Social rented sector housing Average house prices Repossessions for mortgage arrears Evictions due to rent arrears	
Labour market	Unemployment rate Low wage jobs Growth in employment Share of employment in service industries Predicted size of low-skill labour market Percentage of persons in unskilled jobs Wage levels Number unemployed for more than six months Manufacturing employment index	Quigley & Raphael (2001); Lee, Price-Spratlen & Kanan (2003); Quigley, Raphael & Smolensky (2001); Honig & Filer (1993); Elliot & Krivo (1991); Bohanon (1991); Florida, Mellander & Witte (2012); Kemp, Lynch & MacKay (2001)
Demographics	Age Gender Household size Race Household composition (single person households, single parent households) Generation Educational attainment Children present in household Fraction of births to teenage mothers	Early (1999); Lee, Price-Spratlen & Kanan (2003);Fertig & Reingold (2008); Early & Olsen (2002); Early (2005); Honig & Filer (1993); Elliot & Krivo (1991); Bohanon (1991); Florida, Mellander & Witte (2012); Kemp, Lynch & MacKay (2001)
Income, poverty and inequality	Equalised household income Real monthly income Median household income Extreme poverty Percentage of very poor Low-income households Percentage of persons below the poverty line Gini coefficient	Quigley & Raphael (2001); Early (1999); Lee, Price-Spratlen & Kanan (2003); Early & Olsen (2002); Quigley, Raphael & Smolensky (2001);Elliot & Krivo (1991); Florida, Mellander & Witte (2012)
Deinstitutionalisation	Spending on mental health hospitals State mental patients per 100 000 State prisoners per 100 000 Per capita expenditure on mental health beds Total state mental health expenditures Number of persons in state homes for the mentally retarded per 1000 Number of correctional and prison workers Number of persons living in psychiatric homes/hospitals Number of prisoners	Early & Olsen (2002); Quigley, Raphael & Smolensky (2001); Honig and Filer (1993); Elliot & Krivo (1991); Bohanon (1991); Florida, Mellander & Witte (2012); Kemp, Lynch & MacKay (2001)
Government payments/allowances	Percentage of persons on federally funded disability payments Households in receipt of payments by payment type	Quigley & Raphael (2001); Lee, Price-Spratlen & Kanan (2003); Early & Olsen

Structural driver	Data items/indicators used	Studies
	Amount of general assistance payments by cost of living Public assistance availability Local government expenditures on public welfare per capita Maximum benefits for family of three	(2002); Early (2005); Suzuki (2008); Honig & Filer (1993); Bohanon (1991);
Crime	Violent crime rate Number of crimes and offences recorded Number of drug related offences	Early (2005); Kemp, Lynch & MacKay (2001)
Climate	January temperature Precipitation Temperature range March temperature Temperature on night of homeless count Average March rainfall Average July temperature	Quigley & Raphael (2001); Early (1999); Lee, Price-Spratlen & Kanan (2003); Fertig & Reingold (2008); Early & Olsen (2002); Quigley, Raphael & Smolensky (2001); Bohanon (1991); Florida, Mellander & Witte (2012);
Homeless services	Availability and quality of homeless shelters Number of shelter beds Shelter beds per poor persons Shelter beds by homeless persons	Early (1999); Fertig & Reingold (2008); Early & Olsen (2002);
Other	Depression scale score Transience—mobility rate and transport access Self-reported health Domestic violence Drug use Alcohol problems/excessive drinking Informal support Anti-homeless laws Political climate (voting liberal vs conservative) Area population Mental health problems in the past year Vietnam veteran Community health care spending Food availability Public medical care Lack of health insurance Foster care exits per 10 000 Children in state care HIV infection rates Percentage of population with disability Discharges from long-stay hospitals	Early (1999); Lee, Price-Spratlen & Kanan (2003); Fertig & Reingold (2008); Early & Olsen (2002); Early (2005); Suzuki (2008); Florida, Mellander & Witte (2012); Kemp, Lynch & MacKay (2001)

Source: Authors review of the international peer reviewed literature

An important point not sufficiently emphasised in our first report concerns the way that homelessness is measured in the international literature.

Most of the international studies reviewed in our first report, and in the table above, are from the US (with one study from Scotland and one from Japan). The US based literature overwhelming uses a literal definition of homelessness. That is, people are deemed to be homeless if they are either rough sleeping or staying in shelters for homeless persons. In contrast, homelessness is defined much more broadly in Australia, with homelessness counts including not only literal homelessness, but also persons forced by housing circumstances to stay temporarily with friends and family, persons staying In other short-term accommodation such as motels and hotels without permanent accommodation, persons living in rooming house accommodation without the security of a lease, and persons living in severely overcrowded dwellings (see Chapter 2, Section 2.3 for details). The structural factors we have highlighted as relevant to homelessness might not be equally important in relation to each of these different measures of homelessness. For example, the cost of private rental housing may impact on severe over-crowding, but not on the number of persons living in rooming houses. This issue is explored in Chapter 5 and Appendix 3 where we report modelling results for alternative measures of homelessness.

1.4 Aims of stage two

Stage two of the project investigates the following research questions:

1. What role do housing market factors play in shaping the rate of homelessness across Australia over time? If housing markets play a role in shaping the rate of homelessness, is it because:
    - → there is a shortage of low-cost rental properties for those on low incomes (the housing shortage hypothesis)? And
    - → people experiencing homelessness gravitate to areas where there is more affordable housing (the sorting hypothesis)?
2. What role do household income and labour market factors (unemployment and income inequality) play in shaping the rate of homelessness across Australia and over time (the poverty hypothesis)?
3. How do these processes affect Indigenous and lone-person households?

1.5 Research approach

The empirical work for this second project is based on a panel dataset spanning 328 local regions across Australia with data available for three census years: 2001, 2006 and 2011. This dataset includes data at the SA3 level from multiple data sources:

- → Homeless estimates from the ABS Census of Population and Housing
- → Time Series Profile dataset from the ABS
- → Climate data from the Bureau of Meteorology (BoM)
- → Housing affordability, availability and suitability (special request) from the ABS Census of Population and Housing
- → Use of ABS remoteness structure and concordances to classify areas as urban or regional to remote.

The data items selected from these sources are used to give both estimates of homelessness across the local regions as well as estimates for a wide range of structural and other variables. Panel modelling techniques are used to interrogate our dataset and explore relationships between structural factors and rates of homelessness across Australia.

1.6 Structure of report

This report comprises six chapters including this Introduction (Chapter 1).

Chapter 2 presents the method. Here we describe the spatial unit and sample design and the definition of homelessness used. We then go on to describe the variables used, their definitions and sources.

Three empirical chapters follow. In Chapter 3 we present decile level descriptives along with correlations to examine both the sorting and shortage hypotheses. That is, we examine whether the homeless are gravitating to areas with a greater supply of affordable private rental housing, and whether there is an adequate supply of affordable private rental housing in these local regions.

In Chapter 4 we present further decile level descriptives and correlations assessing in a preliminary way the relationships between all new structural variables and rates of homelessness. This chapter also examines possible differences in these relationships in urban versus regional areas of Australia and examines the relationships between all structural drivers and the dynamics of homelessness (changes in the rate of homelessness over the decade).

Our third and final empirical chapter (Chapter 5) presents our modelling work. After a discussion of the modelling techniques used, we report Ordinary Least Squares OLS, fixed and random effects models for the national sample of regions using the ABS statistical definition of homelessness. We then report findings using an urban only sample and compare findings from models estimated with two alternative definitions of homelessness.

Chapter 6 concludes the report by outlining ideas that help to make sense of some unexpected findings on the role of structural factors. We then explore the policy significance of the key findings, and make numerous suggestions for next steps in this research space.

2 METHOD

We begin this chapter by explaining the data sources for our key variables, before describing the spatial unit of analysis that defines our sample design. Important parts of the analyses segregate the local regions into urban versus regional areas and so the definitions of urban and regional areas are discussed next. We then outline the definition and measurement of homelessness. Some of this information is repeated from our first report so that the two reports can be read independently of one another.

Next we define each of the structural indicators and explain the rationale for their inclusion. We begin by recounting the rationale for the structural indicators used in our first report and their definitions. We then describe the new set of structural variables and identify their source. We begin first with the housing affordability, availability and suitability measures sourced via special request from the ABS.

We then define additional housing market, labour market and demographic variables extracted from the TSP dataset. Following this, we describe our data items on climate and finally our income inequality measure. Some descriptives, which indicate the typical values and variation for key measures, are included in the body of this section. However, a comprehensive set of descriptive tables can be found in Appendix 1.

2.1 Data sources

Consistent with our first report, we use variables from the following collections:

- Homeless estimates from the ABS Census of Population and Housing (2001, 2006, 2011)
- Time Series Profile dataset from the ABS
- Specialist Homeless Services Collection (special request) from the AIHW

For this second stage of the research we have extracted additional data items from the ABS Time Series Profile dataset, and obtained the following new data items:

- Climate data from the Bureau of Meteorology (BoM)
- Housing affordability, availability and suitability (special request) from the ABS Census of Population and Housing
- ABS remoteness structure and concordances to classify areas as urban or regional to remote.

All data was requested, sourced, or converted to the Statistical Area Level 3 (SA3) level for the years 2001, 2006 and 2011. This spatial unit was selected as it was the smallest spatial unit at which the homeless estimates were reliably available for all of Australia.[2]

2.2 Sample design and spatial unit[3]

The spatial unit of analysis is SA3 which is a spatial unit under the main structure of the Australian Statistical Geography Standard (ASGS). This geography was

[2] Total homeless estimates were available at the SA2 level, but a breakdown by operational groups could not be released for most SA2s. This was due to small numbers in some SA2s giving the potential for individuals or services to be identified. Our advice from the ABS was that the SA3 geography is the lowest level of geography that sufficiently supports estimates of homelessness disaggregated by operational group for all of Australia.

[3] Much of this material is reproduced from our first report and is included here for ease of reference; see Wood et al. (2014), p.21.

developed by the ABS and introduced in 2011 with the aim of reporting all future statistics from its various collections within this framework. The ASGS works from small mesh blocks (similar to collection districts) which aggregate to SA1s, then SA2s through SA3s and SA4s to states and territories, and then to all of Australia.

There are 351 SA3s in Australia, with populations ranging from 30 000 to 130 000 (ABS 2011). Broadly, SA3s are designed to coincide with areas of economic, social and transport activity. In urban areas, SA3s closely align to an area serviced by a major transport and commercial hub. In regional areas they represent the areas serviced by regional cities with populations over 20 000 persons and in outer regional and remote areas SA3s are areas recognised as having a distinct identity, or similar social and economic characteristics (ABS nd1). Finally, some SA3s have no population as they are national parks or large marine areas.

Following the ABS, we refer to SA3s as local regions throughout the report. However, for the sake of brevity we use the term SA3 throughout the method chapter.

Some local regions (SA3s) were excluded from the analysis, specifically; offshore, shipping and migratory areas and areas with populations under 100. Our final sample of 328 local regions (SA3s) across the state and territories, included 89 SA3s in New South Wales, 65 in Victoria, 80 in Queensland, 28 in South Australia, 33 in Western Australia, 15 in Tasmania, 9 in the Northern Territory and 9 in the Australian Capital Territory.

Data from three consecutive census periods (2001, 2006, 2011) has been assembled on all 328 SA3s to form a panel sample of 984 observations. This is the sample used to conduct the panel modelling reported in Chapter 5.

2.2.1 Urban compared with regional areas

We are interested in whether or not the relationship between structural factors and homelessness differs between urban and regional (including remote) areas of Australia. This is important as the US based studies we reviewed typically focused on metropolitan areas only. Appendix 5 of the first report (Wood et al. 2014) presented preliminary analysis in relation to this question. In this report we use the same classification of areas as urban or regional, and estimate separate models for urban areas compared with regional and remote areas of Australia.

Local regions (SA3s)[4] are classified as urban or regional and remote, using the Accessibility/Remoteness Index of Australia (ARIA+) produced by the University of Adelaide (ABS nd2). This index divides Australia up into 1km square blocks. The average distance to service centres via road for all square kilometre blocks is then calculated for each SA1. This gives each SA1 a remoteness score on a scale of 0–5 based on this average distance; 0 is Major cities of Australia, 1 is Inner Regional, 2 is Outer Regional, 3 is Remote Australia and 4 is Very Remote Australia. 5 is classified as offshore shipping and migratory areas (ABS nd2).

To assign larger spatial units to a remoteness category, the ABS has produced correspondences which detail the percentage of each SA3 in each of the aforementioned categories. Using this correspondence file, we assigned remoteness categories to SA3s based on where the majority of that SA3 was classified. For example, 82.7 per cent of the SA3 of Coffs Harbour was classified as being Inner Regional, while 17.3 per cent was classified as being in Outer Regional. Given that the majority of this SA3 was classified as Inner Regional, the SA3 was classified as

[4] Much of this material is reproduced from our first report and is included here for ease of reference. See Wood et al. (2014), Appendix 5, pp.84–86.

being in an Inner Regional. We then grouped SA3s which were classified as being Major cities into the urban category. The remainder of SA3s that were majority Inner Regional, Outer Regional, Remote and Very Remote, we refer to as regional and remote. We excluded offshore shipping and migratory areas,

Of the 328 SA3s (local regions), we classified 263 urban, and the remaining 65 as regional and remote.

2.3 Definition and measurement of homelessness[5]

For the present study, homelessness has been defined using the statistical definition developed by the ABS. This definition emphasises the 'home' in homelessness; home encompasses a sense of security, stability, privacy, safety and the ability to control one's living space (Mallett 2004). Homelessness is a loss of one or more of these elements and not just about 'rooflessness'.

The ABS (2012c) defines someone as homeless if they do not have suitable alternative accommodation and their current living arrangement:

- is in a dwelling that is inadequate, or
- has no tenure or their initial tenure is short and not extendable,[6] or
- does not allow them to have control of, and access to space for social relations.

In order to estimate those persons experiencing homelessness in the census, the ABS has operationalised this definition by flagging six key operational groups based on living situation:[7]

- People in improvised dwellings, tents or sleeping out (rough sleeping) (operational group 1).
- People in supported accommodation (includes shelters) for the homeless, or in transitional housing (operational group 2).
- People staying temporarily with other households (including with friends and family) (operational group 3).
- People staying in boarding houses (operational group 4).
- People in other temporary lodging (operational group 5).
- People living in severely overcrowded conditions (according to the Canadian National Occupancy Standard)[8] (operational group 6).

Homeless estimates for each SA3 geographical unit were provided by the ABS in response to a special request, as homeless estimates for all of the last three census years were not publicly available when the project commenced. These estimates are

[5] Much of this material is reproduced from our first report and is included here for ease of reference. See Wood et al. (2014), p.20.

[6] Here tenure means legal right to occupy a dwelling—such as holding the title or having a lease. It also includes familial security of tenure such as children living with their parents.

[7] People who live with the constant threat of violence (i.e. family violence) or in dwellings with major structural problems are also considered homeless, but cannot be enumerated with census data. People who are living long-term in caravan parks and those who are in crowded but not severely overcrowded dwellings are considered to be marginally housed and 'at risk' of homelessness, but are not considered homeless under the statistical definition.

[8] The Canadian National Occupancy Standard specifies that no more than two persons should share a room with specific clauses about the age and gender of the occupants and couples. Under the standard a dwelling is considered severely overcrowded if four or more bedrooms are needed to accommodate the residents. See ABS (2012b), p.92 for more detailed information.

derived from the Census of Population and Housing, which occurs every five years, using a complex enumeration strategy (for a detailed description, see ABS 2012b)[9].

Homeless estimates for 2001 and 2006 had been collected under an older geographical system. In response to our request, the ABS brought forward its plans to convert these homeless estimates to its new geographical structure (the ASGS). This enabled our homeless counts to be generated using a consistent methodology and a panel of spatial units that is uniformly defined over the study period (2001–11).

The homeless counts have been transformed into per 10 000 population measures in each census year, and aggregate homeless estimates have been broken down by operational group. We also calculated the percentage change in homeless rates between 2001 and 2011.

However, some operational group totals were suppressed at the local region (SA3) level for confidentiality reasons. Furthermore, counts of persons staying in supported accommodation (operational group 2) were not available for 2001 and needed to be imputed (see Wood et al. 2014, p.28 for a detailed description of the imputation process).

Descriptives for these items are reported in Appendix 1.

Because the way homelessness is defined and counted could substantially impact on our findings, while we focus on the ABS definition, in Chapter 5 (and Appendix 3) of this report we also repeat our modelling exercise for two additional definitions of homelessness: the cultural and literal definitions. These definitions were also applied in the descriptive analysis reported in Appendix 4 in our first report (see Wood et al. 2014, pp.82–83) and are described in more detail below.

Prior to the ABS systematic review of the counting the homeless collection, the cultural definition of homelessness was used in generating counts of Australia's homeless population. This definition is based on minimum community expectations of housing. Chamberlain and McKenzie (1992) assert that in Australia the minimum community standard for housing is a one-bedroom flat with a freestanding kitchen and bathroom. People are considered homeless if their accommodation falls below this standard. Within this definition, Chamberlain and McKenzie (1992) identified three different types of homelessness: primary homelessness, secondary homelessness and tertiary homelessness.

- *Primary homelessness* is being without conventional shelter. It includes: living on the streets, in abandoned buildings, under bridges, in cars or in improvised dwellings.
- *Secondary homelessness* involves moving between different types of temporary shelter. It includes: staying with friends or family, staying in emergency homeless accommodation or refuges and cheap hotels. It also includes people staying temporarily in boarding houses for less than 12 weeks.
- *Tertiary homelessness* involves being housed, but below community standards. Specifically, it refers to living in a single room in a boarding house without a private bathroom, kitchen or the security of a lease, for 13 weeks or longer.

These authors identify some exceptions to this definition. For example, students living in halls of residence and elderly people living in nursing homes are living in conditions

[9] Much of this material is reproduced from our first report and is included here for ease of reference. A more detailed discussion can be found in Wood et al. 2014, pp.21–24.

similar to those in boarding houses long-term. However, culturally, they are excluded as they are not considered homeless.

The operationalisation of the cultural definition for generating counts based on the census, used five of the six operational groups defined by the ABS—with severe overcrowding being excluded. While some changes to counting rules were made by the ABS in their review, we operationalised this definition by simply excluding the severe overcrowding category from the total homeless count supplied by the ABS.

As mentioned in the introduction, the vast majority of the international literature that informs this study is from the US and is based on a literal definition of homelessness. That is, people are considered homeless if they are currently sleeping rough or staying in shelters for the homeless. For our study, this definition was operationalised by simply summing the two relevant operational groups—those sleeping rough and those staying in supported accommodation for the homeless.

2.4 Structural drivers of homelessness

International literature investigating the structural drivers of homelessness, has investigated a range of possible structural drivers, including housing markets, labour markets, demographics, income poverty and inequality, deinstitutionalisation, government payments and income support, crime, climate, and availability of homeless services. Key data items used across the literature for each of these structural drivers are summarised in Table 1 in the introduction.[10] While we selected some preliminary structural indicators for use in the analysis presented in the first report, additional time and information derived from a further survey of the literature have prompted us to include additional indicators in this second report. Below we report on the indicators used in our first report before detailing the additional indicators sourced for this report.

2.4.1 Housing market, labour market and demographic indicators used in report 1

Based on international literature, we investigated a number of demographic indictors, housing market indicators and labour market and income indicators in our first report. For demographic indicators we focused on the percentage of Indigenous persons in an area, the percentage of lone-person households, and household size. These first two indicators were selected given their significance in Batterham's (2012) study.

Housing market indicators included median rents, public housing as a percentage of all private dwellings, dwellings being rented through real estate agents and rent-to-income ratios. Median rents and rent-to-income ratios were selected given their prominent use in the international literature. The percentage of dwellings rented through real estate agents and public housing as a percentage of all dwellings were also used as crude measures of the availability of low-cost housing options. The median rent and rent-to-income ratios give some idea of whether rental housing is cheap or expensive in an area.

Both household income and the unemployment rate were selected for inclusion as empirical studies of homelessness commonly employ them as indicators of poverty and labour market conditions. The variables used in our first report are summarised in Table 2 below with basic descriptives for each of these variables given in Appendix 1.

The demographic variables selected in our first report were chosen for consistency with Batterham (2012). In terms of ethnicity, Indigenous persons are much more likely

[10] For a thorough discussion in the context of a comprehensive literature review see Wood et al. 2014 pp.8–20.

to experience homelessness than the general population, and so the size of the Indigenous population in a region has been included. In terms of household type, lone-person households were identified by Batterham (2012), the Australian Specialist Homeless Services Collection (SHSC) data (AIHW 2012a) and International literature (see e.g. Lee et al. 2003) as potentially being at higher risk of homelessness. Household size was also identified in the international literature as being of potential relevance (see, e.g. Early 1999). A local region with a disproportionately high share of a vulnerable demographic group can be expected to have higher point prevalence measures of homelessness, all else being equal.

Table 2: Structural indicator variables from Report 1 and their definitions[11]

Variable	Definition
Housing market indicators	
Median rent	Median weekly household rent for households enumerated in SA3 *i* on census night in Year *X*
Public housing	Percentage of total occupied private dwellings within SA3 *i* on census night renting from a State Housing Authority in Year *X*
Dwellings being rented by real estate agents	Percentage of total occupied private dwellings within SA3 *i* on census night renting from a Real Estate Agent in Year *X*
Rent-to-income ratio	Ratio of median weekly household rent to median total household income weekly, by Year *X*
Labour market indicators	
Unemployment rate	Percentage of total unemployed persons enumerated within SA3 *i* on census night in Year *X*
Median household income	Median total household weekly income for households enumerated within SA3 *i* on census night in Year *X*
f	
Indigenous people	Percentage of total Indigenous persons enumerated within SA3 *i* on census night in Year *X*
Lone-person households	Percentage of lone-person households enumerated within SA3 *i* on census night in Year *X*
Household size	Mean household size for households enumerated within SA3 *i* on census night in Year *X*

Our first report presents preliminary findings in relation to only three different structural drivers (housing markets, labour markets and demographics) and some of these in a limited way. In this second report we have broadened the variables examined for each of these structural drivers to include additional housing market variables:

- → the supply of affordable and available private rental stock
- → dwelling suitability (in terms of number of bedrooms)
- → dwelling structure
- → Tenure type.

[11] These indicators were all extracted from the Time Series Profile (TSP) data-set, which is derived from the ABS Census of Population and Housing. This data-set includes information about persons, dwellings, household type, income and educational attainment. This data is based on place of enumeration on census night and includes data for 2001, 2006 and 2011 at multiple geographic levels and is freely available.

Additional demographic variables (for use as controls):

- age in three bands
- gender
- marital status
- household type
- educational attainment.

Additional labour market variables:

- Labour force status (including working full-time and part-time and being outside the labour force).
- Unskilled work.

These measures and the rationale for their use are described below.

2.4.2 Housing affordability, availability, and suitability data from the ABS

In an earlier study, Batterham (2012) found that homelessness was concentrated in areas with relatively large supplies of low-cost private rental housing. She argues that this could be due to high demand for low-cost housing in these areas from low-income households resulting in a relative shortage (the shortage hypothesis). The pressure on low-cost housing stock can be intense in areas with abundant private rental housing because this is where low-income households live. This explanation draws on the work of Wulff et al. (2011) who examined the match between the supply of and demand for low-cost private rental housing from low-income households across Australia.

To examine this, we obtained data from the ABS that gives a sense of the match between supplies of affordable and available private rental housing in a region, and the demand from low-income private renters. Using this data we constructed a range of variables that measure the demand for and supply of low-cost private rental housing, the overall supply of low-cost rental stock, and suitability measures based on dwelling size. The variable definitions are similar to those used in Wullf et al. (2011) and each are discussed in turn.

Affordability and availability of private rental stock

For each year and SA3, the ABS provided us with the following information:

The number of private rental households in each SA3 with incomes less than or equal to the 40th percentile of the national income distribution *of all private rental households* (H_i^L)

At the 40th income percentile, we asked the ABS to compute 30 per cent of this income as the upper threshold for affordable rents (R_i)

The ABS then estimated the number of private rental dwellings in each SA3 that had rents less than this affordable rent threshold (D_i).

Using this information we computed a *gross supply measure* (GS_i) using the following formula:

$$GS_i = D_i - H_i^L \qquad 2.1$$

That is, we subtracted the number of low-income households from the number of private rental dwellings deemed affordable to this group. A positive value signals an adequate supply, while a negative value indicates a shortage of affordable rental

housing. To enable the calculation of affordable rental housing that is available for low-income households, the ABS also provided us with:

- The number of private renter households with incomes above the 40th percentile paying rents below the affordable rent threshold in each SA3—that is the number of higher income households occupying affordable private rental stock ($\mathrm{H_i^E}$).

To calculate available supply what we refer to as a *net supply measure* (NS_i)—we use the following formula:

$$NS_i = D_i - H_i^L - H_i^E \qquad 2.2$$

That is, we subtract the number of higher income households renting affordable private rental dwellings from the gross supply (GSi) measure. The resulting balance indicates the adequacy (or shortage) of affordable rental housing once occupation of this affordable stock by higher income households is taken into account.

We also computed a relative measure of both gross and net supply. To obtain a *relative measure of the gross supply* we used the following formula:

$$RGS_i = \frac{GS_i}{H_i^L} \times 100 \qquad 2.3$$

That is, we divided the gross supply by the number of low-income private renter households in each SA3 and then multiplied by 100. To illustrate, suppose the calculation yields a negative 20 per cent estimate; this estimate shows that 20 per cent of low-income private renters miss-out on affordable housing in that area; in the case of a positive 20 per cent figure, at least 20 per cent of the supply of affordable private rental housing will be seeking tenants from income groups above the 40th percentile.

To calculate a *relative net supply measure*, we followed a similar procedure, dividing the net supply by the number of low-income private renter households in each SA3 and then multiplying by 100.

$$RNS_I = \frac{NS_i}{H_i^L} \times 100 \qquad 2.4$$

The base data that the ABS supplied differs from the Wulff et al. (2011) study in a number of important ways that are summarised in Table 3 below.

Table 3: Key differences in the calculation of housing affordability variables for low-income households

Methodological difference	Wulff et al. (2011)	This study
Imputation of missing income and rent values	Yes, complex imputation process	No imputation conducted, missing values excluded
Income quintiles	Calculated using all households nationally	Calculated using only private renter households. Two methods—national income quintiles and capital city/balance of state
Disaggregation of quintile 1 and 2	Yes	No, bottom two quintiles aggregated
Households reporting negative income	Excluded	Included

Wulff et al. followed complex imputation procedures to impute missing values for cases where there was incomplete household income, dwelling structure and rent information (see Appendix 1 of Wulff et al. 2009). However, based on conversations

with key staff at the ABS, we decided to simply exclude households or dwellings with missing information.[12]

Unlike Wulff et al. (2011), we generated income quintiles for private rental households only, and include negative income households in the lowest income quintile. Our rationale here is that the incomes of private renters is a more relevant guide to what is affordable rental housing; the incomes of home owners, and especially outright owners who are never likely to demand rental housing in the future, are not pertinent. Negative incomes are a possible outcome in extreme circumstances (e.g. business failure, or very low earnings combined with losses on financial investments), but could be due to erroneous recording of income information. We have erred on the side of inclusion; these people are likely to be most reliant on access to affordable housing.

We also employed two strategies for deriving income quintiles. The first method follows Wulff et al. (2011) and uses national income quintiles (but for private renter households only). The second method, which was suggested by the ABS, calculated state-based income quintiles separately for capital cities and balance of state. This second approach acknowledges that households in capital cities tend to have higher incomes and are able to pay higher rents than those in non-capital city areas. This assumption is confirmed in the tables defining the 2011 income ranges for each income quintile in Appendix 2.

The relative supply of low-cost housing

To determine the supply of low-cost housing we have trialed another measure that we call the relative supply of low-cost housing. This measure factors in the supply of other low-cost housing options available from housing cooperatives, community and church groups as well as public housing. This is important in understanding the adequacy of the supply of low-cost rental housing since low-income households could also be eligible for these other types of rental housing. By ignoring them we could be exaggerating shortages of affordable rental housing.

This measure is derived using the equation below:

$$\frac{D_i - H_i^L - H_i^E}{D_i + HC_i + PH_i} \times 100 \qquad 2.5$$

The numerator in this equation is equivalent to our net supply measure (NS_i). The denominator is the supply of low-cost housing, where D_i is still the number of private rental properties affordable to private renters in the bottom two income quintiles of the income distribution, HC_i is the number of dwellings being rented through housing cooperatives, community and church groups, while PH_i is the number of public housing dwellings.

Dwelling suitability—number of bedrooms

We also examine the suitability of the affordable stock from the perspective of space and household size. The ABS provided us with data for the 2011 year showing the number of low-income private renter households in each SA3, and the number of

[12] In conversation with staff at the ABS we decided against imputing missing values for rents and incomes as doing so would have added significant complexity and time to our data request with only marginal, if any, improvements to the quality of the data. This was particularly the case for the income data which is collected in ranges only. See the following fact sheet for sense of the issues with census household income data: http://www.abs.gov.au/websitedbs/censushome.nsf/home/factsheetsuid?opendocument&navpos=450.

bedrooms they require according to the Canadian National Occupancy Standard,[13] They also supplied data that showed the number of private rental properties of different size (none—e.g. a studio; one, two, three or four or more bedrooms) that are affordable to low-income households in each region.

While the match between household size and number of bedrooms is only one aspect of suitability, it is an important one given the prominence of the severe overcrowding category in the overall homeless population. Consistent with our analysis of the supply and demand for affordable private rental housing, we calculated a variable for each SA3 gauging the balance between the supply of dwellings of a different size and demand. We use the following formula:

$$\frac{DX_i - HX_i^L}{HX_i^L} \times 100 \qquad 2.6$$

Where DX_i is the supply of low-cost private rental housing in SA3i with X number of bedrooms and HX_i^L is the number of low-income private renter households who require low-cost private rental housing in SA3i with X number of bedrooms. X ranges from zero/one for one bedroom and bedsit or studio apartments to four or more.

There is a surplus of low-cost X bedroom stock in SA3i if the value is positive, and a shortage of low-cost X bedroom stock in SA3i if the value is negative. When there is a shortage, this measure tells us the percentage of households requiring low-cost housing who miss out in a given area. Descriptives for each of these variables are listed below in Table 4.

Table 4: Key descriptives for housing affordability, availability and suitability variables: 2001, 2006 and 2011

Variable	N	Mean	Std. Dev	Median	Min	Max
Using national income quintiles						
2001 relative gross supply	327	56.0	49.0	63.9	-71.5	253.6
2006 relative gross supply	328	29.4	57.7	35.3	-82.5	572.7
2011 relative gross supply	328	5.5	55.0	6.2	-81.6	626.7
2001 relative net supply	327	-11.1	28.1	-2.7	-86.9	68.5
2006 relative net supply	328	-23.5	28.7	-17.9	-88.6	46.7
2011 relative net supply	328	-34.7	27.9	-33.2	-87.9	20.0
Supply of low-cost one-bed dwellings (2011)	328	-74.1	20.6	-80.9	-96.3	37.5
Supply of low-cost two-bed dwellings (2011)	326	49.4	81.5	49.2	-88.1	500.0
Supply of low-cost three-bed dwellings (2011)	326	225.7	248.1	153.1	-80.9	1966.7
Supply of low-cost four or more bed dwellings (2011)	323	289.5	362.8	152.6	-78.0	2342.9
Supply of low-cost total dwellings (2011)	328	5.8	58.9	6.5	-81.6	738.5

[13] The Canadian National Occupancy Standard specifies that no more than two persons should share a room—with specific clauses about the age and gender of the occupants and couples. See ABS (2012b, p.92) for more detailed information.

Variable	N	Mean	Std. Dev	Median	Min	Max
Alternative low-cost housing supply measure 2001	328	-9.4	23.5	-0.9	-142.3	12.7
Alternative low-cost housing supply measure 2006	328	-21.2	34.0	-8.8	-193.1	7.1
Alternative low-cost housing supply measure 2011	328	-20.3	30.4	-9.2	-146.3	7.0
Using capital city, balance of state income quintiles						
2001 relative gross supply	328	57.9	46.9	62.4	-65.3	216.7
2006 relative gross supply	328	38.9	52.8	43.0	-82.4	457.1
2011 relative gross supply	328	8.2	41.1	9.5	-84.4	216.7
2001 relative net supply	328	-12.2	23.6	-8.6	-100.0	56.6
2006 relative net supply	328	-20.2	24.1	-16.0	-87.5	41.5
2011 relative net supply	328	-33.0	22.5	-31.8	-87.8	27.3
Supply of low-cost one-bed dwellings (2011)	328	-73.9	20.1	-80.6	-96.3	12.1
Supply of low-cost two-bed dwellings (2011)	327	61.9	92.0	47.3	-92.0	546.4
Supply of low-cost three-bed dwellings (2011)	325	230.8	222.2	225.2	-73.6	1453.3
Supply of low-cost four or more bed dwellings (2011)	322	306.5	364.0	181.1	-75.9	1920.0
Supply of low-cost total dwellings (2011)	328	8.2	41.4	9.7	-84.4	242.4
Alternative low-cost housing supply measure 2001	328	-6.2	15.9	-1.0	-98.0	13.2
Alternative low-cost housing supply measure 2006	328	-15.6	25.1	-7.7	-174.6	7.8
Alternative low-cost housing supply measure 2011	328	-16.7	26.3	-7.8	-161.9	7.5

Source: Authors calculations using ABS special request data

Examination of the median values for both the relative gross and relative net supply measures in Table 4 shows a worsening of supply across the decade. This is the case whether we look at the national or capital city and balance of state income quintiles. For example, the relative gross supply measure using national income quintiles shows a surplus of affordable private rental housing relative to demand from low-income private renter households of 63.9 per cent in 2001. However, this surplus contracted to 35.34 per cent in 2006 and then to just 6.21 per cent in 2011. A similar story is evident looking at the relative net supply measure—however, it shows a shortage relative to demand in all years. While the pattern is much less dramatic using our alternative low-cost housing supply measure, a shortage is still evident in each year and the shortage does worsen over the study timeframe.

When looking at the suitability of dwellings in terms of size, it is evident that there is an acute undersupply of affordable one-bedroom dwellings relative to demand nationally. And while some areas experience a shortage of dwellings of other sizes, overall there is a surplus of affordable private rental stock of two or more bedrooms.

2.4.3 *Additional housing market variables, labour market variables, and demographic variables*

We have also added a suite of housing market variables to represent dwelling type and tenure. Dwelling type includes categories for the percentage of dwellings classified as: separate houses; semi-detached row or terrace house, townhouses, etc.; flat, unit or apartments; and other dwelling types. Tenure includes dwellings that are: owned outright; owned with a mortgage; rented through a real estate agent; rented from state housing authorities; rented from person not in same household; rented through housing cooperative, community group or church group; rented through other landlord type; and other tenure type.[14]

We have added additional variables to act as controls in our modelling, including age, gender, marital status, household type and educational attainment. These variables have been selected based on the international literature review (see Table 1 Types of structural variables and data items from the international literature in Section 1.3, and, e.g. Early 1999; Lee et al. 2003; Fertig & Reingold 2008). Our age variables include the percentage of a region's population aged 15 to 34 years, 35 to 64 years and 65 years and over. Gender is simply represented by the percentage of persons in a region identifying as male or female. Marital status variables include the percentage of persons who are married, separated, divorced, widowed and never married. In terms of household type, we include measures of the percentage of households who are couples with no children, couples with children, one-parent family, other family type, lone-person household, group household, and other household type. Finally, in terms of educational attainment we selected variables for non-school qualification level. These variables include the percentage of persons with a: post-graduate degree, Graduate Diploma and Graduate Certificate, Bachelor degree, Advanced Diploma and Diploma, or Certificate level non-school qualification.

We have experimented with two additional sets of labour market variables in the second stage of this project—labour force status and unskilled work. Labour force status is represented by the percentage of persons employed full-time, employed part-time, employed but away from work, unemployed, and not in the labour force (unemployment rates were used in Quigley & Raphael 2001; Lee et al. 2003; Elliot & Krivo 1991).

Elliot and Krivo (1991) and Honig and Filer (1993) also investigated the size of the workforce employed in unskilled work in relation to rates of homelessness. To capture unskilled work, we followed the ABS in classifying those in occupations classified as labourer in the unskilled category. Labourer occupations include: cleaners, laundry workers, farm and forestry workers, freight handlers, food preparation assistants, factory process workers and construction and mining workers.[15]

In the US literature, government payments and allowances are frequently added to models because the rules governing eligibility and entitlement to welfare programs vary across state boundaries. There is an expectation in these models that some individuals who are vulnerable to homelessness will move across state boundaries as they 'shop' for welfare payments. In Australia, the means tests determining eligibility and entitlements are federally administered and therefore uniform across the nation. In view of this uniformity, we have not emulated the US approach in this respect.

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[14] See Section 1.3, Table 1 which details the data items used for all structural drivers and the studies using them.

[15] Please see: http://www.abs.gov.au/websitedbs/censushome.nsf/home/CO-65#occupation and http://www.abs.gov.au/AUSSTATS/abs@.nsf/66f306f503e529a5ca25697e0017661f/EE68E3853C83C243CA25697E00184E01?opendocument.

These variables are defined in Table 5 below. Descriptive statistics can be found in Appendix 1.

Table 5: Additional structural indicator variables from the TSP dataset, their definitions, data source and unit of measurement

Additional demographic variables	
Variable	**Definition**
Age in three bands	Percentage of persons in age group *X* of total persons enumerated within SA3 *i* on census night in Year *X* Where age groups include 15–34 years, 35–64 years and 65 and over.
Gender	Percentage of persons identifying as male or female enumerated within SA3 *i* on census night in Year *X*
Marital status	Percentage of persons of marital status *X* enumerated within SA3 *i* on census night in Year *X* Where marital status includes married, separated, divorced, widowed and never married.
Household type	Percentage of households who identified as 'type *X*' enumerated within SA3 *i* on census night in Year *X* Where household types include: couples with no children, couples with children, one-parent family, other family type, lone-person household, group household, other household type.
Additional educational attainment	
Non-school qualifications	Percentage of persons with non-school qualification *X* enumerated within SA3 *i* on census night in Year *X* Where non-school qualification includes: post-graduate degree, Graduate Diploma and Graduate Certificate, Bachelor degree, Advanced Diploma and Diploma, Certificate.
Additional housing market variables	
Dwelling structure	Percentage of total occupied private dwellings of structure type *X* enumerated within SA3 *i* on census night in year *X*. Where dwelling structure includes: separate house, Semi-detached row or terrace house townhouse, etc., Flat, unit or apartment, and other dwelling type
Tenure type	Percentage of total occupied private dwellings of tenure type *X* enumerated within SA3 *i* on census night in year *X.* Where tenure type includes: owned outright, owned with a mortgage, rented through a real estate agent, rented social housing (includes the sum of rentals from state housing authorities and through housing cooperative, community group or church group), rented from person not in same household, and rented through other land lord type.
Additional labour market indicators	
Labour force status	Percentage of persons of labour force status *X* enumerated within SA3 *i* on census night in Year *X* Where labour force status includes: employed full-time, employed part-time, employed but away from work, unemployed, not in the labour force
Unskilled work	Percentage of persons giving their occupation as labourers within SA3 *i* on census night in Year *X*

2.4.4 Climate data—Bureau of Meteorology

A number of US studies found that areas with milder climates (i.e. warmer winters and/or lower rainfall) had higher homelessness rates (See Quigley & Raphael 2001; Early 1999, 2005; Fertig & Reingold 2008; Florida et al. 2012; Lee et al. 2003) These findings prompted us to add climate indicators in our modelling.

We obtained climate data from the Bureau of Meteorology via special request to the climate data services team.[16] They provided us with 2006 average monthly minimum and maximum temperatures in degrees Celsius for all weather stations across Australia, as well as the exact longitude and latitude for each weather station. Data was obtained for 2006 as an indication of the climate in the local regions.

Using the GIS software Map info, and longitudes and latitudes, we assigned each weather station to an SA3. In total, there were 809 weather stations across Australia. In 79 SA3s there was only one weather station and so assignment was straightforward. However, in 115 SA3s there was more than one weather station, and in 134 SA3s there was no weather station.

In local regions, where multiple weather stations were present, we took the average temperatures from the weather stations in that region. In local regions where no SA3 was present, we used GIS software to calculate the distance to the nearest weather station. We then assigned the weather data from the nearest weather station to this SA3. For example, in the Illawarra region of New South Wales the SA3 Dapto–Port Kembla had no weather station present. The nearest weather station was in Kiama Shellharbour which was 2 kilometres from the border with Dapto–Port Kembla. We assigned the weather data from Kiama Shellharbour to Dapto–Port-Kembla.

Once we had designated weather data for each SA3, we selected two variables and generated two more for use in modelling:

- The mean maximum temperature in January.
- The mean minimum temperature in July.
- The average minimum temperature for the three winter months (June, July, August).
- Climate variability—the difference between the mean maximum January temperature and the mean minimum July temperature.

These variables are summarised in Table 6 below, with descriptives reported in Appendix 1.

[16] http://www.bom.gov.au/climate/data-services/.

Table 6: Climate variables and their definitions

Climate indicators	
Variable	**Definition**
The mean maximum temperature in January	The mean maximum daily temperature in January within SA3 *i* in 2006
The mean minimum temperature in July	The mean minimum daily temperature in July within SA3 *i* in 2006
The average minimum temperature for the three winter months (June, July, August)	The average minimum daily temperature for June, July and August within SA3 *i* in 2006
Climate variability	The difference between the mean maximum January temperature and the mean minimum July temperature within SA3 *i* in 2006

2.4.5 Income inequality—Gini coefficients

According to Toro et al. (2007), differences in homelessness between local regions may be explained by the degree of income inequality. The authors hypothesise that in areas where there is a marked discrepancy between the rich and the poor, the latter may be displaced from the housing market as higher income earners drive up the cost of housing. We account for this 'crowding-out' effect by including a Gini coefficient in our model specifications. The Gini coefficient is a widely-used statistical measure of the inequality of income distribution among a nation or region's residents. It plots the share of households in a region (SA3) against the cumulative share of income. It takes a value between 0 and 1 and is the fraction of total income within a region (or country) that would need to be redistributed from high-income households to low-income households in order to achieve perfect equality. Values closer to unity therefore indicate greater income inequality, while values closer to zero signal more equal distributions of income.

We estimate Gini coefficients (G) for each SA3 using the Total Family Income (weekly)[17] grouped data made available in the ABS's Time Series Profile data tables. The Total Family Income data reports frequencies on the number of family households receiving income in 10 mutually exclusive income ranges.[18] We apply the modified Milanovic 94 formula which allows for the calculation of G on grouped data (Abounoori & McCloughan 2003). The modified Milanovic 94 formula can be expressed as follows:

$$G = C \sum_{k=1}^{K} w_k \left(1 - \frac{\overline{y_k}}{\bar{y}}\right) \qquad 2.8$$

[17] Total family income was used rather than household incomes because the household income variable is based on the number of occupied private dwellings being rented and we did not want to restrict analysis to renter households.

[18] Like Cowell (1977) and Abounoori and McCloughan (2003), we excluded family households that received negative incomes from our analysis. We also omitted those households who did not state their income range.

Where *k* denotes the number of income groups, ($\overline{y_k}$) denotes mean income for income group *k* in each SA3,[19] $\bar{y}$ denotes the SA3 population mean income[20] and w_k the weights corresponding to each income group.

$$C = \frac{2}{n(n+1)} \qquad 2.9$$

n denotes the number of families in each. Weights for each income group, w_K, are computed as follows:

$$w_K = \frac{1}{2}\left\{\sum_{k=k}^{K} n_k \left(\sum_{k=k}^{K} n_k + 1\right) - \sum_{k=k+1}^{K} n_k \left(\sum_{k=k+1}^{K} n_k + 1\right)\right\} \qquad 2.10$$

Table 7 below presents some initial descriptive analyses on the trends in income inequality in Australia across the three data years and its relationship with homelessness rates in the corresponding years. The Gini coefficient closely tracks the national homelessness rate—falling between 2001 and 2006 with reductions in homelessness, and then rebounding back close to those at the beginning of the decade.

Table 7: Median Gini coefficient and homelessness rates per 10 000, years 2001–11

Year	2001	2006	2011	National median
Gini coefficient	0.3330	0.3287	0.3392	0.3325
Homelessness rates	31.5	26.8	31.3	29.9[21]

Source: Authors' calculations based on ABS TSP datatset

[19] This was not directly available from the Total Family Income ranges and was therefore derived by computing the mid-point between the maximum and minimum income range for each income group.

[20] Population mean income, $\bar{y}$, was derived using the method of first moments, where $\bar{y}=(y_1 + y_2 + \cdots + y_n)/n$. See Wooldridge (2001, p.87) for a discussion on the application of the method of moments.

[21] These median rates of homelessness are the median rate across SA3s and so differ from the overall national rate of homelessness report by the ABS (see ABS 2012b).

3 HOW IS THE SUPPLY OF AFFORDABLE HOUSING RELATED TO RATES OF HOMELESSNESS ACROSS AUSTRALIA?

3.1 Introduction

This chapter presents a descriptive analysis of our new measures for the supply of affordable housing and explores their relationship to rates of homelessness. This is a preliminary descriptive look at two of our research questions: Is homelessness higher in areas with a shortage of affordable housing for low-income households (shortage effect)? And, do people experiencing homelessness gravitate to areas with a more abundant supply of affordable housing (sorting effect)? We theorise that both a sorting effect and a shortage effect might coexist and work together to explain our earlier descriptive findings (see Wood et al. 2014)—that is, some people experiencing homelessness may gravitate to areas with cheaper and more abundant private rental housing. Regions with shortages of affordable housing displace many of the homeless, pushing them into regions with better supplies of affordable housing. But, because there are a range of factors precipitating homelessness, the regions attracting these marginal groups experience higher per capita rates of homelessness simply because of their high and increasing concentration in regions with more affordable housing opportunities.

The first of these research questions is addressed using cross tabulations and measures of correlation. We conduct two types of indirect tests to assess the second research question.

As previously noted, this report examines a number of additional measures of the adequacy of the supply of affordable rental housing in a region (for details see Chapter 2, Section 2.4.2). These measures include:

- relative gross supply of private rental housing
- relative net supply of private rental hosing
- alternative low-cost housing supply measure
- supply of suitable private rental dwellings.

Each of these variables is defined in detail in Chapter 2. However, for ease of reference we summarise them briefly below.

The *relative gross supply of affordable private rental housing* (hereon relative gross supply) indicates the match between the number of low-income households in a region and the number of low-cost private rental properties in that region, as a percentage of all the low-income households in that region.

A positive value indicates an adequate supply of stock relative to demand, while a negative value indicates a shortage relative to demand. Where there is a negative value, this variable can be interpreted as saying that *X* per cent of low-income households miss out on affordable housing. In contrast, a positive value indicates that affordable private rental housing is oversupplied by *X* per cent relative to demand from low-income households.

The *relative net supply of affordable private rental housing* (hereon relative net supply) indicates the match between the number of low-income households and low-cost private rental dwellings after occupation of the low-cost stock by higher income groups is accounted for. It is also calculated as a percentage of low-income households. Its

interpretation is similar to the relative gross supply measure. A positive value signals an adequate supply, while a negative value signals a shortage.

We have developed a specific *alternative low-cost housing supply measure* to take into account public housing and low-cost rentals supplied by housing cooperatives, community groups and churches. Simply put, this measure expresses the relative net supply of affordable private rental housing in a region as a percentage of the low-cost housing options in that region (including affordable private rental stock, public housing and housing rented through housing cooperatives, community and church groups).

Finally, we also have a measure of the suitability of low-cost private rental stock in a region. This measure assesses the match between the number of low-income households who require a dwelling that meets minimum space standards (measured according to number of bedrooms) and the number of private rental dwellings of that size that are affordable to those low-income households

3.2 How is homelessness related to the supply of affordable rental housing? An examination of the shortage hypothesis

We begin by reporting decile level descriptives for the relative gross and relative net supply measures for each year. We generate results using two different definitions of income quintiles. The first bases quintiles on gross household income for all private renter households across Australia. The second uses household incomes from private renter households in capital cities and balance of states. The results using national income quintiles are shown below, while tables using the capital city balance of state methods are shown in Appendix 2. While the capital city and balance of state method was slightly more sensitive, there were no substantive differences in results using these two different methods.

Table 8 below cross tabulates relative gross and relative net supply measures across deciles formed by grouping local regions into 10 equal-sized groups ranked from lowest to highest in terms of per capita rates of homelessness. Cross tabulations are reported for each of the three census years. In each decile we report the median rate of homelessness, along with the median relative gross and relative net supply measures for each year.

Table 8: Median relative gross and relative net supply measures by the rate of homelessness per 10 000 persons for 2001, 2006 and 2011

Decile	Rate of homelessness per 10 000, 2001	2001 relative gross supply %	2001 relative net supply %	Rate of homelessness per 10 000 2006	2006 relative gross supply %	2006 relative net supply %	Rate of homelessness per 10 000, 2011	2011 relative gross supply %	2011 relative net supply %
1	14.2	50.1	-23.1	10.6	-16.5	-51.0	11.8	-33.7	-59.6
2	17.9	56.0	-17.5	15.7	20.8	-28.5	16.2	-9.8	-47.7
3	21.4	64.7	-2.6	19.1	46.6	-14.3	20.4	10.9	-30.5
4	24.1	75.4	4.3	22.3	29.5	-14.4	24.5	6.0	-30.6
5	28.2	66.7	1.3	25.5	37.4	-17.2	28.3	31.7	-7.8
6	32.9	64.9	-1.3	28.9	44.8	-15.4	33.3	23.8	-23.5
7	38.3	65.6	6.8	34.9	41.4	-12.1	39.8	12.9	-22.3
8	46.0	63.0	1.3	41.4	23.9	-24.5	48.4	-14.1	-46.7
9	68.3	64.7	2.7	57.5	44.5	-13.1	60.1	5.8	-41.2
10	166.9	74.5	-4.4	134.5	70.0	-13.2	168.9	21.1	-35.8
Total	*31.5*	*63.9*	*-2.7*	*26.8*	*35.3*	*-17.9*	*31.3*	*6.2*	*-33.2*

Source: Authors' calculations using ABS special request data

Looking at the total row in Table 8 above, it is clear that both the relative gross and relative net supply of affordable private rental housing has worsened over the period 2001–11. There was a surplus of affordable private rental housing of 64 per cent according to the relative gross measure in 2001—suggesting a healthy supply of affordable housing across the nation. However, there is a dramatic decline to 35.3 per cent in 2006 and further again to 6.2 per cent by 2011. Deteriorating access to affordable private rental stock is also evident using our relative net measure though it suggests a shortage of affordable private rental housing in every census year which has worsened over the decade. In 2001, 2.7 per cent of low-income private renter households could be missing out nationally, but by 2011 the shortfall widens to 33.2 per cent. There is no corresponding decline in national rates of homelessness; they initially fall through to 2006, before rebounding back in 2011 to almost their 2001 rates.

There is some indication in Table 9 below that the supply of affordable rental housing is stronger in local regions with higher levels of homelessness. This relationship is confirmed by positive (and statistically significant) correlation coefficients between regional rates of homelessness and both relative gross and relative net supply measures. This positive relationship was unexpected given ideas about how high-cost housing markets can displace vulnerable individuals into homelessness, and a number (though not all) of US empirical studies that offer some evidence in support of these ideas. Table 9 cross tabulates regional rates of homelessness with the alternative low-cost housing supply measure.

Table 9: Median alternative low-cost housing supply by the rate of homelessness per 10 000 persons for 2001, 2006 and 2011

Decile	2001 rate of homelessness per 10 000	Alternative low-cost housing supply 2001 %	Rate of homelessness per 10 000 2006	Alternative low-cost housing supply 2006 %	Rate of homelessness per 10 000, 2011	Alternative low-cost housing supply 2011 %
1	14.2	-8.2	10.6	-25.3	11.8	-30.8
2	17.9	-6.4	15.7	-17.2	16.2	-19.8
3	21.4	-1.2	19.1	-6.4	20.4	-6.6
4	24.1	1.6	22.3	-6.3	24.5	-7.1
5	28.2	0.5	25.5	-8.6	28.3	-1.8
6	32.9	-0.6	28.9	-7.0	33.3	-5.5
7	38.3	2.3	34.9	-5.8	39.8	-4.7
8	46.0	0.4	41.4	-11.7	48.4	-16.4
9	68.3	1.1	57.5	-4.5	60.1	-8.5
10	166.9	-0.5	134.5	-2.4	168.9	-2.6
Total	*31.5*	*-0.9*	*26.8*	*-8.8*	*31.3*	*-9.2*

Source: Authors' calculations using ABS special request data and TSP dataset

Table 9 confirms a national picture in which the supply of low-cost housing is decreasing over the decade. In 2001 there is an undersupply of low-cost housing options that is equal to around 1 per cent of low-income households across the nation. However, this undersupply worsens to just over 9 per cent by 2011.

This pattern is particularly marked in those local regions with the lowest rates of homelessness. For example, local regions in decile one have a median shortage of 8 per cent in 2001 which has increased to almost 31 per cent in 2011, yet rates of homelessness in this decile have fallen, albeit marginally. But in local regions with the highest rates of homelessness (see the 10th decile), affordable housing shortages begin the decade at close to zero, and remain at between 2 and 3 per cent in 2006 and 2011. Moreover, rates of homelessness in these local regions are marginally higher at the end of the decade than they were at the start.

Next we examine the suitability of the supply of affordable private rental dwellings by examining the match between the supply and demand for different sizes of dwelling in 2011.[22] Table 10 below again breaks down local regions into deciles based on regions' rates of homelessness. We then report the match between the number of low-income private renters requiring housing of the indicated number of bedrooms, and the number of dwellings of this size that they can afford. The shortfall (or excess) is reported as a percentage of low-income private renter households who require the indicated number of dwellings.

Table 10 uncovers some interesting and potentially important findings. They reveal acute shortages of affordable one-bedroom dwellings that will leave one-person low-income households especially vulnerable to homelessness On the other hand, affordable dwellings with two, three and four or more bedrooms are (according to this measure) adequately supplied.

Yet it is puzzling to once more find that even in the case of affordable one-bedroom (or less) dwellings, Table 10 shows that the shortage is more severe in areas with lower rates of homelessness and less severe in areas with higher rates of homelessness.[23]

[22] As mentioned in Chapter 2, Section 2.3, the number of bedrooms required by a household was determined using the Canadian National Occupancy Standards. See ABS (2012b), p.92 for more detailed information.

[23] This is confirmed by a strong positive Pearson coefficient (r =.594**). A positive relationship was also detected between rates of homelessness and the supply of affordable two-bed dwellings (r =.126**), and despite fluctuations shown in Table 10, an overall positive relationship between the total supply of affordable dwellings relative to demand when taking into account the suitability of dwellings (r =.156**).

Table 10: Median relative gross supply of suitable dwellings by the rate of homelessness per 10 000 persons, 2011

Decile	Rate of homelessness per 10 000, 2011	One bed or less	Two beds	Three beds	Four or more beds	TOTAL supply of suitable dwellings
1	11.8	-83.8	-13.9	74.4	119.1	-33.5
2	16.2	-86.7	32.0	141.0	138.1	-9.9
3	20.4	-83.0	61.0	228.2	240.7	10.9
4	24.5	-82.6	49.7	226.3	245.3	6.0
5	28.3	-84.8	67.2	398.4	437.0	31.7
6	33.3	-82.6	38.6	222.1	190.0	23.7
7	39.8	-83.6	47.6	207.4	133.0	12.9
8	48.4	-74.3	55.8	59.6	62.5	-14.4
9	60.1	-74.7	61.9	83.6	41.9	7.1
10	168.9	-44.2	92.8	142.8	100.0	21.4
Total	*31.3*	*-80.9*	*49.2*	*153.1*	*152.6*	*6.5*

Source: Authors' calculations using ABS special request data

3.3 Does the supply of affordable private rental or low-cost housing attract homelessness to an area? A test of the sorting hypothesis.

One possible explanation for the puzzling findings in Section 3.2 is the sorting hypothesis—the idea that people experiencing homelessness gravitate to areas with a more abundant supply of affordable housing in an attempt to resolve their homelessness. We cannot directly test this hypothesis. However, if a sorting effect were occurring, we would expect local regions with greater supplies of low-cost housing in 2001 to subsequently have increasing rates of homelessness relative to local regions with a shortage of low-cost housing.[24] In this section we conduct two tests of this hypothesis.

In Table 11 below we report the first test findings. The 2001 relative gross supply measure is employed to assign local regions to deciles, with local regions in decile 1 having the lowest relative gross supply, and local regions in decile 10 having the most abundant supply. We report the median 2001 relative gross supply in each decile as well as the median percentage change in rates of homelessness between 2001–11. There is little or no pattern in the cross tabulations and no systematic tendency for change in homelessness rates to be positively correlated with the supply situation in 2001.[25]

[24] The mobility of the homeless could instead be driven by labour market considerations, in which case the homeless would gravitate to regions with low unemployment rates. But such regions are more likely to have tight housing markets.

[25] The Pearson correlation coefficient reveals a small negative and statistically insignificant coefficient (r = -.032), suggesting no relationship exists.

Table 11: Median percentage change in rates of homelessness between 2001–11 by the relative gross supply of affordable private rental housing in 2001

Decile	n	2001 relative gross supply	2001–11 per cent change in rates of homelessness
1	32	-53.5	36.0
2	33	8.9	8.4
3	33	32.0	23.6
4	33	50.5	39.9
5	33	61.4	3.7
6	32	66.8	32.6
7	33	75.4	35.3
8	33	83.3	14.9
9	33	94.8	24.6
10	31–32	119.1	-10.7
Total	328	63.9	22.5

Source: Authors' calculations using ABS special request data and ABS homelessness estimates

Tables 12 and 13 below repeat the analysis above but for the relative net supply and alternative low-cost supply measures. These cross tabulations offer a somewhat stronger rejection of the sorting hypothesis. In these tables there are some signs of a negative relationship; in local regions with relatively abundant supplies of rental housing in 2001, growth in homelessness rates seems to be lower.[26] This pattern in the data is confirmed by negative Pearson correlation coefficients. While these findings are suggestive of a weak relationship, they are potentially important. To the extent that *changes in homelessness rates reflect mobility of the homelessness population*, it suggests that employment rather than affordable housing is the magnet precipitating moves. Those local regions with tight housing market conditions are also likely to be ones with relatively strong employment opportunities. However, these are tentative suggestions given a caveat that mobility among the homeless is but one factor causing changes in homelessness.

[26] This pattern in the data is confirmed by negative Pearson correlation coefficients (r = -.183**). A similar negative relationship between the percentage change in homelessness and our alternative low-cost housing measure is evident in Table 13, and is confirmed with a negative and significant Pearson correlation (r = -.165**).

Table 12: Median percentage change in rates of homelessness between 2001–11 by the relative net supply of affordable private rental housing in 2001

Decile	n	2001 relative net supply	2001–11 percentage change in rates of homelessness
1	32	-74.7	36.0
2	33	-40.3	44.8
3	32–33	-28.6	26.4
4	33	-14.8	29.0
5	33	-6.5	24.7
6	32	0.6	34.5
7	33	6.6	21.4
8	33	9.5	22.2
9	33	12.0	11.9
10	32	19.2	-14.0
Total	328	-2.7	22.5

Source: Authors' calculations using ABS special request data and ABS homelessness estimates

Table 13: Median percentage change in rates of homelessness between 2001–11 by the alternative low-cost housing supply measure in 2001

Decile	n	2001 alternative low-cost housing supply measure	2001–11 percentage change in rates of homelessness
1	32	-55.1	26.3
2	33	-22.5	26.8
3	33	-12.8	29.9
4	32–33	-6.4	35.7
5	33	-2.6	24.7
6	32–33	0.2	26.5
7	33	2.3	20.5
8	33	3.7	22.6
9	33	4.9	12.5
10	32	6.5	-3.7
Total	328	-0.9	22.5

Source: Authors' calculations using ABS special request data and ABS homelessness estimates

Our second test procedure regresses the percentage changes in homelessness between 2001 and 2011 against differences between the expected and observed supply of affordable low-cost housing.[27] In order to generate the expected supply variable, we ran a regression with the supply of affordable housing in 2001 as the dependent variable and the 2001 rate of homelessness as the regressor. The

[27] We used the same test in our first report when testing for a possible magnet effect for service availability in an area (see pp.53–54).

estimated coefficients $\hat{\alpha}_0$ and $\hat{\alpha}_1$ from this regression are employed to calculate an expected supply variable for each region. The formula is then:

$$\widehat{ES}_i = \hat{\alpha}_0 + \hat{\alpha}_1 H_i \qquad 4.1$$

Where $\widehat{ES}_i$ is the expected supply of affordable housing in region *i* in 2001, and *Hi* is the 2001 homelessness count per 10 000 persons in region *i*.

We then subtracted the expected supply of affordable housing from observed supply to obtain $\overline{S_i}$. When $\overline{S_i}$ is positive, the observed supply exceeds the expected supply, given the national relationship between homelessness rates and the supply of affordable housing. There are more affordable housing opportunities available to the homeless in local regions where this measure is positive than in local regions where it is negative. If housing market conditions exert a strong influence on homelessness numbers, we might expect homelessness rates to fall in those local regions where affordable supply conditions are relatively healthy according to $\overline{S_i}$. On the other hand, if there is a powerful sorting effect such that those experiencing homelessness gravitate to local regions with affordable rental housing, we could observe rising rates of homelessness in those local regions. Using this new variable, we then ran the following regression:

$$\Delta H_i = \widehat{\beta_0} + \widehat{\beta_1}\overline{S_i} \qquad 4.2$$

Where Δ*Hi* is the change in the homelessness rate between 2001 and 2011. When β_1 is positive and statistically significant, it indicates that where supply relative to homelessness is greater than typical, homelessness rates increase, suggesting a sorting effect.

We ran this test for three of our supply measures—the relative gross supply, the relative net supply, and alternative low-cost housing supply measures. Results on all three measures gave negative coefficients, with the relative net supply coefficient being statistically significant (see Table 14 below).

Table 14: Results from regression based sorting test

Variable	Unstandardised coefficient (std. error)	β
Relative gross supply	-.120	-.089
	(.075)	
Relative net supply	-.385**	-.167
	(.126)	
Alternative low-cost housing supply measure	-.140	-.051
	(.152)	

Source: Authors' calculations using ABS special request data and ABS homelessness estimates

Once again these findings fail to offer support for the sorting hypothesis; while the negative beta coefficients suggest that rates of homelessness tend to fall in local regions with relatively abundant supplies of affordable housing, the evidence is patchy and does not offer strong support for this interpretation of the results.

3.4 Summary of key findings

Descriptive analysis suggests that local regions with relatively strong supplies of affordable rental housing have higher homelessness. This is the case whether or not we use relative gross supply, relative net supply or alternative low-cost housing measures of the supply of affordable rental housing relative to demand. However, the

full modelling undertaken in Chapter 5 of this report will help to ascertain whether the supply of affordable rental housing is related to rates of homelessness once other factors are controlled for.

Using a similar indicator to our relative gross supply measure, we also examined the match between the number of bedrooms available per dwelling and the number of bedrooms required by low-income households in a region. Results revealed an acute shortage of affordable one-bedroom private rental dwellings relative to demand, while larger dwelling sizes (two or more bedrooms) seemed to be adequately supplied. However, we also found that the shortage of affordable one-bedroom dwellings was more severe in areas with lower rates of homelessness. This is consistent with our findings in relation to the supply of affordable private rental dwellings.

One possible explanation for our unexpected findings is the sorting hypothesis. That is, people experiencing homelessness gravitate to areas with more abundant supplies of affordable housing in an attempt to resolve their homelessness. However, both the descriptive and regression-based tests fail to detect a sorting effect, though the tests are indirect and lack the power of analyses that could be conducted if based on micro-data that records the actual movement patterns of the homeless and those vulnerable to homelessness. The expansion of the sorting hypothesis to incorporate those vulnerable to homelessness (a factor not measured in the present study) as well as those actually experiencing homelessness is revisited following the modelling in Chapter 6.

4 EXAMINATION OF ADDITIONAL STRUCTURAL DRIVERS AND THEIR RELATIONSHIP TO HOMELESSNESS[28]

4.1 Introduction

Our first report presented a preliminary statistical investigation using a limited range of structural variables. In this chapter we present descriptive statistics that explore the relationships between rates of homelessness and a range of different housing and labour market structural indicators, as well as new variables representing demographics, climate and income inequality. The statistical associations reported below hint at causation, but the descriptive methods are not robust enough to support firm conclusions. In the following Chapter 5 we exploit the panel dataset by applying modelling techniques that are capable of uncovering causal relationships in a more robust manner.

The chapter begins by examining the bivariate relationships between rates of homelessness and our new structural indicators across all Australian local regions. We then go on to explore differences in the relationships between homelessness rates and structural variables between urban and regional areas. A penultimate section relates the structural indicators to changes in rates of homelessness. The chapter concludes with a summary of key findings.

4.2 Dwelling type and tenure

In Table 15 below we repeat our practice of grouping local regions into 10 equal groups (deciles) according to their rates of homelessness. The first decile contains the 10 per cent of local regions with the lowest rates of homelessness, while the tenth decile contains those 10 per cent of local regions with the highest rates of homelessness. The first row presents the median 2011 rates of homelessness in each decile; they range from a median 12 per 10 000 in decile 1 to a median 169 per 10 000 in decile 10. Each subsequent row displays the median percentage of dwellings of the indicated tenure type in local regions belonging to deciles 1 to 10. These cross tabulations have been completed for every census year between 2001 and 2011, but only the latter are reported. The patterns are very similar across the three census years.[29]

Looking at Table 15, it is clear that homelessness rates are higher where ownership rates are low and the share of rental housing is high. This is particularly marked for local regions with higher shares of public housing and higher shares rented from a housing cooperative, community group or church group.[30] Conversely, there are markedly lower rates of homelessness in local regions with a relatively high share of mortgagees and outright owners.[31] These patterns are a little stronger at the end of the study period and point to a growing polarisation between home ownership

[28] Please note that all correlations reported throughout use logged variables as the rate of homelessness was not normally distributed. All correlations reported are for the 2011 year unless otherwise stated. **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

[29] Results for earlier census years have been omitted for space reasons, but are available from the authors on request.

[30] These positive relationships are confirmed with Pearson correlations with 2011 rates of homelessness: state housing authorities—(public housing r = .539**); persons not in the same household (r =.109*); and housing cooperatives, community housing or church groups (r = .577**).

[31] Rates of homelessness in 2011 and owned outright: r = -.523**; owned with a mortgage: r = -.664**.

oriented local regions[32] , where homelessness is uncommon, and local regions with relatively high shares of rental housing, and especially social housing, where the homeless rate is relatively high.

Table 15: Housing tenure by the rate of homelessness per 10 000 persons in 2011

Decile	Rate of homelessness per 10 000	Owned outright	Owned with a mortgage	Percentage of private rental	Social housing	Rented through other landlord type
1	11.8	37.5	38.6	16.1	1.9	0.8
2	16.2	36.5	37	17.8	2.2	1
3	20.4	37	34.7	18.1	2.7	1.2
4	24.5	35.1	33	20	3.5	1.1
5	28.3	36.6	30.4	19	3.8	1.4
6	33.3	36.1	31.7	19.3	4.5	1
7	39.8	32.4	32.8	20.4	5.1	1.3
8	48.4	28.4	29.9	24.4	4.4	1
9	60.1	32.9	29	21.4	4.5	1.4
10	168.9	24.2	22	21.6	8.2	3.4
Total	31.3	34.1	31.5	19.6	3.9	1.2

Source: Authors' calculations using TSP dataset

Cross tabulations between homelessness and dwelling type are reported in Table 16 below. Each region's housing stock has been classified into three dwelling types—detached (separate) housing, semi-detached housing (including terraced, row and townhouses) and flats and apartments. The patterns mirror those by housing tenure because detached housing is invariably owner occupied, while flats and apartments are commonly occupied by tenants.[33] We therefore find that homelessness rates are generally higher (lower) in local regions where flats and apartments (detached housing) are a relatively high (low) proportion of their housing stock.[34] It seems that the polarisation referred to above extends to the built environment.

[32] Results for earlier census years have been omitted for space reasons, but are available from the authors on request.

[33] There are other reasons why we might expect local regions with a high proportion of flats and apartments to have high homelessness. Overcrowding could be more common in flats/apartments, and overcrowding is the largest component of homelessness.

[34] Rates of homelessness in 2011 and: detached houses, r = -.400**; flats, units and apartments: r = .357**, semi-detached row terrace or town houses, r = .100 (not significant).

Table 16: Dwelling type by the rate of homelessness per 10 000 persons in 2011

Decile	Rate of homelessness per 10 000	Separate/Detached house	Semi-detached row or terrace house townhouse etc.	Flat unit or apartment
1	11.8	87.9	5.7	3.3
2	16.2	85.6	7.4	5.2
3	20.4	88	7	4.6
4	24.5	84.7	6.3	6.1
5	28.3	87.7	5.7	5.3
6	33.3	85.7	6.8	5.9
7	39.8	83.4	7.1	6.6
8	48.4	78	11	11.3
9	60.1	76.1	11	9.5
10	168.9	61.3	9.1	14.8
Total	*31.3*	*82.8*	*7*	*6.5*

Source: Authors' calculations using TSP dataset

4.3 Labour force status and participation in unskilled work

There are a few discernible patterns in the data when homelessness in regions is cross tabulated with labour force status categories (see Table 17 below). These categories distinguish the full-time from the part-time employed, as well as identifying those employed but absent from work on census night. The remaining two groups are the unemployed and those not in the labour force. Unemployment has been highlighted in the literature as a potentially important cause of homelessness. Table 17 does reveal a positive statistical association in 2011; in the regions with the highest homelessness rates (decile 10) unemployment affects 3.6 per cent of the labour force, while this falls to 2.8 per cent in the regions least prone to homelessness (decile 1).[35] The relationship is nevertheless a weak one, and in earlier census years it is even weaker still.[36] The employment rate is lower in regions with higher homelessness rates, but this is largely due to depressed levels of part-time employment. Indeed the bi-variate relationship between part-time employment and rates of homelessness is stronger than that between unemployment and rates of homelessness.[37] Part-time work is less common in unskilled manual occupations, and as labourers make up a higher proportion of the employed workforce in regions with high rates of homelessness,[38] there could be confounding factors at work here.

[35] Unemployment and rates of homelessness in 2011 (r =.202**)

[36] Results for earlier census years have been omitted for space reasons, but are available from the authors on request.

[37] Part-time employment and rates of homelessness in 2011 (r = -.663**).

[38] Unskilled work and rates of homelessness in 2011 (r =.178**) see Table 5: For additional structural indicator variables from the TSP dataset, their definitions, data source and unit of measurement see Chapter 2, Section 2.4.3 as well as the definition of unskilled work.

Table 17: Labour force status and unskilled work by the rate of homelessness per 10 000 persons in 2011

Decilee	Rate of homelessness per 10 000	Employed full-time	Employed part-time	Employed— away from work	Unemployed and looking for work	Not in the labour force	Unskilled work
1	11.8	38.2	20.2	3.7	2.8	30.5	7.2
2	16.2	36.9	19.7	3.5	2.9	32.8	8.8
3	20.4	34.3	18.5	3.5	3.1	33.7	10.9
4	24.5	35.8	17.9	3.6	3.2	33.5	10.9
5	28.3	32.8	17.3	3.6	3.3	34.2	12.4
6	33.3	34.5	18.1	3.5	3.3	34.9	11.3
7	39.8	35.2	17.5	3.5	3.9	34.5	11.6
8	48.4	38.4	16.4	3.6	3.6	32.1	10.2
9	60.1	34.8	15.6	3.5	3.4	34.4	12.2
10	168.9	36.5	14	3.9	3.6	30.4	10.7
Total	*31.3*	*36.3*	*17.8*	*3.5*	*3.3*	*33.1*	*11.6*

Source: Authors' calculations using TSP dataset

4.4 Additional demographic factors

A range of demographic indicators covering marital status, household type, age and gender have been added to the analysis of homelessness in this report. Table 18 below describes the marital status profile of regions that are once more grouped into deciles according to rates of homelessness. The striking feature here is the relationship between marriage and homelessness; the demographics in regions with high rates of homelessness is such that they feature a disproportionate share of never marrieds; in 2011, never marrieds typically comprised 41 per cent of the population in those 10 per cent of regions with the highest homelessness rates, but only 30 per cent in the 10 per cent of regions with the lowest rates of homelessness.[39] The pattern in reversed when examining the share of marrieds [40] and the strength of these relationships has intensified over the decade 2001–11.

Table 18: Marital status by the rate of homelessness per 10 000 persons in 2011

Decile	Rate of homelessness per 10 000	Married	Separated	Divorced	Widowed	Never married
1	11.8	54.3	2.6	7.8	5.5	29.7
2	16.2	52.7	3.0	8.2	6.4	31
3	20.4	50.8	3.2	8.9	6.1	30.9
4	24.5	50.7	3.3	8.9	5.8	33
5	28.3	49.8	3.4	9	6.1	31.3
6	33.3	49.2	3.3	9	6.6	33.7
7	39.8	48.7	3.4	9	6.5	35.3
8	48.4	46.5	3.1	8.4	5.9	37
9	60.1	47.9	3.2	8.1	6.1	35
10	168.9	43.8	2.9	7.9	4	41
Total	*31.3*	*49.8*	*3.2*	*8.6*	*6*	*32.7*

Source: Authors' calculations using TSP dataset

Never marrieds are more common in younger adult cohorts, and so it is no surprise to find that the age profile of regions prone to relatively high homelessness is distinctive because of a higher share of under 35s[41] in their populations (see Table 19 below). Table 19 also shows that areas with a higher percentage of men have higher rates of homelessness.[42] These descriptives are beginning to build a clear picture of the type of regions prone to an elevated incidence of homelessness. They are ones featuring a younger population with a disproportionately high share of rental (particularly public) housing, never marrieds, poor rates of employment (especially part-time) and larger numbers of workers in labourer occupations than is typical across Australian regions. Table 20 below adds another characteristic to this list—household type—and conforms to expectations because it shows that couples without children are

[39] Rates of homelessness in 2011 and never married: *r* = .530**

[40] Rates of homelessness in 2011 and Married: *r* = -.516**

[41] Rates of homelessness in 2011 and: aged 15–34: *r* = .334**; aged 35–64: -311** ; *r* = aged 65 and over: *r* = -336**

[42] Rates of homelessness in 2011 and men r = 0.26** ; women *r* =-0.25**

considerably less common in regions with higher rates of homelessness;[43] couples with children are also underrepresented,[44] but not so strongly.

Table 19: Age and gender by the rate of homelessness per 10 000 persons in 2011

Deciles	% of men	% of women	Persons 15 to 34 years (%)	Persons 35 to 64 years (%)	Persons 65 years and over (%)
1	48.8	51.2	18.0	35.0	14.2
2	49.0	51.0	18.8	34.2	14.7
3	49.2	50.8	18.4	33.5	15.7
4	48.8	51.2	18.9	33.0	15.0
5	49.4	50.6	17.3	33.7	16.1
6	48.8	51.2	19.2	32.6	15.5
7	49.3	50.7	20.8	31.3	13.6
8	49.5	50.5	21.4	30.8	12.7
9	49.6	50.4	21.3	32.4	14.2
10	51.1	48.9	23.0	30.7	10.2
Total	49.3	50.7	19.2	33.0	14.3

Source: Authors' calculations using TSP dataset

Table 20: Household type by the rate of homelessness per 10 000 persons in 2011

Decile	Rate of homelessness per 10 000	Couple with no children	Couple with children	One-parent family	Other family type	Lone-person household	Group household
1	11.8	26.9	38.1	9.1	0.8	19	2.3
2	16.2	27.2	34.1	9.8	0.9	20.9	2.3
3	20.4	27.0	29.9	10.4	0.9	23.8	2.5
4	24.5	25.8	29.1	10.5	0.9	24.2	2.8
5	28.3	28	27.5	10	0.8	24.8	2.5
6	33.3	25.6	28.2	10.8	1	25.5	2.8
7	39.8	24.4	29.8	11.7	1.1	23.9	3.3
8	48.4	23.3	29.1	10.2	1.2	23.1	3.8
9	60.1	23.7	27.2	11.1	1.2	25	3.7
10	168.9	22.1	23.7	9.1	1.3	24.4	4.2
Total	*31.3*	*25.6*	*29.1*	*10.2*	*1*	*23.7*	*2.8*

Source: Authors' calculations using TSP dataset

4.5 Income inequality and climate

Both income inequality and climate have been cited in the literature as potential causes of homelessness (see e.g. Toro et al. 2007; Quigley et al. 2001; Quigley & Raphael 2001; Florida et al. 2012; Lee et al. 2003). Growing income inequality can

[43] Rates of homelessness in 2011 and couple family with no children: r = -520**

[44] Rates of homelessness in 2011 and couple family with no children: r = -520**

increase competition for low-cost housing and displace those most vulnerable to homelessness, while warmer climates are more tolerable if 'living rough'. Our measure of income inequality in each region is the Gini coefficient, which takes values between zero and one, higher values indicating greater inequality in a region's income distribution. Table 21 below groups regions into deciles according to their rates of homelessness in each of the census years 2001, 2006 and 2011. They show that income inequality is more pronounced in regions with higher rates of homelessness,[45] and this is the case in each year.

Table 21: Gini coefficients by the rate of homelessness per 10 000 persons for 2001, 2006 and 2011

Decile	Rate of homelessness per 10 000 2001	Gini 2001	Rate of homelessness per 10 000 2006	Gini 2006	Rate of homelessness per 10 000, 2011	Gini 2011
1	14.2	0.32	10.6	0.32	11.8	0.31
2	17.9	0.32	15.7	0.32	16.2	0.33
3	21.4	0.33	19.1	0.33	20.4	0.35
4	24.1	0.33	22.3	0.32	24.5	0.34
5	28.2	0.33	25.5	0.33	28.3	0.35
6	32.9	0.34	28.9	0.33	33.3	0.34
7	38.3	0.34	34.9	0.33	39.8	0.34
8	46.0	0.34	41.4	0.33	48.4	0.34
9	68.3	0.34	57.5	0.33	60.1	0.35
10	166.9	0.34	134.4784	0.34	168.9	0.35
Total	*31.5*	*0.33*	*26.8*	*0.33*	*31.3*	*0.34*

Source: Authors' calculations using income data from TSP dataset

Table 22 below suggests that regions with warmer climates are linked with elevated rates of homelessness. Our Bureau of Meteorology data is from 2006 and offers a variety of different measures—the July minimum, January maximum, winter average temperatures and climate variability. These measures give an indication of the extremes in winter (July) and summer (January), the severity of climate conditions over the winter season, and the variability of temperatures between winter and summer seasons. The data patterns signal some association between homelessness and warmer climates (though not variability, where the association is weak at best).[46] For example, in the 10 per cent of regions with the highest rates of homelessness, minimum July (winter) temperatures are two degrees higher than those in the 10 per cent of regions with the lowest homelessness rates. This could arise by happenstance; for example, we know from our first report that regions with a higher Indigenous population have correspondingly higher homelessness rates, and to the extent that the Indigenous population are concentrated in drier, hotter and remote regions of Australia, the link with climate could be spurious.

[45] Rates of homelessness in 2011 and income inequality (Gini) in 2011: r = .214**

[46] Rates of homelessness in 2006 and July minimum: r = .230**, January maximum: r = .207**, Winter average: r = .293**, and Climate variability: r = -.136*.

Table 22: Climate indicators by the rate of homelessness per 10 000 for 2006

Decile	Rate of homelessness per 10 000, 2006	July minimum	January maximum	Winter average	Climate variability
1	10.6	7.0	28.6	12.2	21.1
2	15.7	6.1	28.5	10.2	20.9
3	19.1	6.2	28.0	11.1	20.8
4	22.3	5.9	29.3	12.1	21.0
5	25.5	5.8	29.1	11.8	22.4
6	28.9	4.8	28.6	9.8	23.3
7	34.9	6.5	28.7	11.8	22.7
8	41.4	6.6	28.6	12.1	22.0
9	57.5	8.1	30.8	14.4	20.8
10	134.5	9.1	30.6	15.0	20.4
Total	26.8	6.5	28.8	12.0	21.4

Source: Authors' calculations using special request data from Bureau of Meteorology

4.6 The influence of structural drivers in urban compared with regional areas

In an appendix to our first report (Wood et al. 2014, pp.84–86), we explored whether the relationship between structural drivers and rates of homelessness was different in urban compared with regional areas in Australia. This work was prompted by the observation that many of the US based studies we draw on are based on data from metropolitan areas only. We found some differences in the strength and direction of bivariate relationships when separately analysing Australian regions according to whether they belong to an urban or regional area.

Building on this analysis, Table 23 below presents correlation coefficients between rates of homelessness and a number of the new structural variables that we have added since the publication of our first report. Because of the large number of new variables that we have sourced, Table 23 only includes those variables with statistically significant correlation coefficients with rates of homelessness across all areas (reported earlier in footnotes).

Table 23: Correlations between key structural indicators and the rate of homelessness in 2011 for urban compared with regional areas

2011 structural indicators	Rate of homelessness per 10 000, 2011	
	Urban areas	Regional areas
Tenure type		
Owned outright	-.495**	-.626**
Owned with a mortgage	-.561**	-.716**
Social housing	.531**	.630**
Dwelling type		
Separate house	-.557**	-.608**
Flat, unit, or apartment	.497**	.402**
Supply of affordable rental housing		
Relative net supply	.138	-.034
Relative gross supply	.091	.098
Alternative low-cost housing supply	.214**	.069
Labour market		
Employed part-time	-.640**	-.664**
Employed but away from work	-.202**	.575**
Unemployed	.301**	.187*
Unskilled work	.019	.117
Marital status		
Married	-.702**	-.447**
Separated	.158*	-.113
Widowed	-.147*	-.378**
Never married	.683**	.569**
Household type		
Couple family with no children	-.461**	-.742**
Couple family with children	-.564**	-.121
Lone-person household	.473**	-.384**
Group households	.552**	.308**
Income inequality		
Gini coefficient	.140	.226**
Climate		
January maximum	-.032	.220**
Winter average	-.165*	.447**
Climate variability	.053	-.209*
July minimum	-.128	.324**

Source: Authors' calculations using TSP dataset, ABS special request data and ABS homelessness estimates. **. correlation is significant at the 0.01 level (2-tailed), *. correlation is significant at the 0.05 level (2-tailed).

In most cases the direction of bivariate relationships is the same; in other words, a positive (negative) 'urban relationship' is invariably matched by a positive (negative) ‘regional relationship’. There are seven variables where the nature of the urban relationship is reversed in regional areas. But four of these variables are the climate indicators; they show that in urban areas correlation coefficients are negative, though insignificantly different from zero for three out of the four measures. In contrast regional areas offer consistent support for the hypothesis that regions with warmer climates will have higher rates of homelessness. As always, caveats apply to these relationships as confounding factors are likely.

A majority of the bivariate relationships are uniform across urban and regional areas, though the levels of correlation coefficients and their statistical significance can differ. For example, housing tenure, dwelling type and income inequality seems to have a more robust statistical relationship with homelessness in regional areas, yet the reverse pattern is evident for unemployment rates as well as rates of marriage, separation and never married. Finally the generally insignificant relationships with housing supply measures are a noticeable feature.

4.7 Structural drivers and growth in rates of homelessness

In our last report we examined whether changes in homelessness over the period were related to structural factors by focusing on the relationship between structural drivers in 2001 and the percentage change in rates of homelessness from 2001–11. We found only one statistically significant relationship from the suite of variables we tested. Homelessness rates rose in areas with higher concentrations of public housing. We repeat the analysis here using correlation coefficients with results reported below in Table 24. Consistent with the mapping undertaken in our first report (Wood et al. 2014, pp.37–41), the structural features of regions where homelessness is high is quite different from the structural features of those regions where homelessness has increased.

Indeed, homelessness rates have tended to increase in areas with a higher percentage of dwellings owned with a mortgage, and decrease in areas with more dwellings rented through housing cooperatives, community and church groups. Homelessness rates are also more likely to have grown in areas where more people had never married.

Interestingly, while areas with a more abundant supply of affordable housing tend to have higher rates of homelessness, growth in homelessness rates is more likely in areas with a shortage of affordable rental housing. This was the case for the net supply measure and the alternative supply of low-cost housing measure.

Conversely, homelessness rates have tended to decrease in areas with more people who are employed but away from work, or working in unskilled occupations. Homelessness has also tended to decrease in areas with more couple families with no children

Homelessness rates have tended to rise in areas with lower winter temperatures and greater variability between summer and winter months.

Table 24: Correlations between key 2001 structural indicators and the percentage change in rates of homelessness, 2001–11

2001 structural indicators	2001–11 percentage change in rates of homelessness
Tenure type	
Owned outright	.078
Owned with a mortgage	.142*
Social housing	.138*
Dwelling structure	
Separate house	.010
Flat, unit or apartment	.095
Supply of affordable rental housing	
Relative net supply	-.183**
Relative gross supply	-.032
Alternative low-cost housing supply	-.165**
Labour market	
Employed part-time	.062
Employed but away from work	-.284**
Unemployment	.090
Unskilled work	-.174**
Marital status	
Married	-.098
Separated	-.014
Widowed	.095
Never married	.112*
Household type	
Couple family with no children	-.155**
Couple family with children	.100
Lone-person household	.084
Group household	.088
Income inequality	
Gini coefficient	-.050
Climate	
January maximum	-.081
Winter average	-.197**
Climate variability	.142*
July minimum	-.179**

Source: Authors' calculations using TSP dataset, ABS special request data and ABS homelessness estimates

4.8 Summary of key findings

Our earlier report documented the relationship between a limited range of measures of structural drivers and rates of homelessness. In summary, we found that regions that have lower rents, more public housing, lower rent-to-income ratios, higher unemployment and a larger share of Indigenous persons exhibit higher rates of homelessness. In the second stage of our project we have added more sophisticated measures of the supply of affordable rental housing, and as reported in Chapter 5 we again find that regions with a larger surplus of affordable rental housing have higher homelessness. This is the case whether or not we use the relative gross supply, relative net supply, or the alternative low-cost housing measure.

In this chapter we have added some new demographic and labour market variables as well as introducing income inequality and temperature variables that we had not previously considered, but which are flagged in the literature as potentially important. With the descriptive statistics computed with respect to these variables adding to the picture presented above, we are beginning to build a clear depiction of the type of regions prone to an elevated incidence of homelessness. They are ones featuring a warmer climate, younger never-married population, a relatively large Indigenous population, with a disproportionately high share of rental (particularly public) housing, poor rates of employment (especially part-time), higher rates of unemployment, unequal distributions of household income and larger numbers of workers in labourer occupations than is typical across Australian regions. The key socio-economic area characteristics seem to be weak labour markets, concentrations of poverty (as proxied by the share of public housing and unskilled labourers) and income inequality. As these areas are valued less, housing market conditions tend to be weak, and therefore feature relatively abundant supplies of affordable rental housing. It is this concluding idea that we take up in more detail as we introduce our modelling exercises in the next chapter.

Analysis from our first report revealed that areas with the highest rates of homelessness tend to experience a decline in rates over the decade, while those areas where homelessness is low are more likely to experience an increase. Consistent with this, we find that those areas where homeless rates are rising are quite different from areas where homeless rates are high—indeed they are almost a mirror image of one another.

Homeless rates have risen across the decade in regions where a higher percentage of dwellings are owned with a mortgage, where more people had never married, and in areas with lower winter temperatures and greater variability between summer and winter months.

Interestingly, while areas with a more abundant supply of affordable housing tend to have higher rates of homelessness, growth in homelessness rates is more likely in areas with a shortage of affordable rental housing. This was the case for the net supply measure and the alternative supply of low-cost housing measure.

5 MODELLING RESULTS

5.1 Introduction

The descriptive analyses in Chapters 3 and 4 confirm the findings in our first report (Wood et al. 2014). Even on using more sophisticated measures of the supply of affordable housing, our descriptive measures suggest that regions with larger supplies of low-cost housing have higher per capita rates of homelessness. Uncovering puzzling relationships between housing affordability measures and homelessness is not restricted to our own study; for example, in Kemp et al.'s (2001) Scottish study, they find 'an inverse relationship between *local authority rents* and the level of homelessness … As with local authority vacancies, it is not clear why this inverse relationship between local authority rent levels and homelessness should exist' (Kemp et al. 2001, p.4). A similar American example is Early and Olsen (2002) who found that more subsidised housing units were not correlated with lower homelessness.

In this chapter we use modelling techniques with a view to generating more robust estimates of key relationships. Modelling techniques can address at least two weaknesses associated with our descriptive analyses. First, the descriptive analyses explore bivariate relationships that do not control for interrelationships with other variables. For example, particular labour market characteristics, such as high unemployment, may be associated with regional demographic profiles, a relatively high proportion of youths for instance, which are also associated with homelessness. Regression models that include demographic variables as well as measures of housing affordability and labour market conditions could help to disentangle causal relationships.

A second weakness is their failure to exploit the panel attributes of the data base. The omission of potentially important variables is a common problem bedevilling quantitative modelling studies. Variables measuring domestic violence and drug and alcohol use are examples in the present study. Vulnerability to homelessness is thought to be associated with these factors, but measures of them are not available at the preferred spatial unit of analysis. Omitted variables can be the source of biased coefficient estimates. However, if the omitted variables are *time invariant* unobservable or unmeasured factors, then panel regression modelling techniques can be invoked to address the statistical issues.

The chapter begins by explaining our modelling approach and in particular the panel modelling techniques that we employ. It then presents findings for the full sample of 328 regions using the ABS definition of homelessness, before separately estimating models for urban regions. The ABS definition of homelessness is a very broad one; the inclusion of severe overcrowding is deserving of attention because it might reflect different housing market processes as compared to those components that are more traditionally associated with homelessness. We therefore present a set of results using the narrower cultural definition that omits severe overcrowding.[47] A final section sums up.

5.2 Modelling approach

Multivariate regression models offer estimates of the effects of key variables on homelessness after controlling for the possibly confounding effects of other measurable variables that are associated with homelessness. This approach has a particular strength in the present context because we have designed a panel data

[47] An explanation of the different definitions along with some descriptive analysis is provided in our first report (Wood et al. 2014) in Appendix 4, pp.93–94, and in Chapter 2 of this report.

base that allows us to exploit techniques that partially address the problem of omitted variables as a source of bias. Omitted variables arise when the researchers are unable to measure all the relevant factors determining (in this case) the rate of homelessness, or overlook unknown causes. As there are invariably data limitations, and our knowledge of the processes underlying homelessness is imperfect, omitted variables are ubiquitous. It is a potentially serious source of bias especially when the omitted variable(s) is correlated with an included explanatory variable.

Time invariant unmeasured variables that are assumed to be independent of the included variables in model specifications can be dealt with in random effects models that are estimated by a Generalised Least Squares routine. Alternatively, we can allow for the correlation of omitted variables with included variables in fixed effects model estimates. In a fixed effects model, variables are transformed into deviations from the mean, and so measured (and unmeasured) variables that are fixed drop out of the model. While the fixed effects model imposes less restrictive assumptions, and will therefore offer more robust estimates if unmeasured fixed variables are correlated with variables included in model specifications, we will lose potentially valuable information on the role of measured variables that are fixed (e.g. the state where a region is located).

A more thorough explanation follows, but the reader uninterested in the technical details may wish to skip the remainder of this section. Consider the simple linear model 5.1 with an unobservable fixed effect a_i

$$y_{it} = \beta_1 x_{it} + a_i + u_{it} \qquad 5.1$$

Where subscripts *i* and t identify units of analysis (e.g. regions) and time period (e.g. census year) respectively. The dependent variable is y_{it} and there is a single explanatory variable x_{it}. There is an idiosyncratic error u_{it} . If the a_i is correlated with the explanatory variable x_{it}, β_1 will be biased. First differencing is one method of addressing this issue as a_i is swept away by the first difference transformation. A second approach is to average equation 5.1 over time, so that:

$$\bar{y}_i = \beta_i \bar{x}_i + a_i + \bar{u}_i \qquad 5.2$$

And subtract 5.2 from 5.1 to obtain:

$$y_{it} - \bar{y}_i = \beta_i (x_{it} - \bar{x}_i) + u_{it} - \bar{u}_i \qquad 5.3$$

The left-hand side dependent variable in 5.3 is the time de-meaned data on *y*. Equation 5.3 is a fixed effects transformation, also referred to as a within transformation because it only uses within unit variation in the variables to estimate β_1. Pooled OLS estimation of 5.3 is called fixed effect estimation.[48] The fixed effects estimator allows for arbitrary correlation between a_i and the explanatory variables, though u_{it} should be uncorrelated with $x_{it} - \bar{x}_i$ in all time periods. But there are drawbacks; if there are observable time invariant variables such as state (NSW, Victoria, etc.) dummies, we cannot include these variables, and therefore give up potentially valuable insights on factors affecting differences in y_{it}.

But if a_i is uncorrelated with x_{it} the fixed effects transformation is inefficient, and 5.1 becomes a random effects model. However, pooled OLS will result in incorrect

[48] When T=2 fixed effects estimation and first difference estimation are identical. For data sets with a large number of units of analysis (large N) with observations on each unit over a small number of time periods (small T), fixed effects is more efficient provided the u_{it} are serially uncorrelated. Since this is implicitly assumed in 14.1, the fixed effects estimator is more commonly employed (Wooldridge 2009, p.487).

standard errors and t-statistics because the composite errors $\vartheta_{it} = a_i + u_{it}$ are serially correlated due to the presence of a_i. Random effects estimation is a Generalised Least Squares solution to this serial correlation problem. An advantage of the random effects estimator is that it allows inclusion of explanatory variables that are constant over time, an attribute not shared by first difference and fixed effects estimation methods. While this is an attraction, an important motivation for using panel data is to estimate key variable effects allowing the unobserved effect to be correlated with the explanatory variables.

We therefore present model estimates using random effects, fixed effects and pooled OLS, though with the proviso that pooled OLS standard errors and test statistics are unreliable. Nevertheless, comparison of coefficient estimates generated by these alternative estimators can be informative about the nature of the bias caused by leaving the unobserved effect a_i entirely in the error term, as is the case with pooled OLS.

The model specifications feature a vector comprising demographic variables, as well as controls for census year (2001 omitted) and state or territory that a region belongs to (NSW omitted). The demographics can act as proxies for the kind of social ills commonly associated with homelessness; so young males, for instance, are thought to be more prone to drug and alcohol problems (AIHW 2013), while sole parents and domestic violence tend to be correlated. The state and territory dummies will capture institutional variations that might have a bearing on variations in rates of homelessness across jurisdictional boundaries, while census year dummies will detect underlying trends over the decade that raw national rates of homelessness could mask. The idea that more unequal distributions of income lead to rising rates of homelessness is tested through the inclusion of our Gini coefficient measure of income inequality. The proposition that regions with extremes of climate will prompt migration of the homeless to more temperate climates is also allowed for by the addition of a climate variability variable.

A vector of housing variables includes flats and apartments as a percentage of the region's housing stock—these accommodation types have tighter space standards and are therefore more likely to be severely overcrowded[49] (all else being equal)—as well as the percentage of a region's housing stock that is occupied by outright owners. This group of households have relatively large amounts of housing equity to fall back on when there are emergencies of the kind that can tip mortgagors and renters into homelessness.

The key housing affordability and labour market condition variables are the relative net (housing) supply measure, social housing as a percentage of the housing stock and the rate of unemployment. Variable definitions are listed in Table 25 below. As is evident from Chapters 3 and 4 we have collected a wider array of variables, and those listed in Table 25 are a selection entered into preferred model specifications. The final subset of explanatory variables for inclusion in the model specifications were selected with the assistance of statistical criteria. Statistical tests such as Wald tests and Variance Inflation Factors (VIF) were exploited to identify which variables contributed to the predictive power of the overall model, and to diagnose symptoms of multicollinearity between the independent predictors. Variables that did not

[49] However, in our census data there is no correlation between number of persons in severely overcrowded accommodation per 10 000 persons and the percentage of dwellings that are flats, units or apartments (in 2011) coefficient (r = -.039, p = 576, n = 212). There could be confounding factors masking the relationship. Flats might also typically feature one earner and no-earner households that are more vulnerable to homelessness.

significantly improve the predictive power of the model, or that were strongly collinear with other main variables of interest, were omitted from the final model.

Table 25: Variable names and definitions

Variable type	Variable name	Definition
Demography	% males	Percentage of persons identifying as male enumerated within SA3*i* on census night in Year *X*
	% sole parents	Percentage of households enumerated within SA3*i* who identified as being sole parent families on census night in Year *X*
	% Indigenous	Percentage of total Indigenous persons enumerated within SA3*i* on Census night in Year *X*
	% aged 15–34	Percentage of persons aged 15–34 years of total persons enumerated within SA3*i* on census night in Year *X*
	% never married	Percentage of persons enumerated within SA3*i* who identified as never having married on census night in Year *X*
	% couple families with children	Percentage of households enumerated within SA3*i* who identified as being a couple family with children on census night in Year *X*
Income inequality and labour market	Gini coefficient	See Chapter 2, Section 2.4.5
	% unemployed	Percentage of total persons enumerated within SA3*i* on census night who were unemployed in Year *X*
Tenure type	% outright owners	Percentage of dwellings owned outright enumerated within SA3*i* on census night in year *X*
	% in social housing	Percentage of dwellings classified as social housing enumerated within SA3*i* on census night in year *X*, where social housing is the sum of rentals from state housing authorities and through housing cooperative, community group or church group
Dwelling type	% living in flat, unit or apartment	Percentage of dwellings identified as being flats, units or apartments enumerated within SA3i on census night in year *X*
Housing supply	% relative net supply	The percentage of private rental dwellings affordable (i.e. costing 30% or less of household income) to those in the bottom 40% of the income distribution, less the number of higher income households renting these affordable dwellings, within SA3i on census night in year *X*. This is expressed as a percentage of low-income households.
Climate	Climate variability	The difference between the mean maximum January temperature and the mean minimum July temperature within SA3*i* in 2006
Time	Year *x*	Dichotomous variable to denote census year; equal to 1 if census count is based on year *X*, 0 otherwise (year 2001 is omitted category)
State	State *x*	Dichotomous variable to denote the state that each SA3 belongs to; equal to 1 if SA3 belongs to state *X*, 0 otherwise (New South Wales is omitted category)

5.3 Findings

5.3.1 Modelling results using the national sample

Table 26 below reports findings for the pooled OLS, random effects and fixed effects estimation of a log-linear specification.[50] The pooled OLS estimates yield a large number of statistically significant coefficient estimates. From the group of demographic variables we learn that regions with relatively high population shares of young (15–34) persons, males, sole parents, Indigenous persons and never marrieds have relatively high rates of homelessness. These demographic profiles are unsurprising; but one finding—regions with high shares of couples with children—is unexpected. The estimated effects are particularly large for males; a one percentage point increase in the male population share is associated with a 12 per cent increase in rates of homelessness. At the average rate of homelessness this is equivalent to an 8 in every 10 000 persons increase in the numbers of those who are homeless.

Three of these demographic variables (male, sole parent and Indigenous population shares) are consistently statistically significant at the 1 per cent level regardless of the estimation method. Moreover, the size of the estimated impacts on homelessness strengthens under preferred random and fixed effects models. The never married and couples with children pooled OLS estimates are likely biased as the random and fixed effects coefficients jump around in both direction and significance. We should therefore discount the puzzling pooled OLS result concerning couples with children.

Next consider the income distribution, housing stock and climate variables. Pooled OLS estimates indicate that regions with a high proportion of flats and apartments in their housing stock are prone to have elevated rates of homelessness, though the effect is small as compared to the male variable.[51] Climate is found to be insignificant, as is the outright owner variable, but the Gini coefficient measure of income inequality is just significant at 10 per cent and positively impacts homelessness. The random and fixed effects estimates of the impact of income inequality and flats/apartments are even stronger. In the fixed effects model a one standard deviation change[52] in the Gini coefficient is found to increase rates of homelessness by 8 per cent, or six in every 10 000 persons when measured at the mean rate of homelessness.

The census year and state and territory controls in the pooled OLS analysis suggest that there has been lower adjusted rates of homelessness in 2006 and 2011 relative to a 2001 base year, and after accounting for other homelessness drivers, the Northern Territory, Queensland, South Australia, Victoria and Western Australia exhibit elevated rates of homelessness compared to the benchmark state—New South Wales. The lower trend 2006 and 2011 estimates in adjusted homelessness are more robust and larger when generated by random and fixed effects models; they indicate a rate of homelessness that in the typical region is 25 per cent (16%) lower in

[50] A log-linear functional form was considered a suitable model specification in this analysis because of the non-normal distribution of homelessness rates. Log transformations are a standard procedure for normalising variables with a skewed distribution. To estimate the effect of changes in the covariates on the rate of homelessness, we apply the formula 100*(exp(β)-1) where exp(β) represents the exponential of the coefficient β. Where the covariate is a continuous variable (say, percentage of males in an area), the above formula measures the percentage change in homelessness rates corresponding to a 1 percentage point increase in the percentage share of males in an area. For dichotomous variable (i.e. census year), the formula measures the percentage change in homelessness rates in year *X* compared to the reference census year (2001).

[51] A 1 per cent increase in flats/apartments share of the housing stock raises the rate of homelessness by 3.2 per cent according to the Fixed Effects estimates; this is equivalent to an increase of 2.2 per 10 000 population at the average rate.

[52] A one standard deviation change in the Gini coefficient is 0.024. The Gini coefficient is tightly clustered around its mean value of 0.33, so the large estimated coefficient does not translate into a large impact.

2006 (2011) as compared to 2001. Random effects generates generally larger state impacts, with Northern Territory *adjusted* rates of homelessness the highest at nearly double (94% higher) those in New South Wales (state and territory dummies drop out of the fixed effects analysis).

Table 26: Modelling estimates on national sample using ABS definition of homelessness[1]

Variable type	Variable name	(1)	(2)	(3)
		Pooled OLS	**Fixed effects**	**Random effects**
Demography	% males	0.112***	0.159***	0.126***
		(0.0110)	(0.0237)	(0.0132)
	% sole parents	0.0475***	0.113***	0.0692***
		(0.0132)	(0.0310)	(0.0153)
	% indigenous	0.0627***	0.0906***	0.0670***
		(0.00497)	(0.0308)	(0.00673)
	% aged 15-34	0.00840**	0.0109*	0.00917**
		(0.00399)	(0.00560)	(0.00434)
	% never married	0.0213***	-0.0140	0.0134**
		(0.00497)	(0.0145)	(0.00644)
	% couple families with children	-0.00970***	0.0334***	-0.00578
		(0.00366)	(0.00954)	(0.00440)
Income inequality and labour market	Gini	1.918*	3.350**	2.020**
		(1.012)	(1.328)	(1.012)
Labour market	% unemployed	0.0430***	-0.0255*	0.0134
		(0.0115)	(0.0133)	(0.0109)
Tenure type	% outright owners	0.00361	-0.00712	0.00168
		(0.00371)	(0.00703)	(0.00439)
	% in social housing	0.000332	-0.0363**	-0.00681
		(0.00742)	(0.0171)	(0.00932)
Dwelling type	% living in flat, unit or apartment	0.0179***	0.0311***	0.0240***
		(0.00256)	(0.00792)	(0.00326)
Housing supply	% relative net supply	-0.000811	-0.000568	0.000112
		(0.000984)	(0.00130)	(0.000991)
Climate	Climate variability	0.00289		0.00223
		(0.00394)		(0.00587)
Year	2006	-0.105**	-0.222***	-0.162***
		(0.0534)	(0.0660)	(0.0459)
	2011	-0.106*	-0.147**	-0.134***
		(0.0556)	(0.0710)	(0.0475)
State	Australian Capital Territory	-0.183		-0.127
		(0.119)		(0.171)
	Northern Territory	0.715***		0.665***
		(0.142)		(0.209)

Variable type	Variable name	(1)	(2)	(3)
		Pooled OLS	Fixed effects	Random effects
	Queensland	0.221***		0.237***
		(0.0507)		(0.0740)
	South Australia	0.255***		0.320***
		(0.0728)		(0.105)
	Tasmania	-0.0482		0.0257
		(0.0889)		(0.131)
	Victoria	0.412***		0.430***
		(0.0526)		(0.0760)
	Western Australia	0.205***		0.226**
		(0.0668)		(0.0977)
	Constant	-4.718***	-7.376***	-5.292***
		(0.722)	(1.548)	(0.894)
	Number of Observations	984	984	984
	R-squared	0.694	0.181	0.6881
	Number of SA3's	328	328	328

Standard errors in parentheses, Coefficients significant at: *** p<0.01, ** p<0.05, * p<0.1

Note: The OLS standard errors underestimate the true standard errors because they ignore positive serial correlation of the composite error term, but are reported here for comparison purposes.

Examination of the key labour and housing market variables uncovers some curious findings. In the OLS estimates, the supply of affordable housing measures (social housing[53] and relative net supply) are insignificantly different from zero. Weak labour market conditions, as represented by relatively high unemployment, are linked to high rates of homelessness. But the more reliable random and fixed effects models offer conflicting evidence. In the fixed effects model unemployment changes sign, and the puzzling negative coefficient even proves to be weakly significant at 10 per cent. Relative net supply is unrelated to homelessness regardless of estimation method, while social housing's coefficient estimate is volatile, eroding confidence in the statistically significant (at 5%) negative coefficient in the fixed effects model.

In Appendix 5 we organise the regression models' explanatory variables into three groups—demographic and climate controls, income inequality, labour and housing market variables and calendar year and state dummy variables. Pooled OLS estimates of three restricted models that sequentially omit one vector of variables at a time are used to evaluate each group of variables contribution to 'explanation' of variation in rates of homelessness. They suggest that demographic and climate controls are the most important group of variables, a finding that reflects the individual significance of each of the demographic variables in the unrestricted pooled OLS model estimates (see Table 26).[54]

[53] The social housing and Indigenous variables have a correlation coefficient of 0.75, so multicollinearity might be a factor here.

[54] The vector of demographic and climate controls 'explain' 15% of the variation in rates of homelessness in the national sample, while the other two groups contribute roughly one third of this 'explanatory' power. Details can be found in Appendix 5.

5.3.2 Modelling structural drivers in urban regions only

In the USA, empirical models have typically been estimated across urban metropolitan regions. Labour and housing markets are denser in urban areas, and so the market processes that we expect to impact on homelessness might be more readily detectable. Moreover, urban populations have different demographic characteristics; for example, the Indigenous account for a much smaller share of the urban population. In urban SA3s the Indigenous persons' population shares never exceed 4.5 per cent. However, in some regional SA3s Indigenous Australians account for over 50 per cent of the regions' population. This was more likely to be the case in remote and very remote areas. Further, only 34 per cent of the Indigenous population live in urban areas, with the remainder living in regional areas. This is particularly the case in remote and very remote areas of Australia where 24 per cent of Indigenous Australians live in remote or very remote areas (ABS 2010b).

Table 27 below reports a set of estimates based on a sample containing 263 urban local regions.[55] Among the demographic variables male and sole parent population shares are again always positive, highly statistically significant, and the size of the impacts is larger than in the national sample.[56] The urban population share of the young is insignificantly different from zero in the pooled OLS model, where estimates are more vulnerable to bias, but positive and significant (at 5%) in the more reliable fixed effects analysis. The notable difference here between national and urban results is that the Indigenous variable drops out as far as its influence on urban homelessness is concerned. This suggests that the relationship between the percentage of Indigenous persons in a region and homelessness is a particular issue for regional areas of Australia.

Among the housing stock/tenure variables, the share of flats/units/apartments in urban housing stocks is once again consistently important. The share of outright ownership and climate are once again unimportant. However, the Gini coefficient measure of income inequality proves to have a large positive effect in both pooled OLS and Fixed Effects estimates. The pooled OLS standard error is biased downwards, which may account for loss of significance in the random effects analysis, but the latter does not allow for correlation between omitted (time invariant) variables and included variables. When we do allow for such correlation, income inequality returns to statistical significance at conventional levels.

[55] For a full explanation of the way that local regions were classified as urban or regional, see Chapter 2, Section 2.2.1.

[56] For example, 1 percentage point increases in the male share of an urban region's population will (according to the OLS estimates) increase rates of homelessness 7.2 per cent. This is equivalent to an increase of 5 per 10 000 population at the average rate. A one standard deviation increase in the proportion of males, on the other hand, increases the percentage of homeless rates by 18 per cent or 12 in every 10 000 persons at the average homelessness rate. The male population shares are tightly centered on the mean, so a one standard deviation change gives a more accurate depiction of impacts.

Table 27: Model estimates, urban regions using ABS definition of homelessness

Variable type	Variable name	(1) OLS	(2) Fixed effects	(3) Random effects
Demography	% males	0.0700***	0.449***	0.153***
		(0.0143)	(0.0357)	(0.0184)
	% sole parents	0.0428***	0.162***	0.0840***
		(0.0144)	(0.0324)	(0.0174)
	% indigenous	0.0762***	-0.0289	0.0601*
		(0.0236)	(0.0610)	(0.0311)
	% aged 15-34	0.00471	0.0104**	0.00792*
		(0.00420)	(0.00525)	(0.00448)
	% never married	0.0251***	-0.0160	0.0159**
		(0.00521)	(0.0160)	(0.00690)
	% couple families with children	-0.00602	0.00826	-0.00952*
		(0.00415)	(0.0107)	(0.00524)
Income inequality	Gini Coefficient	2.980***	4.376***	1.602
		(1.118)	(1.475)	(1.143)
Labour market	% unemployed	0.0444***	-0.0270*	0.0103
		(0.0124)	(0.0148)	(0.0124)
Tenure type	% outright owners	-0.000546	-0.000821	0.000741
		(0.00390)	(0.00842)	(0.00488)
	% in social housing	-0.00319	-0.0507***	-0.00921
		(0.00809)	(0.0191)	(0.0104)
Dwelling type	% living in flat, unit or apartment	0.0177***	0.0254***	0.0219***
		(0.00258)	(0.00897)	(0.00344)
Housing supply	% relative net supply	-0.000457	-0.00113	-0.000713
		(0.00113)	(0.00149)	(0.00118)
Climate	Climate variability	-0.00404		-0.00619
		(0.00499)		(0.00749)
Year	2006	-0.110*	-0.192**	-0.175***
		(0.0573)	(0.0816)	(0.0533)
	2011	-0.0546	-0.0645	-0.102*
		(0.0597)	(0.0874)	(0.0549)
State	Australian Capital Territory	-0.0629		-0.205
		(0.124)		(0.177)
	Northern Territory[57]			

[57] Coefficient estimates for the State of Northern Territory (NT) could not be generated because there are no urbanised SA3's in the NT; local regions within this State are classified as either remote or very remote.

Queensland	0.0890*		0.107
	(0.0532)		(0.0780)
South Australia	0.166*		0.251**
	(0.0859)		(0.123)
Tasmania	-0.178*		-0.0644
	(0.107)		(0.160)
Victoria	0.354***		0.374***
	(0.0664)		(0.0923)
Western Australia	0.0249		0.0571
	(0.0739)		(0.108)
Constant	-2.778***	-21.63***	-6.282***
	(0.797)	(2.096)	(1.064)
Number of Observations	789	789	789
R-squared	0.496	0.332	0.4680
Number of SA3's		263	263

Standard errors in parentheses, coefficients significant at *** p<0.01, ** p<0.05, * p<0.1, Note: See note 1 Table 26

In urban areas the adjusted trend declines in rates of homelessness are not as strong as in the national sample of local regions. Lower adjusted rates are confirmed in 2006, but at conventional levels of significance (at least 5%), adjusted rates in 2011 appear to have bounced back to their 2001 levels. Differences between states and territories are weaker in the urban sample. The Northern Territory's higher adjusted rates in the national sample seem to be due to regional area differentials. Once demographic and other variables are taken into account, the one state with strongly higher urban rates of homelessness is Victoria. In the random effects model Victorian rates are typically 45 per cent higher than in the reference state (New State Wales).

Puzzling results on key variables are once again obtained. The unemployment variable does attain a positive coefficient in the pooled OLS model, but turns negative (and weakly significant at 10%) in the more reliable fixed effects model. The relative net supply measure is unimportant in all models, though social housing is negatively related to homelessness rates in fixed effects estimates.

5.3.3 Exploring the relationships between operational groups and experimenting with different definitions of homelessness

As mentioned in the introduction, the international literature that informs this project is based on a narrower 'literal' definition of homelessness which includes only those sleeping rough, or staying in shelters for the homeless. It may be that the relationships detected between rates of homelessness and structural factors—in particular housing markets—is an artefact of this specific definition of homelessness used. To explore this issue we have rerun the pooled OLS, random effects and fixed effects models using two alternative definitions of homelessness—the cultural and literal definitions (see Chapter 2, Section 2.3[58]). Results are presented for the national sample of local regions in Appendix 3. The cultural definition omits severe overcrowding and by modelling this measure we hope to detect differences in the processes driving the (point) prevalence of severe overcrowding from those determining other components

[58] 2011 rates of homelessness per 10 000 for the three different definitions are: *ABS definition*: mean: 66.72, median: 31.26 std. dev: 219.58; *Cultural definition*: mean: 32.48, median: 23.81 std dev: 31.58 ; *Literal definition*: mean: 16.55, median: 11.43, std dev: 18.79.

of the ABS measure of homelessness. We begin by highlighting those drivers with a different relationship to the narrower cultural definition. The share of young persons is noticeable among the demographics because it becomes statistically insignificant, a finding that hints at severe overcrowding being especially prominent among the young. Also losing statistical significance (at 5%) is the share of flats/units/apartments in fixed effects analysis; the young are more inclined to live in this style of accommodation, so this result is unsurprising. While the share of Indigenous persons remains positive and statistically significant, the size of this variable's impact is now smaller, again indicating that severe overcrowding is an important feature in areas with relatively high shares of Indigenous persons.[59]

The other parameters in the homelessness model retain the same sign and roughly the same statistical significance and size as in the model estimated using the ABS severe overcrowding inclusive definition of homelessness.[60] This includes the key housing and labour market variables; indeed in the case of unemployment rates we obtain a larger negative coefficient estimate on omitting the severe overcrowding component.

Finally, consider the narrow literal/US definition (see Appendix 3). Most relationships now break down, and the model fit is inferior; with the cultural definition the fixed effects model's R^2 is 0.19, but this falls to 0.13 on using the literal/US definition. There is considerably less variation in the narrow homelessness definition, which could be one important reason for the breakdown.[61]

While the results of the shift-share analysis in our first report suggested that the spatial distribution of homelessness was not due to regional differences in the components of homelessness, it remains possible that the different components of homelessness in the ABS definition (the operational groups) are related differently to the various structural factors. For example, rough sleeping may be related to the cost of private rental housing, while severe overcrowding is related to the available supply regardless of cost. To explore this possibility, we produced correlation matrices (see Appendix 4) that describe the way that different operational groups are related to each other in each year. We have done this using both the rate of homelessness and the raw count of homelessness. If correlations are positive and statistically significant, it is an indication that these components have similar causes. If, on the other hand, these components are either unrelated or negatively related, it suggests different causes may be driving different components of homelessness.

Examination of the tables in Appendix 4 reveals that in the main the operational groups are significantly positively correlated with one another in each year. For example, using the rate measure, 80 per cent (12 out of 15) of all the correlations between operation groups are both positive and statistically significant, while 66.7 per cent in 2006 and 80 per cent in 2011 were both positive and statistically significant. However, there were some exceptions. Looking at the rate per 10 000 measures, operational groups 2 (persons staying in supported accommodation for the homeless) and 3 (persons staying temporarily with other households) are not significantly correlated, and neither are operational group 5 (persons in other temporary lodging) and 6 (severe overcrowding) or operational group 4 (persons staying in boarding houses) and 6 (severe overcrowding). This pattern was also evident in 2006. In 2011,

[59] This is consistent with findings from the ABS that most Indigenous homelessness (75%) is in the severe overcrowding category (ABS 2013).

[60] An exception is the Western Australian dummy that becomes statistically insignificant when employing the cultural definition.

[61] In the national sample of regions, the literal/US measure has a coefficient of variation equal to 1.1; the coefficient is 3.3 for the ABS definition

a significant and positive relationship was detected between operational groups 2 and 3, but the lack of a significant relationship between operational groups 5 and 6 and 4 and 6 persisted.

Looking now at tables using the raw count of homeless persons, the 2001 table shows no significant relationship between operational group 6 (severe overcrowding) and any other group except operational group 1 (persons in improvised dwellings, tents or sleepers out). This pattern is repeated in 2006 and 2011, with the only difference being operational group 2 (persons staying in supported accommodation for the homeless), which becomes significantly and positively related to operational group 6 (severe overcrowding) in 2011. Relationships between all other operational groups are positive and statistically significant.

These exceptions suggest that the overcrowding component of the ABS definition of homelessness (operational group 6) may be determined by a different set of causes, as it is common to many of the bivariate correlations that are 'exceptions to the rule'. However, we find in Appendix 3 that on dropping the overcrowding component and modelling the cultural definition of homelessness, our coefficient estimates are largely unaffected in terms of direction and statistical significance. Consider, for example, the fixed effects estimates as reported in Table 26 above (for the ABS definition), and Table A14 below (for the cultural definition). The five variables with positive and statistically significant coefficients when using the cultural definition (Table A14), are also positive and statistically significant, when employing the broader ABS definition that includes overcrowding. There is also uniformity with respect to the four variables with negative and statistically significant coefficients using the cultural definition. In only two cases are variables statistically significant using the broader definition, but insignificant with the narrower cultural definition.[62] There is scope for further research here and we discuss this further in Chapter 6.

5.4 Summary of key findings

The model estimates offer strong findings on key demographic drivers of homelessness. Local regions with high shares of males, Indigenous persons and sole parents have elevated rates of homelessness. The importance of the first of these three variables could be due to drug, alcohol and behavioural problems that are *relatively* more common among men (AIHW 2013). Domestic violence is a probable association for the second (Mulroney nd.) and third of these variables. The population share of Indigenous persons is especially important in regional Australia. There is weak evidence in support of the idea that a younger demographic profile is associated with homelessness, and what evidence there is suggests that this is an urban phenomenon.

There is some evidence backing the proposition that income inequality and the type of housing stock in a region are important drivers. The latter could be important because of the association between severe overcrowding and dwelling types (flats, apartments and units) which have inferior space standards. However, there are other possible confounding factors that could be responsible for this finding (see footnote 49 above). On the other hand, income inequality's significance is more likely a direct causal one; regions with relatively unequal income distributions have housing markets where competition for low-cost housing is more intense.

[62] These variables are per cent aged 15–34 and per cent couples, both becoming positive when overcrowding is included, suggesting that these demographic groups are prone to overcrowding but not other forms of homelessness.

In the national sample of local regions, we detect a decline in rates of homelessness once allowance is made for changes in demographics, income inequality and so on. This conclusion is stronger in the national sample of local regions; when we restrict the sample to urban local regions, the results confirm declines between 2001 and 2006, but it seems that the underlying urban trend was reversed in the second half of the 2001–11 decade. Indeed, our estimates suggest that adjusted 'urban' rates had by 2011 re-bounded back to their 2001 levels.

We also find considerable differences in adjusted rates of homelessness between states and territories and across regional Australia in particular. For the national sample of local regions, New South Wales is found to have rates of homelessness that are lower than those in most states and territories, once allowance is made for differences in demographic profiles, income inequality etc. The Northern Territory has noticeably high adjusted rates. In the urban sample of local regions, many of these inter-state and inter-territory differentials disappear. The exception is Victoria; we have strong evidence that adjusted rates of homelessness are higher in Victoria, and it is conspicuous in both national and urban only samples.

The findings with respect to key housing and labour market variables are curious. Parameter estimates are reported with respect to three measures—unemployment rates, social housing and affordable rental housing supply. However, we have experimented with a range of different measures, and conclusions are unaffected.[63] In models that offer more robust estimates, weak labour markets are associated with lower per capita rates of homelessness, a puzzling finding, since we might expect job losses and limited job opportunities to precipitate homelessness. The supply of affordable private rental housing is seemingly irrelevant as far as a region's rate of homelessness is concerned. While there is some indication that relatively healthy supplies of social housing are associated with lower rates of homelessness, the evidence is less than compelling. We offer a more detailed commentary on these intriguing findings in a final discussion section.

[63] We also experimented with alternative area-wide measures of income and labour market (median total household income, rent-to-income ratio, proportion employed part-time; proportion with a bachelor's degree), housing supply (proportion of national gross affordable supply of housing), marital status (proportion of households divorced/separated, proportion of lone households), dwelling type (proportion in private rental) and mortgage debt (median monthly mortgage repayment). Despite using these alternative measures, our main findings remain unchanged.

6 DISCUSSION

In Australia it has become accepted wisdom that a lack of affordable housing and poor job prospects causes as well as perpetuates homelessness. This assumption is embedded in state and federal homelessness policies (e.g. Department of Human Services 2010; Commonwealth of Australia 2008) as well as the advocacy work of the homelessness sector. Yet the findings from both our descriptive analysis and modelling work in this report, as well as our previous work (Wood et al. 2014) paint a much more complex, if not puzzling, picture of the way that housing markets, labour markets, demographic factors, climate and income inequality might be related to aggregate rates of homelessness.

In this final chapter we offer an explanation for our puzzling findings that rests on the interrelationships between labour and housing markets. This is followed by a discussion of the policy significance of our findings and suggestions for future research.

6.1 A possible explanation for our findings

Our findings on the relationship between homelessness rates and the supply of affordable housing in an area contrasts with those presented in most of the US literature we reviewed. However, the results reported in Kemp, Lynch and MacKay (2001), Early and Olsen (2002) and Early (2005) are clear exceptions as they also suggest that affordable housing supply and homelessness rates are positively linked. The puzzling feature of our findings is the statistical insignificance of most of the variables representing housing and labour market conditions, and on occasion their significance but in unexpected directions. One explanation for these findings relies on the observation that supplies of affordable housing and unemployment rates are likely to be positively related.

To illustrate this idea, consider the following Table 28 which presents two hypothetical regions (region A and region B) with identical population size. In region A the 'at risk' group of persons vulnerable to homelessness is large because unemployment is more severe, and low income more prevalent. Moreover, targeting of public/social housing in areas where the need is greatest has resulted in a higher percentage of households residing in public housing in region A. These labour, income and public housing variables could also correlate with unmeasured factors such as the incidence of drug and alcohol abuse, family violence and so on that we know from other studies can precipitate homelessness. We know that public housing is targeted to people most in need, including those with these characteristics. In region A 25 per cent of the ‘at risk’ group become homeless; all but two of the 'at risk' group manage to retain housing because it is typically low cost.

On the other hand, in region B, where unemployment is low, incomes are higher and this is reflected in higher rents. As a consequence, a greater proportion of region B’s ‘at risk’ group is tipped out into homelessness (50% as compared to 25% in region A), but because the ‘at risk’ group is small the per capita rate of homelessness in region B is 1 per 100, compared with 2 per 100 in region A, where housing is more affordable. The causal effect that tight housing markets have on homelessness is masked by two features of this hypothetical scenario. Firstly, per capita homelessness rates are unrelated to the proportion of 'at risk' groups that find themselves homeless. When modelling per capita rates of homelessness, the underlying relationships between housing and labour market conditions and the predicament of those vulnerable to homelessness is masked. Secondly, the difficulty in uncovering the true relationships is due to the positive relationship between supplies of low-cost housing and

unemployment rates. Where unemployment rates are high, 'at risk' of homelessness groups will be large (all else being equal). But a high proportion of the 'at risk' groups is able to find housing because low-cost housing is more abundant where labour markets are weak, and these regions are also ones that tend to feature high levels of social housing.

Table 28: Comparison of two hypothetical regions with differing housing market, labour market and homeless profiles

	Region A	Region B
Population	100	100
Median rent per week	$300	$600
Unemployment rate	12%	3%
Median household income per week	$900	$1800
Public housing as % of all households	7%	2%
'at risk' group	8	2
Homeless	2	1
Homeless rate per 100	2	1
Homeless as percentage of 'at risk' group	25%	50%

The analysis illustrated in Table 28 above can also be extended to help interpret the importance of understanding the dynamics of homelessness. Note that if mobility (of the homeless and those 'at-risk' or vulnerable to homelessness) is motivated more by the search for better job opportunities, rather than a search for regions or areas with a lower cost of living, some of those prone to homelessness will gravitate to region B, *but expose themselves to a higher risk of homelessness* (50% of at risk vulnerable groups become homeless in region B, but only 25% in region A because of the more affordable housing in A). It is noticeable from early examination of *Journeys Home* data [64] that of those moving across labour market boundaries, post-move homelessness rates are higher among the 'at risk' group that move as compared to those staying in the same area (Johnson et al. 2015).[65] There are potentially important policy implications and we draw on these below.

But there is a second variant of this mobility argument based on the idea that moves among the homeless and those vulnerable to homelessness is motivated more by the search for a lower cost of living, rather than a search for regions or areas with better job opportunities. In which case some of those prone to homelessness but living in regions like B will gravitate to regions like A where the risk of becoming homeless is lower because housing is cheaper and relatively abundant. This is a variation on the sorting hypothesis outlined previously. However, rather than those who are homeless gravitating to these regions, in this hypothetical, we focus on those at risk of homelessness. It is noteworthy that the findings in our first report (Wood et al. 2014) showed that regions with high rates of homelessness were experiencing a decline in

[64] *Journey's Home* is a dataset which follows a core group of people experiencing homelessness or at risk of homelessness over time

[65] On looking at the rent levels in the areas that at-risk individuals moved away from Johnson et al 2015 cannot detect a relationship between rents and next wave rate of homelessness. There is also no relationship between unemployment rates in areas moved away from and next wave homelessness rates. But among the homeless, those moving from an expensive area to a cheaper area (in terms of rents) are more likely to exit homelessness than those moving in the opposite direction, and also compared to non-movers regardless of the levels of rent in the latter's area.

homeless rates over time, while areas with lower homeless rates were experiencing an increase over time. This pattern is consistent with more moves into Region B type areas, rather than Region As, but this evidence is weak at this stage. The Journey's Home data will be a valuable source of information on these mobility patterns, and should shed important light on the kind of relationships discussed above.

The association between higher rates of homelessness and a relatively more abundant supply of affordable private rental housing reported in our descriptive work in Chapter 3 bears revisiting here. If the vulnerable gravitate to where affordable housing is more abundant, a lower proportion of them become homeless as compared to those in the regions they depart, but because there is a concentration of the vulnerable in these destination areas, per capita rates of homelessness may be higher—a finding reflected in our descriptive work.

6.2 Policy significance

While some of our results were unexpected and require further research, there are some tentative suggestions for policy-makers.

1. Our findings offer some support for the targeting of services towards particular demographic groups. The strongest predictors in our modelling work were demographics. Areas with higher homelessness tended to have more men, more sole-parent families, and more Indigenous persons (especially in regional areas). There was also some evidence that areas with more youth (persons aged 15–34) had higher rates of homelessness.
2. Beyond the targeting of programs toward particular demographic groups, the demographic profiles of regions could be used as 'markers' to aid decision-making regarding the spatial resource allocation. That is, regions with demographic profiles suggesting relatively more Indigenous persons, more sole-parent families, more men and more youth could be targeted for more intensive homeless service provision. The enormous geographical variation in rates of homelessness (and regions' shares of national homelessness) highlights the importance of appropriately addressing the spatial allocation issue.
3. Our empirical results highlight the importance of understanding the mobility patterns of the homeless and the prioritising of affordable rental housing in regions with strong labour markets. To the extent that the homeless gravitate away from areas with weak labour markets (as they search for job opportunities elsewhere), policy needs to prioritise affordable housing provision in regions with strong labour markets. A failure to retain and add to affordable housing in those strong labour market areas, will leave those both mobile and vulnerable to homelessness at higher risk because they have less chance of securing housing following moves. Our analysis implies that if the 'footloose' homeless do tend to gravitate toward stronger labour markets, their movement will tend to lift national rates of homelessness (all else being equal).
4. The strong relationship between the size of the Indigenous population and rates of homelessness was a feature specific to regional areas. Policy that aims to address Indigenous homelessness needs to focus on regional areas, especially those areas where the Indigenous population make up the largest share of the population—remote and very remote areas of Australia.

6.3 Future research

This is the first Australian research project to investigate the spatial dynamics of homelessness and the first to investigate the structural drivers of homelessness nationally and over time. This work represents only the beginning of a program of

research in the homelessness field and there is significant work to be done in this space. Our results, and the interpretations we have offered, are tentative.

In the process of doing this research colleagues and peer reviewers raised a number of issues and made invaluable comments that will help inform future research. We discuss these suggestions along with our own insights below.

6.3.1 The geographical mobility of the homeless population

The mobility of the homeless population is a key factor which could be influencing our results. Little is known about the geography of the moves made by persons before, during and after they experience homelessness. The homeless estimates we have used are simply point prevalence rates. They tell us where homeless people are at a point in time—not where they first became homeless. Further, these homeless estimates are very unlikely to contain the same individuals across the three census counts. Data from the ABS General Social Survey shows that, for their most recent period of homelessness, only 22 per cent of persons had been without somewhere to live for six months or more (ABS 2010a). A full investigation of the role that mobility might play in relation to homelessness and both housing markets and labour markets requires longitudinal micro-data which identifies the location of individuals when they become homeless, and tracks their subsequent moves along with information about the characteristics of these areas. This is the subject of planned future research.

6.3.2 Additional structural drivers

There were some additional structural indicators suggested by the international literature which we did not incorporate as the data was unavailable at the desired spatial unit of measurement. These include available mental health and drug and alcohol supports in a region, rates of family violence and child protection notifications, health problems, and the incidence of disability in a region's population. Given the highly targeted nature of public housing in Australia, it is likely that individuals who have experienced family violence, have ongoing significant health issues, disabilities, problematic drug and alcohol use, and mental health issues will be disproportionately represented in public housing. Perhaps the amount of social housing in a region should be interpreted as a proxy measure for the importance of these groups in a region's population, and this offsets their impact as a source of affordable rental housing. However, the capacity of the health, mental health and disability service systems to respond in a region and its relationship to homelessness is unknown and warrants further investigation.

Future research could also investigate the use of a contemporaneous weather variable rather than a climate variable. That is, a variable which indicates the weather in the local region in (say) the two weeks prior to the homeless counts. This should be possible using data from the Bureau of Meteorology.

The type of data employed in this study is unsuitable for the investigation of other structural barriers that may be preventing access to housing. A potentially important candidate is discrimination in private rental markets against ethnic and minority groups, as well as those with low and precarious incomes or income support. This was beyond the scope of the present study, but future research should examine the role that discrimination might play in elevating the risk of homelessness among marginal and vulnerable groups in our society.

6.3.3 Separate regression for each of the operational groups used in the ABS definition

While both modelling using different definitions and the correlations between operational groups in Appendix 4 found that the various components of homelessness

(the operational groups) were positively and significantly correlated, future research could estimate separate models for each operational group to ascertain whether different factors are driving different components. However, some of these components have small sample numbers; indeed it is common for the smaller components to have sample numbers suppressed for reasons of confidentiality.

6.3.4 Investigating lags

In the literature review presented in our first report, we discussed the theoretical contribution of Glomm and John (2002) who argued that current housing affordability will affect future homelessness. Their argument rests of the existence of hysteresis effects; a worsening in housing affordability (or unemployment) tips some persons into homelessness. There are adverse feedback effects on health, through to unemployment that makes future escapes from homelessness less likely, even if the initial deterioration in housing affordability is reversed. This line of reasoning should motivate future research that explores the presence of lags and the possibility of scarring effects—that is, the relationship between housing market (and labour market conditions) in a region in one period and rates of homelessness in that region in future time periods.

6.3.5 Different spatial units

It is possible that our findings are in part an artefact of the spatial unit we have chosen. A significant part of the reason we selected the SA3 spatial unit was that we wanted to investigate the role that composition of the homeless population might play in regional differences, and this was the smallest spatial unit at which data was available by operational group for the homeless estimates. However, housing market research is usually carried out at the SA2 level (formerly SLA level) while labour market research more commonly employs SA4s. Future research should experiment with data at the SA2 level to explore housing market drivers in particular.

6.3.6 Teasing out the importance of individual vs structural level drivers

Our findings in relation to demographics suggest that some individuals or households at different stages of the life course and belonging to particular household types and ethnic groups may be more ‘at risk’ of homelessness than others. Research is currently under way (see Johnson et al. 2015) to examine the way that structural factors, such as those investigated in the present study, and individual risk factors associated with these demographics, such as health, psychological distress and substance use, interact to bring about homelessness. This will shed further light on the role that housing and labour markets play in the homeless story in Australia. By combining panel microdata (*Journeys Home*) with measures of structural factors, this research will be able to explore how these interactions affect whether those ‘at risk’ groups are actually tipped into homelessness. In terms of Table 28 above—a study that focuses on the ‘at risk’ group in row 6, and how variation in structural conditions (across regions) affect who of this ‘at risk’ group become homeless (row 7), will be better able to identify the key relationships.

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APPENDICES

Appendix 1: key descriptives for structural variables

Table A1: Descriptive statistics for key homelessness variables

Variable	Year	N	Mean	Std. dev.	Median	Min	Max
Overall total of homeless persons—count	2001	328	290.6	478.8	160.3	0.0	3,982.5
	2006	328	273.6	432.0	152.0	0.0	3,767.0
	2011	328	320.8	473.8	184.5	0.0	4,218.0
Rate of homelessness per 10 000 persons	2001	328	76.0	252.5	31.5	0.0	3,226.8
	2006	328	64.5	217.4	26.8	0.0	2,572.4
	2011	328	66.7	219.6	31.3	0.0	2,878.0
Share of national homelessness	2001	328	0.3	0.5	0.2	0.0	4.2
	2006	328	0.3	0.5	0.2	0.0	4.2
	2011	328	0.3	0.5	0.2	0.0	4.0
2001–11 growth in rate of homelessness per 10 000 persons		326	33.3	64.4	22.5	-76.9	323.6
Persons in improvised dwellings, tents or sleeping out	2001	328	27.3	56.7	8.0	0.0	546.0
	2006	328	22.1	45.3	6.0	0.0	343.0
	2011	249	25.4	46.6	9.0	0.0	488.0
Persons in supported accommodation for the homeless	2001	328	40.9	45.2	23.7	0.0	411.3
	2006	172	66.9	75.4	41.0	0.0	479.0
	2011	250	78.7	88.3	53.5	0.0	676.0
Persons staying temporarily with other households	2001	210	58.9	33.7	53.5	0.0	214.0
	2006	320	54.0	33.3	49.0	0.0	268.0
	2011	295	55.6	32.2	53.0	0.0	187.0
Persons staying in boarding houses	2001	210	88.4	159.5	34.5	0.0	1,116.0
	2006	177	68.6	152.2	17.0	0.0	997.0
	2011	179	81.2	180.7	25.0	0.0	1,485.0
Persons in other temporary lodging	2001	328	1.1	2.5	0.0	0.0	24.0
	2006	328	1.5	3.1	0.0	0.0	22.0
	2011	233	1.8	4.3	0.0	0.0	31.0
Persons living in 'severely' crowded dwellings	2001	328	101.9	398.0	19.0	0.0	3,831.0
	2006	328	96.1	355.9	22.5	0.0	3,590.0
	2011	212	184.4	457.0	59.0	0.0	4,133.0

Source: Authors' calculations using ABS homelessness estimates

Table A2: Descriptives for structural variables used in our first report

Variable	Year	N	Mean	Std. dev.	Median	Min	Max
			Housing market indicators				
Median weekly rent	2001	328	144.3	51.1	140	32	371
	2006	328	187.5	61.8	180	30	420
	2011	328	271.4	91.1	280	26	575
Rent to income ratio	2001	328	0.2	0	0.2	0	0.3
	2006	328	0.2	0	0.2	0	0.3
	2011	328	0.2	0.1	0.2	0	0.4
Dwellings being rented by real estate agents	2001	328	10.3	5.5	9.7	0	29
	2006	328	12.3	6.1	11.8	0	39.2
	2011	328	14.1	6.5	13.1	0	40
Public housing	2001	328	4.4	3.6	3.6	0	29.2
	2006	328	4	2.9	3.4	0	19.6
	2011	328	4	3.5	3.4	0	27.4
			Income and labour market indicators				
Median household income	2001	328	798.7	203	753	492	1,628
	2006	328	1023.8	253.4	1,005	595	2,137
	2011	328	1263.5	368.3	1,184	727	2,690
Unemployment rate	2001	328	7.5	2.6	7.2	2	17.2
	2006	328	5.2	1.8	4.9	2	13
	2011	328	5.6	1.6	5.4	1.1	11.4
			Demographic indicators				
Indigenous persons	2001	328	3.2	7.1	1.4	0	59.4
	2006	328	3.3	7.2	1.4	0.1	59.5
	2011	328	3.6	7.2	1.7	0	58.6
Lone-person households	2001	328	22.4	5.8	22.7	9.6	43
	2006	328	22.6	5.4	23.3	8.8	46.2
	2011	328	23	5.3	23.7	9.5	48.1
Average household size	2001	328	2.6	0.3	2.6	1.7	4.4
	2006	328	2.6	0.3	2.5	1.8	4.5
	2011	328	2.6	0.3	2.5	1.8	4

Source: Authors' calculations using TSP dataset

Table A3: Descriptives for additional housing market indicators from the TSP dataset

	Variable	Year	N	Mean	Median	Std. dev.	Min	Max
Tenure type	Owned outright	2001	328	39.3	40.4	9.0	2.9	60.6
		2006	328	33.0	33.8	8.0	2.7	50.5
		2011	328	33.9	34.1	7.7	2.6	52.3
	Owned with a mortgage	2001	328	26.3	24.9	8.9	1.0	54.0
		2006	328	31.8	30.4	9.0	1.2	60.1
		2011	328	32.5	31.5	8.7	1.2	60.8
	Rented from a real estate agent	2001	328	10.3	9.7	5.5	0.0	29.0
		2006	328	12.3	11.8	6.1	0.0	39.2
		2011	328	14.1	13.1	6.5	0.0	40.0
	Social housing	2001	328	5.4	4.3	5.0	0.0	38.5
		2006	328	5.0	4.1	4.7	0.0	39.9
		2011	328	4.8	4.0	4.4	0.0	34.7
	Rented from person not in same household	2001	328	8.5	7.9	3.1	2.8	24.7
		2006	328	6.8	6.6	2.6	2.3	29.7
		2011	328	6.8	6.7	2.2	2.0	19.7
	Rented from other landlord type	2001	328	3.2	1.8	4.2	0.6	43.1
		2006	328	2.2	1.2	3.6	0.2	37.2
		2011	328	2.3	1.2	4.2	0.2	43.2
Dwelling structure	Separate house	2001	328	77.5	83.7	17.4	3.3	100.0
		2006	328	77.5	83.3	17.6	4.7	100.0
		2011	328	76.7	82.8	17.9	4.3	98.7
	Semi-detached row or terrace house, townhouse, etc.	2001	328	7.8	5.9	6.6	0.0	43.0
		2006	328	8.1	6.4	6.5	0.0	42.1
		2011	328	8.7	7.1	6.3	0.0	40.5
	Flat, unit or apartment	2001	328	11.0	6.1	12.7	0.0	68.3
		2006	328	11.8	6.6	13.5	0.0	76.9
		2011	328	12.0	6.5	13.9	0.2	79.3

Source: Authors' calculations using TSP dataset

Table A4: Descriptives for additional labour market variables from the TSP dataset

	Variable	Year	N	Mean	Median	Std. dev.	Min	Max
Labour force status	Employed full-time	2001	328	35.9	36.2	5.9	20.2	54.0
		2006	328	36.6	36.6	5.6	21.0	52.5
		2011	328	36.4	36.3	5.9	20.0	54.1
	Employed part-time	2001	328	16.0	16.0	2.2	10.0	27.3
		2006	328	16.9	16.9	2.4	9.7	24.5
		2011	328	17.6	17.8	2.7	6.6	24.8
	Employed away from work	2001	328	4.0	3.8	0.8	2.7	9.0
		2006	328	3.9	3.7	0.7	2.6	8.7
		2011	328	3.7	3.5	0.7	2.7	9.0
	Unemployed	2001	328	4.4	4.4	1.2	1.5	8.8
		2006	328	3.1	2.9	0.8	1.3	5.9
		2011	328	3.4	3.3	0.8	0.8	5.5
	Not in the labour force	2001	328	35.5	35.4	6.2	18.6	56.9
		2006	328	33.2	33.0	6.1	15.3	51.8
		2011	328	33.3	33.1	6.2	11.1	51.7
Unskilled work	Labourers	2001	328	11.5	11.6	4.6	2.1	28.8
		2006	328	11.6	11.9	4.5	2.1	25.3
		2011	328	10.4	10.7	3.9	1.9	21.3

Source: Author calculations using TSP dataset

Table A5: Descriptives for climate variables

Variable	N	Mean	Std. dev.	Median	Min	Max
Minimum average temperature in July 2006	328	7.1	3.6	6.5	-2.1	20.4
The maximum average temperature in January	328	28.7	3.9	28.8	12.7	40.0
The average minimum temperature for the three winter months (June, July, August)	328	12.3	3.9	12.0	1.5	24.5
Climate variability	328	21.6	4.7	21.4	7.6	34.1

Source: Authors' calculations using special request Bureau of Meteorology data

Table A6: Descriptives for additional demographic and educational attainment variables from the TSP dataset

	Variable	Year	N	Mean	Median	Std. dev.	Min	Max
Non-school qualifications	Postgraduate degree level	2001	328	1.7	1.0	1.7	0.2	9.0
		2006	328	2.4	1.4	2.2	0.3	11.9
		2011	328	3.3	2.1	2.9	0.4	14.4
	Graduate Diploma and Graduate Certificate level	2001	328	1.4	1.1	0.8	0.0	4.7
		2006	328	1.4	1.2	0.8	0.3	4.5
		2011	328	1.7	1.4	0.9	0.4	5.2
	Bachelor Degree level	2001	328	9.2	7.1	5.4	2.6	28.1
		2006	328	10.9	8.7	6.0	3.1	29.6
		2011	328	12.6	10.2	6.6	3.9	32.1
	Advanced Diploma and Diploma level	2001	328	5.8	5.5	1.6	2.6	10.1
		2006	328	6.9	6.7	1.7	3.1	11.7
		2011	328	7.8	7.7	1.7	4.1	12.8
	Certificate level	2001	328	15.9	16.2	3.1	6.6	22.9
		2006	328	17.2	18.1	3.8	6.8	26.0
		2011	328	18.7	20.2	4.7	6.6	30.1
Marital status	Married	2001	328	51.8	52.9	5.9	31.0	62.4
		2006	328	50.1	51.0	5.9	27.6	63.3
		2011	328	49.0	49.8	5.3	28.4	61.0
	Separated	2001	328	3.5	3.5	0.6	1.4	6.5
		2006	328	3.1	3.2	0.6	0.0	7.1
		2011	328	3.1	3.2	0.6	0.9	5.6
	Divorced	2001	328	7.4	7.4	1.3	3.9	12.3
		2006	328	8.3	8.3	1.4	4.4	15.6
		2011	328	8.5	8.6	1.5	4.7	13.4
	Widowed	2001	328	6.1	6.2	1.7	2.1	11.4
		2006	328	5.8	6.0	1.6	1.9	10.2
		2011	328	5.5	5.5	1.5	1.3	9.8
	Never married	2001	328	31.3	30.0	5.8	19.0	54.1
		2006	328	32.7	31.4	6.1	20.7	59.3
		2011	328	33.9	32.7	5.9	21.8	59.4
Household type	Couple family with no children	2001	328	24.8	24.7	3.8	14.1	38.2
		2006	328	25.4	25.4	4.0	14.5	38.4
		2011	328	25.9	25.6	3.9	15.3	37.3
	Couple family with children	2001	328	32.5	32.2	8.5	8.2	55.4
		2006	328	30.6	29.8	8.0	7.3	54.8
		2011	328	30.1	29.1	7.8	7.6	54.3
	One-parent family	2001	328	10.2	10.2	2.3	4.5	18.7
		2006	328	10.2	10.2	2.4	4.0	19.5
		2011	328	10.3	10.3	2.4	3.7	19.8
	Lone-person household	2001	328	22.5	22.7	5.8	9.6	43.0
		2006	328	22.6	23.3	5.4	8.8	46.2
		2011	328	23.0	23.7	5.3	9.5	48.1
	Group household	2001	328	3.5	2.7	2.2	1.3	13.8
		2006	328	3.5	2.7	2.2	1.2	14.5
		2011	328	3.7	2.8	2.3	1.3	14.2

Source: Authors' calculations using TSP dataset

Table A7: Descriptives for additional age and gender variables from the TSP dataset

	Variable	Year	N	Mean	Median	Std. dev.	Min	Max
Age	15–34 years	2001	328	20.0	20.0	3.6	12.0	36.0
		2006	328	19.2	19.0	3.8	10.5	39.9
		2011	328	19.4	19.2	4.0	8.3	38.7
	35–64 years	2001	328	30.8	30.8	2.6	21.5	41.0
		2006	328	32.7	32.7	2.9	22.9	42.1
		2011	328	32.9	33.0	2.9	23.0	40.6
	65 and over	2001	328	12.4	12.8	4.2	2.0	25.5
		2006	328	13.3	13.4	4.2	2.1	27.5
		2011	328	14.3	14.3	4.4	2.6	30.0
Gender	Men	2001	328	49.7	49.4	1.8	46.3	63.9
		2006	328	49.7	49.3	1.8	46.5	60.2
		2011	328	49.7	49.3	2.2	46.7	67.6
	Women	2001	328	50.3	50.6	1.8	36.1	53.7
		2006	328	50.3	50.7	1.8	39.8	53.5
		2011	328	50.3	50.7	2.2	32.4	53.3

Source: Authors' calculations using TSP dataset

Appendix 2: Income quintile ranges and rent ranges for each year for the two income quintile methods

Table A8 below shows the upper and lower bounds of household weekly income for each quintile in 2011. Moving down the left-hand side of the table, these lower and upper bounds are specified for each capital city followed by the balance of that state. The income quintiles for all of Australia are shown in the bottom row of the table in bold. The column highlighted in red shows the upper limit of household income for quintile 2. This is maximum household income for households in the lowest 40 per cent of the income distribution for that year. Again, moving down the table shows this upper bound calculated for each capital city and balance of state, and in the final row for all of Australia. All values are in dollar amounts.

Table A8: 2011 income quintile ranges calculated for capital cities and balance of state, and also Australia-wide

	Income quintiles								
	Q1		Q2		Q3		Q4		Q5
	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower
Greater Sydney	-707	698	699	1,107	1,108	1,695	1,696	2,579	2,580
NSW balance of state	-404	487	488	698	699	1,107	1,108	1,674	1,675
Greater Melbourne	-606	612	613	1,047	1,048	1,528	1,529	2,259	2,260
VIC balance of state	-606	487	488	698	699	976	977	1,534	1,535
Greater Brisbane	-606	698	699	1,107	1,108	1,536	1,537	2,214	2,215
QLD balance of state	-505	487	488	896	897	1,265	1,266	1,805	1,806
Greater Adelaide	-404	487	488	896	897	1,185	1,186	1,775	1,776
SA balance of state	-404	487	488	698	699	961	962	1,396	1,397
Greater Perth	-707	698	699	1,107	1,108	1,659	1,660	1,775	1,776
WA balance of state	-404	526	527	974	975	1,443	1,444	2,259	2,260
Greater Hobart	-404	487	488	698	699	1,107	1,108	1,695	1,696
TAS balance of state	-303	487	488	698	699	896	897	1,383	1,384
Greater Darwin	-505	976	977	1,534	1,535	2,003	2,004	2,701	2,702
NT balance of state	-202	896	897	1,363	1,364	1,792	1,793	2,579	2,580
ACT	-404	1,054	1,055	1,594	1,595	2,061	2,062	2,726	2,727
Aust	-707	526	527	961	962	1,396	,1397	2,182	2,183

Source: ABS customised data request

What Table A8 above shows is that in most states (except for South Australia and Tasmania) household incomes in capital cities are higher than in the rest of that state. Further, it also highlights the variability in household income across capital cities and balance of states relative to the Australia-wide income range specified at the bottom of the table. Table A9 below mirrors this pattern for affordable rent ranges.

Table A9 reports the corresponding rent ranges for each income quintile where rent is set at 30 per cent of household income. Again, the column highlighted in red shows the upper limit of rent that households in the bottom two income quintiles (bottom 40% of the income distribution) can afford to pay for their housing costs to be affordable (no more than 30% of their income).

Table A9: Thirty per cent rent cut-offs calculated for two income quintile methods— capital city and balance of state and Australia-wide for 2011

	Rent quintiles								
	Q1		Q2		Q3		Q4		Q5
	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower
Greater Sydney	1	209.4	209.5	332.1	332.2	508.5	508.6	773.7	773.8
NSW balance of state	1	146.1	146.2	209.4	209.5	332.1	332.2	502.2	502.3
Greater Melbourne	1	183.6	183.7	314.1	314.2	458.4	458.5	677.7	677.8
VIC balance of state	1	146.1	146.2	209.4	209.5	292.8	292.9	460.2	460.3
Greater Brisbane	1	209.4	209.5	332.1	332.2	460.8	460.9	664.2	664.3
QLD balance of state	1	146.1	146.2	268.8	268.9	379.5	379.6	541.5	541.6
Greater Adelaide	1	146.1	146.2	268.8	268.9	355.5	355.6	532.5	532.6
SA balance of state	1	146.1	146.2	209.4	209.5	288.3	288.4	418.8	418.9
Greater Perth	1	209.4	209.5	332.1	332.2	497.7	497.8	532.5	532.6
WA balance of state	1	157.8	157.9	292.2	292.3	432.9	433	677.7	677.8
Greater Hobart	1	146.1	146.2	209.4	209.5	332.1	332.2	508.5	508.6
TAS balance of state	1	146.1	146.2	209.4	209.5	268.8	268.9	414.9	415
Greater Darwin	1	292.8	292.9	460.2	460.3	600.9	601	810.3	810.4
NT balance of state	1	268.8	268.9	408.9	409	537.6	537.7	773.7	773.8
ACT	1	316.2	316.3	478.2	478.3	618.3	618.4	817.8	817.9
Aust	1	157.8	157.9	288.3	288.4	418.8	418.9	654.6	654.7

Source: ABS customised data request

Table A10: 2006 income quintile ranges calculated for capital cities and balance of state, and also Australia-wide

	2006 Income quintiles								
	Q1		Q2		Q3		Q4		Q5
	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower
Greater Sydney	-672	500	501	887.3	888.3	1,381	1,382	2,002.8	2,003.8
NSW balance of state	-480	314.9	315.9	514.9	515.9	887.3	888.3	1,205.4	1,206.4
Greater Melbourne	-576	500	501	762	763	1,115.5	1,116.5	1,759.8	1,760.8
VIC balance of state	-384	314.9	315.9	500	501	814.9	815.9	1,190.5	1,191.5
Greater Brisbane	-576	500	501	814.9	815.9	1,115.5	1,116.5	1,615.5	1,616.5
QLD balance of state	-384	500	501	690.5	691.5	1,000	1,001	1,410	1,411
Greater Adelaide	-576	400	401	690.5	691.5	958.8	959.8	1,387.3	1,388.3
SA balance of state	-288	314.9	315.9	500	501	771.5	772.5	1,187	1,188
Greater Perth	-480	500	501	690.5	691.5	1,115.5	1,116.5	1,610	1,611
WA balance of state	-576	500	501	700	701	1,115.5	1,116.5	1,615.5	1,616.5
Greater Hobart	-384	314.9	315.9	629.8	630.8	887.3	888.3	1,381	1,382
TAS balance of state	-192	314.9	315.9	500	501	700	701	1,115.5	1,116.5
Greater Darwin	-192	690.5	691.5	1,005.4	1,006.4	1,387.3	1,388.3	1,910	1,911
NT balance of state	-120.5	690.5	691.5	958.8	959.8	1,381	1,382	1,806	1,807
ACT	-288	887.3	888.3	1,190.5	1,191.5	1,615.5	1,616.5	2,259.8	2,260.8
Aust	-672	500	501	690.5	691.5	1,115.5	1,116.5	1,615.5	1,616.5

Source: ABS customised data request

Table A11: Thirty per cent rent cut offs calculated for two different income quintiles—capital city and balance of state and also Australia-wide for 2006

	2006 Rent quintiles								
	Q1		Q2		Q3		Q4		Q5
	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower
Greater Sydney	1	150	150.1	266.19	266.3	414.3	414.4	600.84	600.94
NSW balance of state	1	94.47	94.57	154.47	154.6	266.19	266.29	361.62	361.72
Greater Melbourne	1	150	150.1	228.6	228.7	334.65	334.75	527.94	528.04
VIC balance of state	1	94.47	94.57	150	150.1	244.47	244.57	357.15	357.25
Greater Brisbane	1	150	150.1	244.47	244.6	334.65	334.75	484.65	484.75
QLD balance of state	1	150	150.1	207.15	207.3	300	300.1	423	423.1
Greater Adelaide	1	120	120.1	207.15	207.3	287.64	287.74	416.19	416.29
SA balance of state	1	94.47	94.57	150	150.1	231.45	231.55	356.1	356.2
Greater Perth	1	150	150.1	207.15	207.3	334.65	334.75	483	483.1
WA balance of state	1	150	150.1	210	210.1	334.65	334.75	484.65	484.75
Greater Hobart	1	94.47	94.57	188.94	189.0	266.19	266.29	414.3	414.4
TAS balance of state	1	94.47	94.57	150	150.1	210	210.1	334.65	334.75
Greater Darwin	1	207.15	207.25	301.62	301.7	416.19	416.29	573	573.1
NT balance of state	1	207.15	207.25	287.64	287.7	414.3	414.4	541.8	541.9
ACT	1	266.19	266.29	357.15	357.3	484.65	484.75	677.94	678.04
Aust	1	150	150.1	207.15	207.3	334.65	334.75	484.65	484.75

Source: ABS customised data request

Table A12: 2001 income quintile ranges calculated for capital cities and balance of state and also Australia-wide

	2001 Income quintiles								
	Q1		Q2		Q3		Q4		Q5
	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower
Greater Sydney	0	492	493	794	795	1,154	1,155	1,774	1,775
NSW balance of state	0	346	347	449	450	695	696	997	998
Greater Melbourne	0	426	427	654	655	987	988	1,445	1,446
VIC balance of state	0	330	331	449	450	695	696	997	998
Greater Brisbane	0	360	361	595	596	887	888	1,202	1,203
QLD balance of state	0	349	350	529	530	750	751	1,096	1,097
Greater Adelaide	0	349	350	529	530	750	751	1,103	1,104
SA balance of state	0	330	331	449	450	654	655	930	931
Greater Perth	0	349	350	548	549	775	776	1,154	1,155
WA balance of state	0	349	350	548	549	848	849	1,202	1,203
Greater Hobart	0	306	307	449	450	695	696	997	998
TAS balance of state	0	246	247	426	427	563	564	887	888
Greater Darwin	0	496	497	750	751	1,103	1,104	1,503	1,504
NT balance of state	0	548	549	798	799	1,099	1,100	1,500	1,501
ACT	0	595	596	887	888	1,154	1,155	1,702	1,703
Aust	0	349	350	595	596	887	888	1,298	1,299

Source: ABS customised data request

Table A13: Thirty per cent rent cut offs calculated for two income quintile methods— capital city and balance of state and Australia-wide, for 2001

	2001 Rent quintiles								
	Q1		Q2		Q3		Q4		Q5
	Lower	Higher	Lower	Higher	Lower	Higher	Lower	Higher	Lower
Greater Sydney	1	147.6	147.7	238.2	238.3	346.2	346.3	532.2	532.3
NSW balance of state	1	103.8	103.9	134.7	134.8	208.5	208.6	299.1	299.2
Greater Melbourne	1	127.8	127.9	196.2	196.3	296.1	296.2	433.5	433.6
VIC balance of state	1	99	99.1	134.7	134.8	208.5	208.6	299.1	299.2
Greater Brisbane	1	108	108.1	178.5	178.6	266.1	266.2	360.6	360.7
QLD balance of state	1	104.7	104.8	158.7	158.8	225	225.1	328.8	328.9
Greater Adelaide	1	104.7	104.8	158.7	158.8	225	225.1	330.9	331
SA balance of state	1	99	99.1	134.7	134.8	196.2	196.3	279	279.1
Greater Perth	1	104.7	104.8	164.4	164.5	232.5	232.6	346.2	346.3
WA balance of state	1	104.7	104.8	164.4	164.5	254.4	254.5	360.6	360.7
Greater Hobart	1	91.8	91.9	134.7	134.8	208.5	208.6	299.1	299.2
TAS balance of state	1	73.8	73.9	127.8	127.9	168.9	169	266.1	266.2
Greater Darwin	1	148.8	148.9	225	225.1	330.9	331	450.9	451
NT balance of state	1	164.4	164.5	239.4	239.5	329.7	329.8	450	450.1
ACT	1	178.5	178.6	266.1	266.2	346.2	346.3	510.6	510.7
Aust	1	104.7	104.8	178.5	178.6	266.1	266.2	389.4	389.5

Source: ABS customised data request

Appendix 3: Additional modelling results

Table A14: modelling estimates on national sample using cultural definition of homelessness

Variable type	Variable name	(1) OLS	(2) Fixed effects	(3) Random effects
Demography	% males	0.0746***	0.164***	0.0951***
		(0.0121)	(0.0262)	(0.0145)
	% sole parents	0.0570***	0.138***	0.0740***
		(0.0142)	(0.0353)	(0.0162)
	% Indigenous	0.0173***	0.0704**	0.0201**
		(0.00656)	(0.0336)	(0.00823)
	% aged 15–34	0.00364	-0.00943	0.00269
		(0.00461)	(0.0118)	(0.00575)
	% never married	0.0231***	-0.0256	0.0153**
		(0.00534)	(0.0170)	(0.00674)
	% couple families with children	-0.0413***	0.0127	-0.0341***
		(0.00816)	(0.0138)	(0.00845)
	Average household size	0.154	0.419	0.111
		(0.232)	(0.339)	(0.241)
Income inequality and labour market	Gini	-0.360	2.766*	0.180
		(1.134)	(1.608)	(1.157)
Labour market	% unemployed	0.0151	-0.0496***	-0.0107
		(0.0126)	(0.0147)	(0.0118)
Tenure type	% outright owners	0.00142	-0.00463	0.000665
		(0.00407)	(0.00805)	(0.00466)
	% in social housing	-0.0128	-0.0378*	-0.0156
		(0.00790)	(0.0197)	(0.00976)
Dwelling type	% living in flat, unit or apartment	0.00999***	0.0178*	0.0160***
		(0.00271)	(0.00908)	(0.00341)
Housing supply	% relative net supply	-0.000830	0.000472	0.000581
		(0.00108)	(0.00149)	(0.00110)
Climate	Climate variability	0.00509		0.00348
		(0.00427)		(0.00602)
Year	2006	-0.244***	-0.264***	-0.274***
		(0.0559)	(0.0746)	(0.0485)
	2011	-0.329***	-0.253***	-0.321***
		(0.0618)	(0.0837)	(0.0529)
State	Australian Capital Territory	-0.190		-0.102
		(0.128)		(0.177)
	Northern Territory	0.750***		0.704***
		(0.158)		(0.217)
	Queensland	0.220***		0.239***

Variable type	Variable name	(1) OLS	(2) Fixed effects	(3) Random effects
		(0.0554)		(0.0764)
	South Australia	0.188**		0.220**
		(0.0793)		(0.109)
	Tasmania	0.0301		0.0854
		(0.104)		(0.138)
	Victoria	0.395***		0.397***
		(0.0570)		(0.0782)
	Western Australia	0.143*		0.163
		(0.0738)		(0.101)
	Urban	-0.185***		-0.145*
		(0.0610)		(0.0843)
	Constant	-1.090	-7.318***	-2.151**
		(0.827)	(1.832)	(1.001)
	Number of observations	868	868	868
	R-squared	0.564	0.194	
	Number of SA3s		328	328

Standard errors in parentheses. Coefficients significant at *** p<0.01, ** p<0.05, * p<0.1

Table A15: Modelling estimates on national sample using literal or US style definition of homelessness

Variable type	Variable name	(1) OLS	(2) Fixed effects	(3) Random effects
Demography	% males	0.0660***	0.00966	0.0568***
		(0.0173)	(0.0335)	(0.0206)
	% sole parents	0.00147	-0.0150	-0.00555
		(0.0203)	(0.0460)	(0.0233)
	% Indigenous	0.0241***	0.0563	0.0352***
		(0.00776)	(0.0452)	(0.0106)
	% aged 15–34	-0.00388	0.0135*	0.00316
		(0.00606)	(0.00769)	(0.00632)
	% never married	0.00992	0.0530**	0.00625
		(0.00757)	(0.0211)	(0.00979)
	% couple families with children	-0.0325***	0.0236*	-0.0255***
		(0.00563)	(0.0141)	(0.00669)
Income inequality and labour market	Gini	0.303	-1.382	0.0973
		(1.571)	(1.895)	(1.519)
Labour market	% unemployed	0.0524***	-0.0179	0.0213
		(0.0175)	(0.0186)	(0.0159)

Tenure type	% outright owners	-0.0104* (0.00570)	-0.0628*** (0.0101)	-0.0215*** (0.00658)
	% in social housing	-0.00742 (0.0114)	-0.0862*** (0.0242)	-0.0256* (0.0141)
Dwelling type	% living in flat, unit or apartment	-0.000917 (0.00388)	0.0178 (0.0113)	0.00252 (0.00495)
Housing supply	% relative net supply	0.000869 (0.00153)	0.000392 (0.00192)	0.00226 (0.00152)
Climate	Climate variability	0.00797 (0.00609)		0.00812 (0.00909)
Year	2006	-0.0481 (0.0803)	-0.552*** (0.0944)	-0.163** (0.0672)
	2011	-0.0778 (0.0857)	-0.599*** (0.104)	-0.185*** (0.0708)
State	Australian Capital Territory	-0.0106 (0.180)		-0.0247 (0.263)
	Northern Territory	0.761*** (0.214)		0.527 (0.323)
	Queensland	0.0310 (0.0785)		-0.0284 (0.115)
	South Australia	-0.148 (0.114)		-0.0799 (0.163)
	Tasmania	-0.197 (0.137)		-0.0951 (0.203)
	Victoria	0.769*** (0.0830)		0.726*** (0.118)
	Western Australia	0.000812 (0.107)		-0.0815 (0.153)
	Urban	-0.391*** (0.0856)		-0.394*** (0.126)
	Constant	-0.257 (1.126)	2.495 (2.191)	0.830 (1.383)
	Number of observations	905	905	905
	R-squared	0.439	0.131	
	Number of SA3s		328	328

Standard errors in parentheses, coefficients significant at *** p<0.01, ** p<0.05, * p<0.1

Appendix 4: Contemporaneous correlations between operational groups

The following six tables report the Pearson correlation coefficients for the six operational groups in each year (2001, 2006 and 2011) using two different measures. The first three tables report correlation coefficients for each year using a rate per 10 000 measure. The final three tables report these same correlation coefficients but using the raw count of homeless persons in each operational group.

What these tables show is that most of the operational groups are significantly positively correlated with each other in each year. This broadly indicates that local regions with more homelessness in one operational group will also tend to have more homelessness in the other operational groups—supporting our decision to look at all components together rather than individually in modelling work. There are, however, some exceptions. In 2001, using the rate measure, operational groups 2 and 3 are not significantly correlated, and neither are operational groups 5 and 6 and operational groups 4 and 6. This pattern was also evident in 2006. In 2011, a significant and positive relationship was detected between operational groups 2 and 3, while the lack of a relationship between operational groups 5 and 6 and 4 and 6 persisted.

Looking now at Tables A19 through to A21, which use the raw count of homeless persons in each group, the 2001 table shows no significant relationship between operational group 6 and any other group except operational group 1. This pattern is repeated in 2006 and 2011, with the only difference being operational group 2 becomes significantly positively related to operational group 6 in 2011.

Table A16: The rate of homelessness per 10 000 persons for each of the six homeless operational groups for 2001

		Persons in improvised dwellings, tents or sleepers out (Op. group 1)	Persons staying in supported accommodation for the homeless (Op. group 2)	Persons staying temporarily with other households (Op. group 3)	Persons staying in boarding houses (Op. group 4)	Persons in other temporary lodging (Op. group 5)	Persons in severely crowded dwellings (Op. group 6)
Op. group 1	Pearson correlation	1	.329**	.390**	.391**	.283**	.610**
	N	328	328	210	210	328	328
Op. group 2	Pearson correlation	.329**	1	.072	.648**	.293**	.125*
	N	328	328	210	210	328	328
Op. group 3	Pearson correlation	.390**	.072	1	.184**	.277**	.218**
	N	210	210	210	210	210	210
Op. group 4	Pearson correlation	.391**	.648**	.184**	1	.448**	.057
	N	210	210	210	210	210	210
Op. group 5	Pearson correlation	.283**	.293**	.277**	.448**	1	.009
	N	328	328	210	210	328	328
Op. group 6	Pearson correlation	.610**	.125*	.218**	.057	.009	1
	N	328	328	210	210	328	328

Source: Authors' calculations using ABS homelessness estimates

Table A17: The rate of homelessness per 10 000 persons for each of the six homeless operational groups for 2006

		Persons in improvised dwellings, tents or sleepers out (Op. group 1)	Persons staying in supported accommodation for the homeless (Op. group 2)	Persons staying temporarily with other households (Op. group 3)	Persons staying in boarding houses (Op. group 4)	Persons in other temporary lodging (Op. group 5)	Persons in severely crowded dwellings (Op. group 6)
Op. group 1	Pearson correlation	1	.441**	.333**	.619**	.277**	.662**
	N	328	172	320	177	328	328
Op. group 2	Pearson correlation	.441**	1	.054	.622**	.417**	.000
	N	172	172	172	172	172	172
Op. group 3	Pearson correlation	.333**	.054	1	.065	.156**	.139*
	N	320	172	320	172	320	320
Op. group 4	Pearson correlation	.619**	.622**	.065	1	.386**	.065
	N	177	172	172	177	177	177
Op. group 5	Pearson correlation	.277**	.417**	.156**	.386**	1	.005
	N	328	172	320	177	328	328
Op. group 6	Pearson correlation	.662**	.000	.139*	.065	.005	1
	N	328	172	320	177	328	328

Source: Authors' calculations using ABS homelessness estimates

Table A18: The rate of homelessness per 10 000 persons in each of the six operational groups for 2011

		Persons in improvised dwellings, tents or sleepers out (Op. group 1)	Persons staying in supported accommodation for the homeless (Op. group 2)	Persons staying temporarily with other households (Op. group 3)	Persons staying in boarding houses (Op. group 4)	Persons in other temporary lodging (Op. group 5)	Persons in severely crowded dwellings (Op. group 6)
Op. group 1	Pearson correlation	1	.440**	.529**	.479**	.408**	.478**
	N	249	189	233	150	173	157
Op. group 2	Pearson correlation	.440**	1	.187**	.573**	.288**	.226**
	N	189	250	229	143	191	166
Op. group 3	Pearson correlation	.529**	.187**	1	.005	.167*	.261**
	N	233	229	295	159	202	193
Op. group 4	Pearson correlation	.479**	.573**	.005	1	.523**	-.006
	N	150	143	159	179	147	133
Op. group 5	Pearson correlation	.408**	.288**	.167*	.523**	1	-.026
	N	173	191	202	147	233	161
Op. group 6	Pearson correlation	.478**	.226**	.261**	-.006	-.026	1
	N	157	166	193	133	161	212

Source: Authors' calculations using ABS homelessness estimates

Table A19: The raw number of homeless persons in each of the six homeless operational groups for 2001

		Persons in improvised dwellings, tents or sleepers out (Op. group 1)	Persons staying in supported accommodation for the homeless (Op. group 2)	Persons staying temporarily with other households (Op. group 3)	Persons staying in boarding houses (Op. group 4)	Persons in other temporary lodging (Op. group 5)	Persons in severely crowded dwellings (Op. group 6)
Op. group 1	Pearson correlation	1	.250**	.198**	.269**	.421**	.607**
	N	328	328	210	210	328	328
Op. group 2	Pearson correlation	.250**	1	.402**	.648**	.487**	-.022
	N	328	328	210	210	328	328
Op. group 3	Pearson correlation	.198**	.402**	1	.339**	.329**	.066
	N	210	210	210	210	210	210
Op. group 4	Pearson correlation	.269**	.648**	.339**	1	.497**	.018
	N	210	210	210	210	210	210
Op. group 5	Pearson correlation	.421**	.487**	.329**	.497**	1	.066
	N	328	328	210	210	328	328
Op. group 6	Pearson correlation	.607**	-.022	.066	.018	.066	1
	N	328	328	210	210	328	328

Source: Authors' calculations using ABS homelessness estimates

Table A20: The raw number of homeless persons in each of the six homeless operational groups for 2006

		Persons in improvised dwellings, tents or sleepers out (Op. group 1)	Persons staying in supported accommodation for the homeless (Op. group 2)	Persons staying temporarily with other households (Op. group 3)	Persons staying in boarding houses (Op. group 4)	Persons in other temporary lodging (Op. group 5)	Persons in severely crowded dwellings (Op. group 6)
Op. group 1	Pearson correlation	1	.436**	.272**	.570**	.482**	.500**
	N	328	172	320	177	328	328
Op. group 2	Pearson correlation	.436**	1	.486**	.593**	.463**	.118
	N	172	172	172	172	172	172
Op. group 3	Pearson correlation	.272**	.486**	1	.265**	.317**	.022
	N	320	172	320	172	320	320
Op. group 4	Pearson correlation	.570**	.593**	.265**	1	.424**	.100
	N	177	172	172	177	177	177
Op. group 5	Pearson Correlation	.482**	.463**	.317**	.424**	1	.040
	N	328	172	320	177	328	328
Op. group 6	Pearson correlation	.500**	.118	.022	.100	.040	1
	N	328	172	320	177	328	328

Source: Authors' calculations using ABS homelessness estimates

Table A21: The raw number of homeless persons in each of the six homeless operational groups for 2011

		Persons in improvised dwellings, tents or sleepers out (Op. group 1)	Persons staying in supported accommodation for the homeless (Op. group 2)	Persons staying temporarily with other households (Op. group 3)	Persons staying in boarding houses (Op. group 4)	Persons in other temporary lodging (Op. group 5)	Persons in severely crowded dwellings (Op. group 6)
Op. group 1	Pearson correlation	1	.514**	.385**	.655**	.621**	.263**
	N	249	189	233	150	173	157
Op. group 2	Pearson correlation	.514**	1	.493**	.634**	.463**	.194*
	N	189	250	229	143	191	166
Op. group 3	Pearson correlation	.385**	.493**	1	.278**	.312**	.049
	N	233	229	295	159	202	193
Op. group 4	Pearson correlation	.655**	.634**	.278**	1	.686**	.053
	N	150	143	159	179	147	133
Op. group 5	Pearson correlation	.621**	.463**	.312**	.686**	1	.056
	N	173	191	202	147	233	161
Op. group 6	Pearson correlation	.263**	.194*	.049	.053	.056	1
	N	157	166	193	133	161	212

Source: Authors' calculations using ABS homelessness estimates

Appendix 5: Sequential Application of F-Test on Pooled OLS Estimates[66]

The regression models reported in Chapter 5 contain three groups of variables; the first is a set of controls for climate and demography, where the latter capture the effects of disproportionate numbers of high risk demographic groups (e.g. Indigenous) on a region's per capita rates of homelessness. A second set contains measured structural variables that include income inequality, housing and labour market measures. Finally, there are unobserved or unknown structural factors that develop as time unfolds, or vary across jurisdictional boundaries due to differences in relevant institutional arrangements. We hope to pick these effects up by the addition of calendar year dummies (2006 and 2011), as well as state dummies.

In this appendix we use an F-Test to judge whether each *group* of variables make a statistically significant combined contribution to the model's explanatory power. In addition, we evaluate each group's contribution to the 'explained' part of the variation in rates of homelessness (across 328 local regions). We begin with the unrestricted pooled OLS estimates that contain all three groups of variables. One set of variables is then omitted (say climate and demographics) and pooled OLS estimates of this restricted model are obtained. The error sum of squares from the unrestricted (ESS_{UR}) and restricted (ESS_R) models are then used to form an F statistic to test the exclusion restrictions, that is, the null hypothesis that each of the coefficients in the vector of climate and demographic controls is zero (Wooldridge 2009, pp.143–48). The R^2 from the unrestricted (R^2_{UR}) and restricted (R^2_R) models is used to compute the proportion of 'explained' variation in the dependent variable is due to the vector of climate and demographic controls. The procedure is repeated with demographic and climate controls reinstated, but with the vector of income inequality, housing and labour market variables now omitted. Finally, calendar year and state dummies are omitted and a restricted model containing demographic and climate controls alongside income inequality, labour and housing market variables is estimated and the test routine repeated.

Our findings are reported in Table A22 below. The F-test statistic is always statistically significant at 1 per cent or better in each of the three restricted models. However, demographics and climate controls appear to be the most important vector of variables as they contribute 15 per cent of the model's explanatory power, while the other two sets of variables contribute roughly one-third of this explanatory power.[67] Indeed, when demographic and climate controls are omitted, there is considerable instability in coefficient estimates with four variables and the constant changing sign, and a total of seven variables either losing significance at conventional levels (10% or better), or becoming significant. The pooled OLS estimates are more stable in the other two restricted models. For example, when calendar year and state dummies are omitted, two variables change sign, and only two variables either lose or gain significance.

[66] We are grateful to an anonymous peer reviewer for suggesting this approach.

[67] The contribution of each vector to the model's explanatory power is computed from

$$1 - \bar{R}^2_{\bar{R}} \Big/ \bar{R}^2_{U\bar{R}}$$

Table A22: F-tests on exclusion of groups of variables

			Model 1 results omits demographic and climate	Model 2 results omits inequality, housing and labour market	Model 3 results omits year and state
Model	**Variable type**	**Variable name**			
Model 1—demography and climate	Demography	% males	NA	0.093***	0.086***
				(0.010)	(0.011)
		% sole parents	NA	0.048***	0.022*
				(0.008)	(0.013)
		% Indigenous	NA	0.058***	0.068***
				(0.003)	(0.004)
		% aged 15–34	NA	0.013***	0.009**
				(0.004)	(0.004)
		% never married	NA	0.037***	0.029***
				(0.003)	(0.005)
		% couple families with children	NA	-0.025***	-0.002
				(0.002)	(0.003
	Climate	Climate variability	NA	-0.004	-0.002
				(0.004)	(0.004)
Model 2—Inequality, housing and labour market	Income inequality and labour market	Gini	4.847***	NA	2.730***
			(1.107)		(0.990)
	Labour market	% unemployed	0.004	NA	0.050***
			(.011)		(0.010)
	Tenure type	% outright owners	-0.008**	NA	0.001
			(0.003)		(0.003)
		% in social housing	0.073***	NA	-0.004
			(.006)		(0.006)
	Dwelling type	% living in flat, unit or apartment	0.021***	NA	0.017***
			(0.002)		(0.002)
	Housing supply	% relative net supply	0.006***	NA	0.002**
			(0.001)		(0.001)
	Year	2006	-0.106*	-0.253***	
			(0.055)	(0.040)	NA
		2011	0.065	-0.241***	
			(0.055)	(0.041)	NA

			Model 1 results omits demographic and climate	Model 2 results omits inequality, housing and labour market	Model 3 results omits year and state
Model	**Variable type**	**Variable name**			
Model 3—Year and state variables	State	Australian Capital Territory	-0.223*	-0.506***	
			(0.124)	(0.110)	NA
		Northern Territory	1.428***	0.604***	
			(0.138)	(0.141)	NA
		Queensland	0.324***	0.062	
			(0.053)	(0.047)	NA
		South Australia	-0.156**	0.062	
			(0.075)	(0.066)	NA
		Tasmania	-0.147	-0.237***	
			(0.096)	(0.086)	NA
		Victoria	0.258***	0.271***	
			(0.056)	(0.049)	NA
		Western Australia	0.169**	-0.066	
			(0.072)	(0.061)	NA
		Constant	1.572***	-2.233***	-3.604***
			(0.323)	(0.517)	(0.695)
Statistics		Number of observations	984		
		F-statistic	F(15,968)= 91.86	F(16,967)= 117.77	F(13,970)= 141.77
		Restricted - squared	0.5874	0.6609	0.6552
		Unrestricted $\bar{R}$ squared	0.6939		
		Change in R square	0.1066***	0.0331***	0.0388***

Note: *** denotes significance at 1 per cent; ** denotes significant at 5 per cent; * denotes significance at 1 per cent.

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