External Research Report
Issue Date: 04/08/2017
ISSN: 2423-0839

Report ER22 (B)

Modelled housing quality and tenure in New Zealand

Lucy Telfar-Barnard

Project LR0487
University of Otago, funded by the Building Research Levy

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Preface

This paper is the second of two papers in the New Zealand Rental Sector project, funded by BRANZ according to Industry Research Strategy priorities. It addresses questions related to building condition within two research priority topics. Addressing the "Maintaining and improving the performance of existing buildings" research priority, it reports on differences between New Zealand's rental and non-rental housing stock, and identifies housing conditions in rental tenure, socio-economically deprived areas, and older houses, as priority areas for improving conditions. It may also contribute to understanding the implications of increased rental tenure, which is part of the research priority "Meeting the housing needs of all New Zealanders".

Acknowledgments

The author acknowledges and thanks the Ministry of Business, Innovation and Employment (MBIE) for a secondment allowing access to Tenancy Bond data; CoreLogic for their prompt and comprehensive advice on their data; James Kerr of MBIE for feedback and comments on an initial draft; Helen Viggers and Zhang Wei for advice on relationships between the Healthy Housing Index and the Housing Warrant of Fitness; Michael Keall for providing access to Home Injury Prevention Study data; and BRANZ for funding the broader Rental Sector research project of which this report is part.

Intended audience

This paper will be of primary interest to local and central government policy makers and businesses who are interested in housing quality and condition, and in particular in how to measure housing quality and condition at a national or regional scale; and also to policy makers and researchers interested in housing quality and tenure.

Report peer reviewed by Dr Nicholas Preval, Centre for Sustainable Cities, University of Otago, Wellington.

Abstract

With wide-scale individual housing inspections being expensive, cost-effective ways are needed to measure housing quality and differences in quality by tenure, demography and housing attributes. We used nationwide data from CoreLogic and Tenancy Bonds, and 714 Healthy Housing Index inspections, to develop a Modelled Inspection-Derived Condition Score (MIDCS). We assessed the MIDCS as a measure of housing quality or condition, and also measured differences in MIDCS by tenure, rental quartile, main centre, census area socio-economic status (NZDep2013), and dwelling size, type, and construction era.

The MIDCS was lower in rental than non-rental properties; lower in Wellington and Dunedin than in Auckland and Christchurch; lower in older than in newer properties; decreased with increasing socio-economic deprivation; and varied by housing type. However, the model explained very little of the variation in dwelling condition. Nationwide survey data is needed to better measure broader housing quality.

Keywords: housing quality, housing condition, tenure, property value, minimum standards, modelling

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Background

New Zealand has experienced a profound transition over the last generation, from a nation of predominantly home owners, to one where almost as many people live in rental tenure as live in their own homes. A separate, concurrent report to BRANZ (Witten et al 2017) details changes and differences in tenure distribution over time, and by age and region.

While New Zealand as a nation may aspire to returning to greater home ownership rates, the structure of the property and investment markets, as well as low levels of new builds compared to population growth, mean that such a return is unlikely to happen quickly.

As rates of rental tenure have increased, attention has turned to the quality of rental properties. New Zealand housing is generally thought to have significant deferred maintenance[1-4], and have poor health and safety measures[5]. However, objective and systematic data on national housing quality is sparse.

The Building Research Association of New Zealand (BRANZ) has provided the best evidence of quality and changes in quality over time in its House Condition Surveys (1995[4], 1999[3], 2005[2], 2010[1], 2016), but resource limitations mean inspections have covered only a relatively small proportion of dwellings. Rental properties were included in the 2010 and 2016 surveys, but sample sizes were too small to enable statistically valid disaggregation. Inspections required tenant consent, and contact was made by landline, meaning the survey may not have included the worst of our dwellings.

Statistics New Zealand found in their 2014/15 General Social Survey that people in the lowest income band were more likely to find their homes cold or damp than those in the highest income band; and also that renters were more likely than owner-occupiers to find their homes cold and/or damp[6]. Findings were not disaggregated by both tenure and income, so the effect of tenure independent of income was not clear.

International evidence of a clear relationship between dwelling tenure and condition is surprisingly sparse. A February 2016 literature review using Medline, Google Scholar and Google, searching on the words “tenure” and “housing quality” or “housing condition” produced only six relevant results. Markham and Gilderbloom found that among the elderly, rental tenure was associated with housing inadequacy[7]. Lane and Kinsey found lower satisfaction with housing characteristics among renters than home owners[8]. Ellaway and McIntyre found that “renters were almost four times as likely to report problems with dampness and/or condensation … [as] owner-occupiers.”[9] Iwata and Yamaga found “that the quality of renter-occupied housing is lower than that of owner-occupied housing … for single-family housing in Japan.”[10] In Ghana, Fiadzo found tenure to be a significant predictor of housing condition[11]. However, López-Colás and Módenes argued that while owners had better residential conditions than other tenures in Norway, Germany, the UK, Spain and Poland, more of the variation in Spanish housing quality was explained by house type than by tenure.

Housing quality, and differences in quality by tenure, matter. Rental tenure has been found to be associated with a broad range of poor outcomes, including poor physical and mental health[12-19]; and also with greater residential mobility, leading to worse health[20] and educational outcomes[21 22]. However, researchers continue to debate how much of the association between tenure and poor outcomes is due to issues the quality of rental housing; and how much is due to people who are likely to have poor outcomes for other reasons, such as low assets or income, being more likely to live in rental tenure[23 24]. Poor quality housing does cause ill health[25-30], but so too does the low socio-economic status that puts people in poor housing [31 32]. Better understanding of the quality of rental housing, and the ability to differentiate between the separate contributions of housing quality and other rental-tenure-associated risks would contribute to better understanding of how to improve outcomes.

At the national economic level, poor housing quality has economic implications for energy use, with poorly-insulated and/or damp properties requiring more energy to heat, and therefore impacting New Zealand's ability to meet climate change obligations, and bringing a range of cold-housing-related health costs[33]. Deferred maintenance and deteriorated materials also represent an additional national financial liability, as they will eventually need to be repaired or replaced if the country is to be adequately housed.

The importance of housing condition; the need to measure and monitor differences in housing quality by tenure, and identify areas in particular need of attention; and well as the utility of housing quality measures in other research; make it timely to investigate cost-effective ways to measure housing quality (condition, health and safety) across the country.

While international evidence is limited, New Zealand is in the enviable position of having a good range of nationwide administrative data available and able to be matched in ways that preserve the anonymity of individuals. This study aimed to contribute to knowledge of New Zealand housing standards, by investigating whether administrative data could serve as a proxy for housing inspection; and to model a nationwide housing condition indicator to investigate differences in housing quality by tenure.

Aims

This study had four broad aims:

- to see whether administrative data was a suitable proxy for housing inspection in assessing housing quality, with housing quality covering the two separate issues of health and safety, and housing condition.
- to combine data sources to derive an individual dwelling-level modelled housing quality indicator for the majority of New Zealand houses;
- to develop a census meshblock housing quality index for use in subsequent ecological studies; and
- to analyse differences in modelled housing quality by tenure, and across rental quartiles, with sub-analyses for Auckland, Wellington, Christchurch and Dunedin.

Methodology

Housing quality was assessed using the University of Otago's *He Kainga Oranga*/Housing and Health Research Programme's 29-point Housing Warrant of Fitness (HWoF). A full list of HWoF items is provided in Appendix A, and the assessment manual is available online at http://www.healthyhousing.org.nz/wp-content/uploads/2016/09/WOF-Assessment-Criteria-and-Methodology-Version-2.1-June-2014.pdf.

All statistical regressions and machine matching were carried out in Stata 13.1.

Data sources

Data sources used in the study were as follows:

- CoreLogic data: 12 April 2017 data providing dwelling age, style, condition, location, tenure estimate; for most dwellings in New Zealand; and April 2006 data providing dwelling age, style, condition, and location; for dwellings matched at the time to 2006 National Health Index addresses.
- University of Otago Healthy Housing Index (HHI) inspection data for 865 dwellings in Taranaki, carried out between January 2007 and December 2008 as part of the University of Otago Home Injury Prevention Study. As HHI inspections were conducted between January 2007 and December 2008, these were matched to 2006 CoreLogic data for model development.
- Tenancy Bond data; estimated to include roughly 85% of all rental properties, current to 14 February 2017; supplied with a qpid assigned in previous matching carried out by the Ministry of Business, Innovation and Employment.
- University of Otago data on 27,217 properties insulated under the EECA insulation scheme, and 232,099 control properties, matched to CoreLogic identifiers for the Warm Up New Zealand: Heat Smart (WUNZ) evaluation[34].

For the 865 Taranaki HHI-inspected, we checked HHI inspection results against HWoF checklist items. Four HWoF items (15,16, 28, 29) were not mappable from the 2007/08 HHI.

Data matching

HHI-inspected properties were matched by address to 2006 CoreLogic addresses, using machine and manual matching carried out by the author. Addresses and unmatched properties were then deleted from the dataset, leaving the CoreLogic individual dwelling identifier “qpid”, and the HWoF item pass/fail indicators.

Tenancy Bond data qpids were merged with CoreLogic- supplied housing data. Matched properties with a bond current between 1 January 2016 and 14 February 2017 (the date the data was produced) were labelled as rented, and assigned a territorial authority rental quartile based on the current rent.

Association between CoreLogic fields and HWoF items

We used logistic regression to assess whether any of three CoreLogic fields potentially associated with housing quality were associated with likelihood of pass or fail for each of the 26 mapped HWoF measures. The CoreLogic variables used were:

- Wall condition (0=Poor, 1=Fair; 2= Mixed, 3=Average, 4=Good)
- Roof condition (0=Poor, 1=Fair; 2= Mixed, 3=Average, 4=Good)
- A property improvement value/m^2 index (development of this index is described below).

Other variables in the CoreLogic data, such as roof and wall material, house type and age, and floor area, may vary with housing quality but were not quality assessments, so were not compared to HWoF item passes.

The results of the regression are described in the Results section. At least one CoreLogic variable was positively associated with passing at least one of seven of the 26 HWoF items. We therefore assigned an inspection-derived condition score (IDCS) to each dwelling, based on points achieved across the seven HWoF inspection items associated with CoreLogic potential quality indicators. Dwellings were given 1 point for each item found to be satisfactory.

As no CoreLogic fields were found to be associated with presence or absence of insulation or fixed heating, nor with other HWoF health or safety hazards, these items could not be included in an inspection-derived quality measure. We therefore describe the IDCS as a condition score rather than a quality score because of the absence of key quality indicators from the rating.

Property improvement value/m^2 index

In order to separate the part of a property value that was due to the condition and aesthetics of the property, from its value due to size and location, we first calculated the improvement value by subtracting the CoreLogic land value field from the total capital value field. We then considered the relationship between improvement value and dwelling size. Improvement values for HHI-inspected properties were adjusted upwards by the overall 2006 – 2017 increase in improvement values for their territorial authorities.

We excluded 1959 properties of $0m^2$ as not indicating the true size of the dwellings. We also excluded 4,504 properties between 1 m^2 and $29m^2$ as unlikely to represent standalone dwellings and/or unlikely to be well represented by the HHI dwelling inspections, the smallest of which was $60m^2$. Where information on house type was available these $<30m^2$ properties were predominantly (70%) categorised as “Bach”, although baches made up only 2% of total residential property records.

We also immediately excluded 7,404 properties with no floor area data; and 352 properties of more than $1000m^2$, as either implausible or similarly unlikely to be well-represented by HHI dwelling inspections, the largest of which was recorded as $440m^2$.

Finally, we excluded 2554 further outliers by plotting the distribution of remaining properties by floor area and identifying $550m^2$ as a reasonable and safe, if somewhat arbitrary, point at which to cut off floor area. The $420m^2$ difference from the $130m^2$ median represented 7.25 times the $59.3m^2$ Median Absolute Deviation (MAD), well outside the 3 MADs commonly selected as “very conservative” for selection of outliers[35].

The remaining distribution of property sizes is shown in Figure 1.

To identify included improvement values, we first excluded 373,238 properties with no capital value. Next excluded were 57 properties with a $0 improvement value. The median improvement value for remaining properties was 205,000. Having used 7.25 MADs as the upper limit for floor area, we used the same cut-off for improvement value, excluding 5,647 properties with more than $1,020,000 difference between the capital value and the land value. The distribution of the remaining dwellings by improvement value is shown in Figure 2.

For the remaining 1,144,688 dwellings, we divided the improvement value by the total building area, and excluded a further 294 properties above $5,455/$m^2$, i.e. more than 7.25

MADs above the $1,500/m^2 median. The returned improvement values per square metre were then divided into fifty groups of 2 percentile points within each territorial authority (pre-amalgamation territorial authorities were used for Auckland), to account for any additional variation in improvement values and building costs around the country. These quinquagintiles made up the property improvement value/m^2 index in the model.

Figure 1. Distribution of dwellings by floor area.

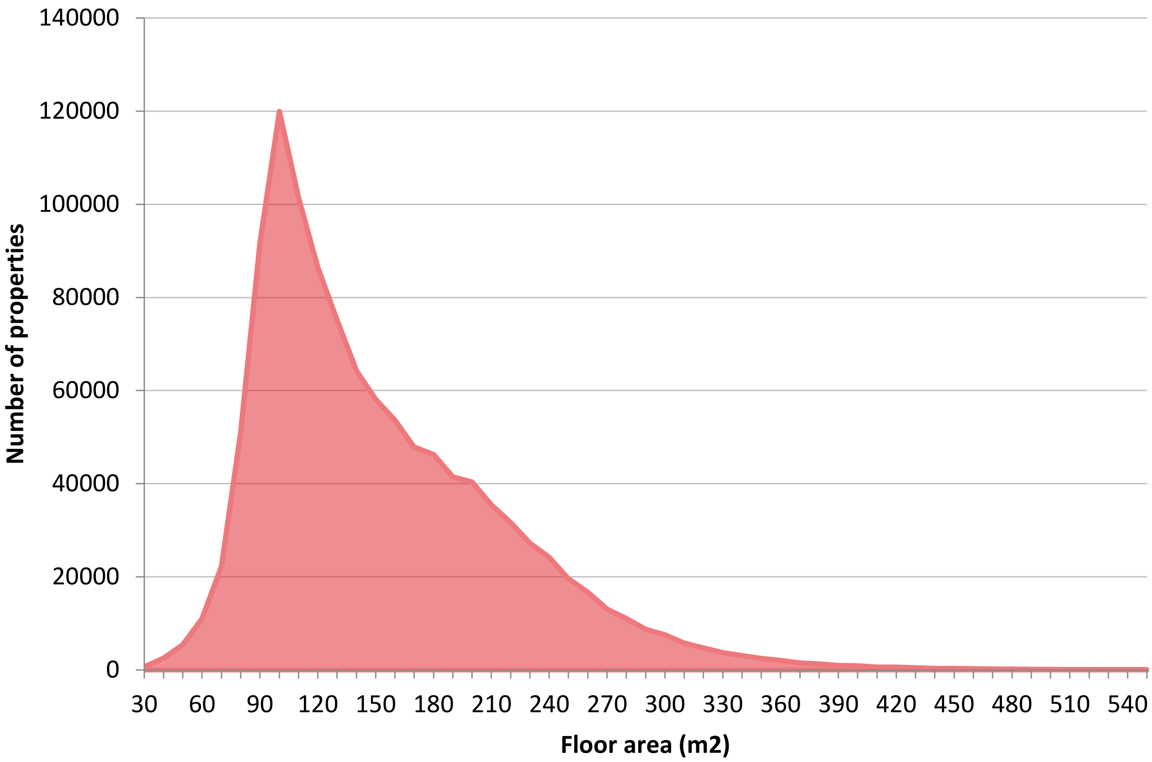
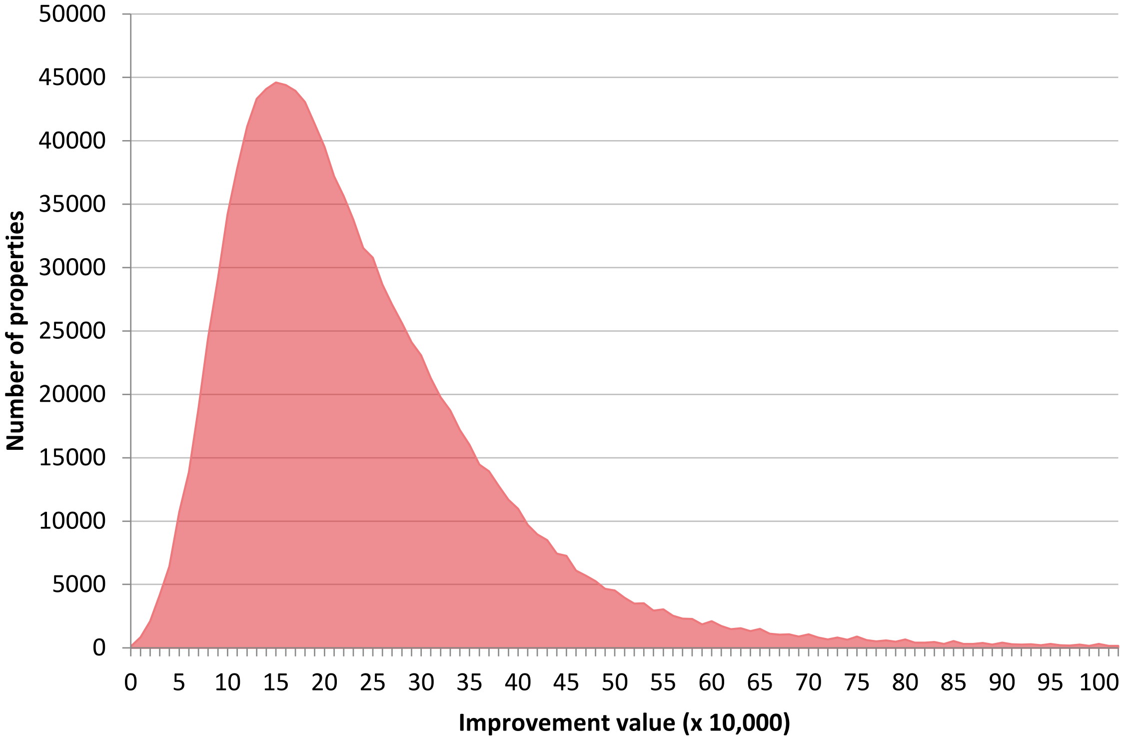


Figure 2. Distribution of dwellings by improvement value.



The Modelled Inspection-Derived Condition Score

CoreLogic data covering all New Zealand's 2017 residential dwelling stock was added to CoreLogic data for the 714 matched HHI-inspected Taranaki dwellings. Poisson regression was used, with the IDCS as the dependent variable, and property improvement value/m^2 index, roof condition and wall condition as the independent variables, to predict a modelled IDCS (MIDCS).

The MIDCS was averaged for each census meshblock to provide meshblock MIDCS indices.

With these data assigned, we analysed differences in MIDCS by tenure and rental quartile, and tenure and property floor area, with sub-analyses for Auckland, Wellington, Christchurch and Dunedin; and tenure and house type, construction era, and NZDep decile, for the whole of New Zealand.

Last, as a final check on whether the MIDCS might measure quality as well as condition, we measured how well the MIDCS predicted insulation status by comparing MIDCS scores of WUNZ insulated and control properties.

Results

Data matching

714 HIPI addresses were matched to 2006 qpids, either by machine, or manually using the QV online database. 151 HIPI addresses could not be matched to a current qpid, either because

the address was not sufficiently specific; was incorrectly entered; or an associated qpid could not be found.

CoreLogic provided data for 1,541,117 dwellings. 309,763 of these were matched to rentals current on or after 1 January 2016. After excluding properties with no MIDCS, the dataset contained 925,164 non-rentals and 219,944 rental properties.

MBIE match rates between CoreLogic and Tenancy Services bond addresses ranged from 60 - 63% for all bonds lodged after 2006 (average 61.5%). SHORE research has estimated that roughly 80% of residential tenancies have a bond lodged with Tenancy Services. We therefore estimate that the properties identified as rented in the dataset include only half (49.2%) of all rentals. Matched properties accounted for 20.1% of the CoreLogic residential property database, which would imply that 40.9% of residential properties were rented. However, the matched properties included tenancies that had ended after 1 January 2016. If ended tenancies were excluded, the derived percentage of dwellings in rental tenure would be 32.9%. The 2013 New Zealand census showed 35.2% of households where tenure was stated were “not owned and not held in a family trust”, and this figure is assumed to have risen since, making the 32.9% and 40.9% estimates a fair representation of the likely range within which true household rental tenure might fall.

The corollary of this is that we would expect another 220,000 of the 925,164 “non-rental” dwellings to also be in rental tenure, but not identified as such. It should therefore be noted that “rentals” in this study would be more accurately described as “known rentals”, while “non-rentals” are “predominantly non-rentals”.

Finally, as not all CoreLogic entries had data for all fields in the model, the number of dwellings included in analyses is as shown in Table 1. Wellington had the largest proportion of dwellings excluded, and Dunedin the least.

Table 1. Numbers of dwellings included in analysis.

Tenure	All New Zealand (%)	Auckland	Wellington	Christchurch	Dunedin
Non-Rented	924,564 (60.0)	256,705 (57.1)	34,864 (56.3)	86,512 (63.7)	30,648 (69.4)
Rented	219,830 (14.3)	76,702 (16.9)	7,887 (12.7)	19,161 (14.0)	6,969 (15.8)
Excluded due to missing data	395,966 (25.7)	123,090 (26.0)	19,756 (31.0)	31,136 (22.3)	6,526 (14.8)

N.B. Numbers for some regressions vary where other data, e.g. weekly rent, was unavailable.

Association between CoreLogic variables and HWoF items

Associations between CoreLogic variables and HWoF item passes are shown in Table 2.

Table 2. Association between property improvement value/m² index, roof condition and wall condition; and HWoF items.

HWoF item	Property improvement value/m² index (95%CI, p-value)	Roof condition (95%CI, p-value)	Wall condition (95%CI, p-value)
Stove & oven	**1.04 (1.01-1.06, 0.006)**	1.31 (0.99-1.73, 0.056)	1.20 (0.90-1.60, 0.218)
Food prep	**1.02 (1.00-1.04, 0.038)**	1.09 (0.84-1.40, 0.529)	**1.30 (1.02-1.65, 0.036)**
Potable water	0.99 (0.94-1.05, 0.732)	0.91 (0.36-2.26, 0.834)	1.44 (0.72-2.89, 0.302)
Safe water C°	***0.98 (0.97-1.00, 0.038)***	0.88 (0.69-1.12, 0.294)	0.86 (0.67-1.09, 0.208)

Toilet	1.03 (0.99-1.08, 0.158)	1.35 (0.88-2.07, 0.169)	1.19 (0.75-1.90, 0.458)
Bath/shower	**1.04 (1.01-1.07, 0.013)**	**1.37 (1.02-1.84, 0.039)**	1.28 (0.94-1.74, 0.123)
Safe storage	1.01 (0.91-1.11, 0.890)	0.24 (0.03-2.18, 0.203)	
Fixed heating	1.01 (0.99-1.03, 0.315)	1.17 (0.92-1.48, 0.196)	1.06 (0.83-1.36, 0.614)
Ventilation	**1.02 (1.01-1.04, 0.002)**	**1.42 (1.14-1.76, 0.002)**	**1.47 (1.18-1.84, 0.001)**
Mould absent	1.00 (0.96-1.04, 0.947)	**1.54 (1.05-2.25, 0.026)**	1.28 (0.84-1.96, 0.253)
Power outlets	1.03 (0.99-1.07, 0.136)	1.28 (0.86-1.90, 0.222)	1.36 (0.92-2.01, 0.122)
Indoor lighting	0.99 (0.91-1.08, 0.768)	1.81 (0.76-4.29, 0.177)	1.44 (0.51-4.05, 0.493)
Smoke alarms	**1.03 (1.01-1.04, 0.002)**	1.18 (0.95-1.46, 0.146)	1.14 (0.92-1.42, 0.221)
Window latches	1.00 (0.97-1.02, 0.892)	0.86 (0.60-1.24, 0.417)	0.89 (0.62-1.26, 0.508)
*Window stays**			
*Curtains**			
Visibility strips	0.99 (0.97-1.00, 0.106)	0.84 (0.65-1.07, 0.160)	***0.73 (0.56-0.95, 0.021)***
Ceiling insulation	***0.97 (0.95-1.00, 0.040)***	0.90 (0.65-1.23, 0.499)	0.87 (0.64-1.20, 0.407)
Floor insulation	1.00 (0.97-1.02, 0.786)	0.93 (0.68-1.26, 0.634)	0.98 (0.71-1.35, 0.910)
Vapour barrier	***0.97 (0.94-0.99, 0.020)***	0.87 (0.63-1.21, 0.420)	0.85 (0.62-1.18, 0.326)
Weathertight	1.00 (0.98-1.02, 0.858)	1.01 (0.81-1.28, 0.904)	1.02 (0.81-1.28, 0.875)
State of repair	**1.06 (1.03-1.08, 0.000)**	**1.48 (1.16-1.90, 0.002)**	**1.31 (1.01-1.70, 0.042)**
Drainage	0.99 (0.98-1.01, 0.327)	1.01 (0.83-1.23, 0.895)	1.12 (0.92-1.37, 0.252)
No ponding	1.00 (0.96-1.05, 0.888)	1.27 (0.65-2.47, 0.478)	1.18 (0.63-2.23, 0.607)
Outdoor lighting	1.01 (0.99-1.03, 0.205)	1.16 (0.96-1.42, 0.130)	1.19 (0.98-1.45, 0.080)
Structure sound	0.99 (0.96-1.03, 0.704)	1.02 (0.64-1.64, 0.920)	0.93 (0.57-1.53, 0.788)
Handrails	1.00 (0.99-1.02, 0.928)	1.09 (0.89-1.32, 0.410)	1.12 (0.92-1.36, 0.257)
*Address clear**			
*Door locks**			

*Not mapped

Only two items were significantly associated with all three assessments; these were 9. “Do the bathroom, kitchen and all bedrooms have some form of ventilation to the outside”; and 22. “Is the house in a reasonable state of repair”.

Improvement value/m^2 index and wall condition were both significantly associated with item 2. “Is there adequate space for food preparation and storage”; improvement value/m^2 index and roof condition were both significantly associated with item 6. “Is there a suitably located bath or shower in good working order?”

Improvement value/m^2 index alone was also significantly associated with items 1. “Is there a functional, safe stove-top and oven?”; and 13. “Does the house have adequate working smoke alarms?”; and significantly *negatively* associated with items 4. “Is the hot-water at the tap 55^oC (+/-5^oC)?”; 18. “Does the house have ceiling insulation to WOF standards?”; and 20. “Is a ground vapour barrier installed under the ground floor?”

Roof condition alone was significantly associated with item 10. “Is the house reasonably free of visible mould, i.e. the total area of mould is less than an A4 sheet of paper?”. Wall condition alone was significantly *negatively* associated with item 17. “Do glass doors have safety visibility strips?”

Across the 714 matched HHI-inspected properties, IDCS points were distributed as shown in Table 3.

Table 3. IDCS point allocation for HHI-inspected dwellings.

Points scored	1	2	3	4	5	6	7	Total
Number of properties	1	11	47	126	228	222	79	714
Percentage	0.1%	1.5%	6.6%	17.7%	31.9%	31.1%	11.1%	100%

Association between IDCS and potential quality indicators

The IDCS was significantly correlated with all three potential quality indicators, which were also significantly correlated with each other. Roof condition and wall condition were particularly closely correlated. Correlation coefficients are shown in Table 4.

Table 4. Correlation coefficients between IDCS, improvement value/m^2 index, roof condition and wall condition.

	IDCS	Improvement value/m^2 index	Roof condition
Improvement value/m^2 index	0.2203		
Roof condition	0.1713	0.2444	
Wall condition	0.1601	0.2501	0.7917

Model fit

The model fit had copious room for improvement, as it captured only 0.44% (pseudo-R value=0.0044) of the variation in IDCS. The rate ratio between MIDCSs for rented and non-rented dwellings was 0.98. A separate model using the property improvement value/m^2 index as the dependent variable and rental tenure as the independent variable returned a rate ratio of 0.90, indicating that the difference in improvement value/m^2 between rented and non-rented properties is larger than the difference in MIDCS between rented and non-rented properties. If improvement value per square metre is a good indicator of dwelling condition, including the IDCS in the model may hide tenure differences in dwelling condition rather than expose them.

Distribution

The average MIDCS over the country was 5.33, with a minimum of 4.17 and a maximum of 6.02. The distribution was non-normal, with a skew towards higher ratings, and a double peak in the distribution, as shown in Figure 3.

Across territorial authorities, the highest average MIDCSs were in Queenstown-Lakes (5.41) and Selwyn (5.40). The lowest average MIDCSs were in Kawerau (5.14) and Taupo (5.21). All of these were significantly different from the Auckland baseline; however, it should be noted that with such large numbers of dwellings, even small differences were statistically significant.

Meshblock MIDCS Indices

The distribution of meshblock MIDCS indices is illustrated in Figure 4. There were 35,069 meshblocks with an MIDCS index assigned, so the indices are not published here, but are available from the author on request.

Figure 3. Distribution of dwellings across MIDCS range.

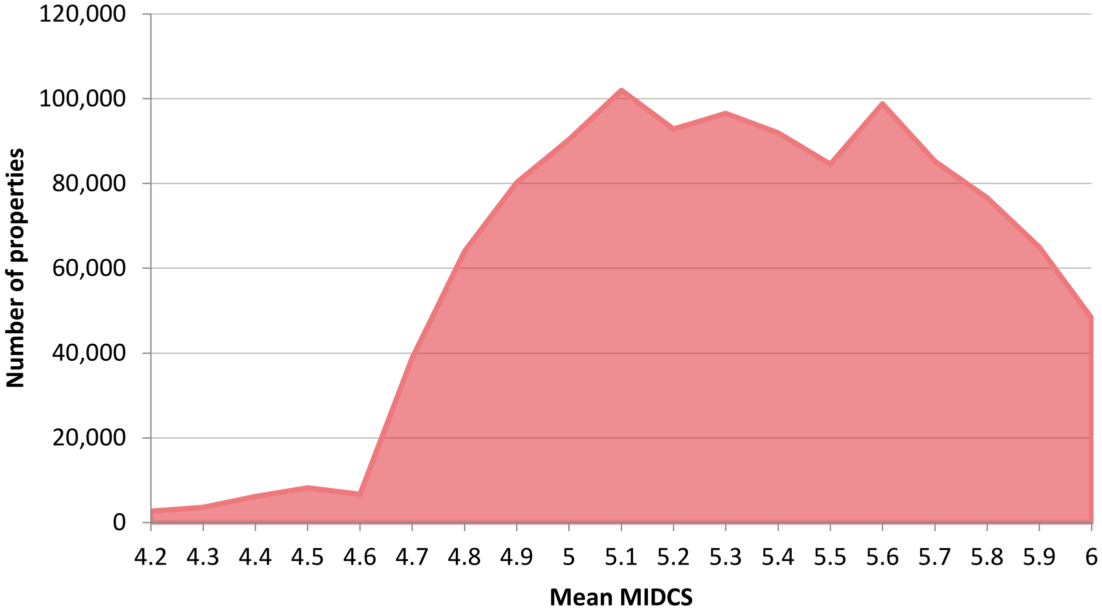
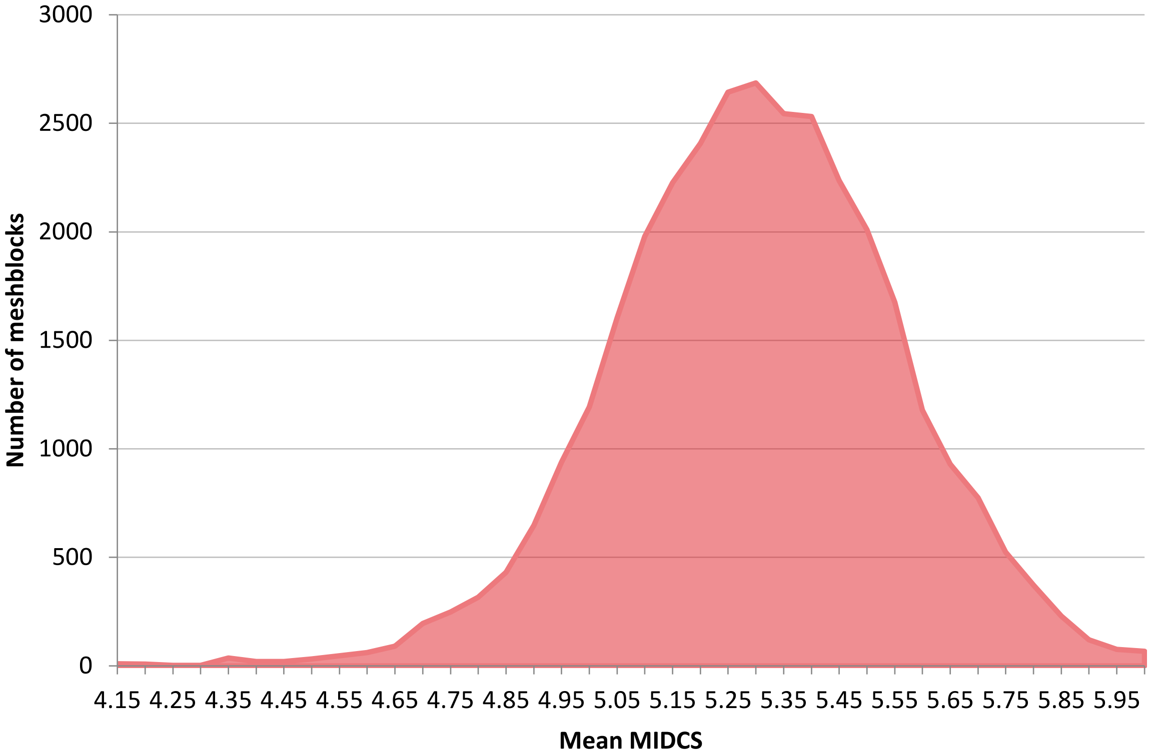


Figure 4. Number of meshblocks by mean MIDCS.



MIDCS and tenure

Mean MIDCSs were lower for rental properties than for non-rentals, as shown in Table 5. This difference was statistically significant. While the 0.09 difference in mean score appears small, it represents just under a quarter of a standard deviation, and is therefore meaningful.

Table 5. Mean MIDCSs by tenure, all New Zealand and main centres.

	n	Mean MIDCS	RR (95%CI)
All New Zealand			
Non-rentals	922,605	5.35	Baseline
Rentals	219,431	5.26	0.98 (0.98-0.99), p<0.001
Auckland			
Non-rentals	256,527	5.37	Baseline
Rentals	76,640	5.29	0.98 (0.98-0.99), p<0.001
Wellington			
Non-rentals	34,860	5.30	Baseline
Rentals	7,886	5.32	1.00 (0.99-1.01), p=0.529
Christchurch			
Non-rentals	86,311	5.37	Baseline
Rentals	19,095	5.26	0.98 (0.97-0.99), p<0.001
Dunedin			
Non-rentals	30,568	5.33	Baseline
Rentals	6,963	5.24	0.98 (0.97-0.99), p=0.003

The highest mean MIDCSs for rental properties were in Waimakariri (5.45) and Selwyn (5.44), and each was (statistically) significantly higher than the rest of the country, with rate ratios of 1.04 (95%CI 1.01-1.06, p=0.001) and 1.03 (95%CI 1.01-1.06, p=0.013) respectively. Rentals in Auckland, Hamilton, Tauranga and Wellington also had significantly higher rental MIDCSs than the rest of the country.

The lowest mean MIDCSs for rental properties were in Kawerau (5.07) and Taupo (5.14), though of these only Taupo was significantly different from the rest of the country, with a rate ratio of 0.98 (95%CI 0.96-1.00, p=0.015). Rentals in Gisborne, Rotorua, Wanganui, Tararua, Horowhenua and Masterton also had statistically lower rental MIDCSs than the rest of the country.

Rate ratios between rented and non-rented properties were equivalent to the national average for Auckland, and lower for Christchurch and Dunedin, but not significantly different for Wellington, as shown in Table 6.

MIDCS and rental quartile

MIDCSs varied by rental quartile and region. Across New Zealand as a whole, the mean MIDCS was lowest in the lowest rental quartile, and highest for highest quartile rental properties. These differences were small but statistically significant. In Auckland, Christchurch and Dunedin, non-rental properties had higher MICDSs than all four rental quartiles, but in

Wellington, MIDCSs for non-rented properties was at the same level as the second rental quartile.

Table 6. Mean MIDCSs by tenure.

	N	Mean weekly rent	Mean MIDCS	RR (95%CI, p-value)
All New Zealand		$341	5.33	
Quartile 1	53,397	$129*	5.17	Baseline
Quartile 2	54,437	$314*	5.23	1.01 (1.01-1.02, 0.000)
Quartile 3	52,644	$405*	5.28	1.02 (1.01-1.02, 0.000)
Quartile 4	53,606	$553*	5.37	1.02 (1.02-1.03, 0.000)
Not rented	922,605		5.35	1.04 (1.03-1.04, 0.000)
Auckland		$435	5.36	
Quartile 1	18,625	$121	5.19	Baseline
Quartile 2	19,651	$380	5.27	1.02 (1.01-1.02, 0.001)
Quartile 3	17,987	$511	5.31	1.02 (1.01-1.03, 0.000)
Quartile 4	18,674	$733	5.37	1.03 (1.03-1.04, 0.000)
Not rented	256,527		5.38	1.04 (1.03-1.04, 0.000)
Wellington		$485	5.30	
Quartile 1	1,904	$225	5.26	Baseline
Quartile 2	1,972	$426	5.30	1.01 (0.98-1.04, 0.612)
Quartile 3	1,899	$529	5.34	1.02 (0.99-1.04, 0.259)
Quartile 4	1,919	$760	5.37	1.02 (0.99-1.05, 0.146)
Not rented	34,860		5.30	1.01 (0.99-1.03, 0.478)
Christchurch		$378	5.35	
Quartile 1	4,727	$152	5.22	Baseline
Quartile 2	4,482	$351	5.25	1.00 (0.99-1.02, 0.645)
Quartile 3	4,849	$432	5.27	1.01 (0.99-1.03, 0.334)
Quartile 4	4,683	$576	5.28	1.01 (0.99-1.03, 0.205)
Not rented	86,311		5.37	1.03 (1.01-1.04, 0.000)
Dunedin		$294	5.31	
Quartile 1	1,697	$104	5.18	Baseline
Quartile 2	1,650	$245	5.22	1.01 (0.98-1.04, 0.603)
Quartile 3	1,774	$320	5.28	1.02 (0.99-1.05, 0.210)
Quartile 4	1,710	$502	5.27	1.02 (0.99-1.05, 0.274)
Not rented	30,568		5.33	1.03 (1.01-1.05, 0.010)

N.B. Properties where the rent was $0 or not known were excluded

*Rental quartiles were assigned by territorial authority, so these are means of rents within those quartiles in their territorial authority. Overall mean rentals for nationwide quartiles were $116, $276, $396 and $613 per week.

MIDCS and property size

The average floor area of non-rented properties was 158m^2, which was larger than the 129m^2 average size of rented properties.

Non-rental properties smaller than 60m^2 had lower mean MIDCSs than rental properties, but for properties larger than 60m^{2,} non-rental MIDCSs were higher.

For non-rental properties, MIDCS increased with increasing floor area between 30m^2 and 70m^2, fell for properties up to 130m^2, rose again up to 330m^2, then decreased in the small percentage of properties larger than 330m^2. In rental properties, the mean MIDCS fell as property size increased from 40m^2 to 100m^2 (the most common size), rose sharply between 130m^2 and 160m^2, then remained at a similar level across larger floor areas.

However, these relationships were not consistent across the main centres. In Wellington, in particular, MIDCS decreased with increasing floor area, in both rentals and non-rentals.

MIDCSs were significantly lower in rentals than in non-rentals across most size categories (Table 7), but for main centres, differences were only significant in properties under 100m^2 in Auckland and Christchurch.

Figure 5. Mean MIDCS and proportion of properties by floor area and tenure category.

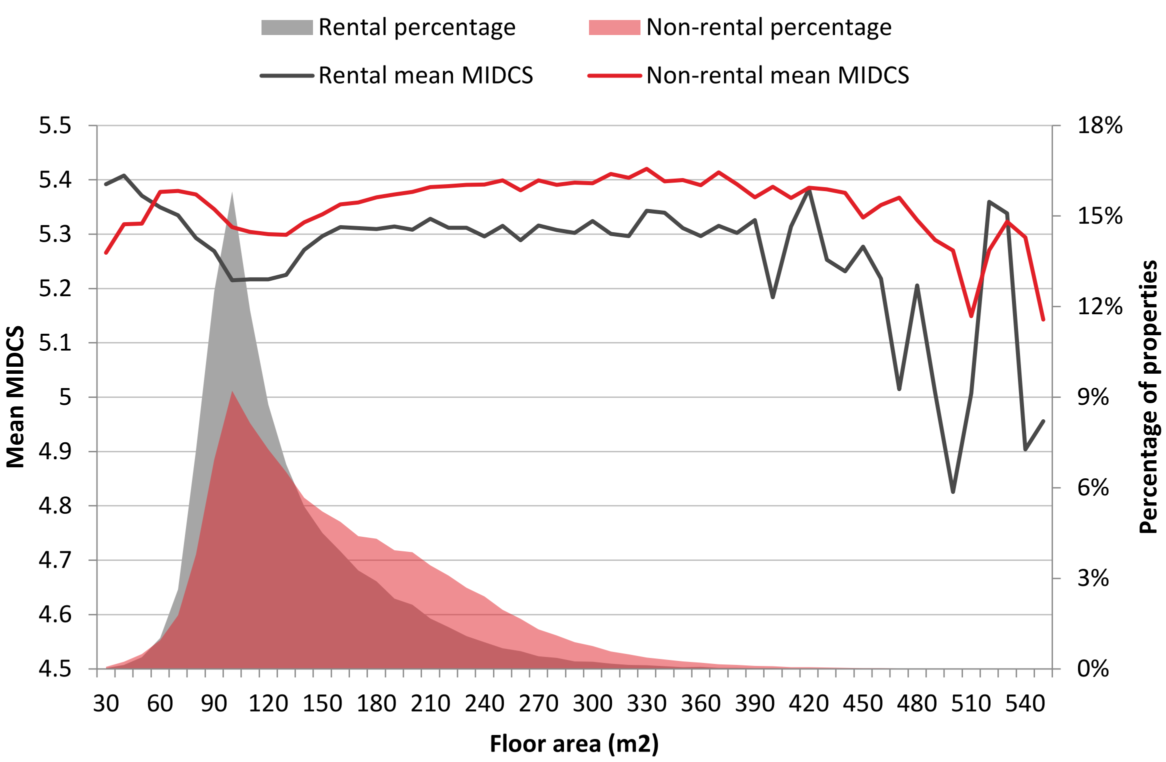


Table 7. Mean MIDCSs by floor area and tenure categories.

	Non-rented		Rented		Rented vs non-rented
	n	Mean MIDCS	n	Mean MIDCS	RR (95%CI, p-value)
All New Zealand					
30-100	207,582	5.34	83,396	5.26	0.99 (0.98-0.99, 0.000)
101-120	143,787	5.30	46,921	5.22	0.98 (0.98-0.99, 0.000)
121-153	166,809	5.32	38,558	5.26	0.99 (0.98-0.99, 0.000)
154-203	198,038	5.37	32,185	5.31	0.99 (0.98-1.00, 0.000)
204-550	208,348	5.39	18,770	5.31	0.99 (0.98-0.99, 0.013)

Auckland					
30-100	50,718	5.36	27,007	5.26	0.98 (0.97-0.99, 0.000)
101-120	30,259	5.33	13,426	5.24	0.98 (0.98-0.99, 0.000)
121-153	43,169	5.35	13,996	5.30	0.99 (0.98-1.00, 0.020)
154-203	60,657	5.38	13,389	5.33	0.99 (0.98-1.00, 0.040)
204-550	71,902	5.42	8,884	5.36	0.99 (0.98-1.00, 0.017)
Wellington					
30-100	5,462	5.46	2,454	5.45	1.00 (0.98-1.02, 0.751)
101-120	4,995	5.37	1,572	5.33	0.99 (0.97-1.02, 0.494)
121-153	7,412	5.32	1,681	5.27	0.99 (0.97-1.01, 0.471)
154-203	8,668	5.25	1,390	5.22	0.99 (0.97-1.02, 0.684)
204-550	8,327	5.18	790	5.16	1.00 (0.96-1.03, 0.772)
Christchurch					
30-100	17,395	5.45	6,233	5.30	0.97 (0.96-0.98, 0.000)
101-120	16,119	5.32	5,087	5.21	0.98 (0.97-0.99, 0.003)
121-153	16,197	5.33	3,576	5.24	0.98 (0.97-1.00, 0.049)
154-203	16,931	5.35	2,713	5.27	0.99 (0.97-1.00, 0.104)
204-550	19,870	5.36	1,552	5.24	0.98 (0.95-1.00, 0.039)
Dunedin					
30-100	7,762	5.34	3,026	5.28	0.99 (0.97-1.01, 0.238)
101-120	5,804	5.31	1,696	5.21	0.98 (0.96-1.01, 0.137)
121-153	6,082	5.31	1,111	5.21	0.97 (0.94-1.01, 0.123)
154-203	5,623	5.34	716	5.20	0.97 (0.93-1.01, 0.149)
204-550	5,377	5.36	420	5.19	0.98 (0.94-1.02, 0.312)

MIDCS and house type

MIDCS varied considerably by CoreLogic house type category (Table 8). “Multi-unit” dwellings, which include “Apartments”, “Townhouses” and “Terraced Apartments”, had the highest MIDCS, at 5.52, closely followed by “Contemporary” dwellings (defined by CoreLogic as architecturally designed dwellings, often cedar-clad and/or built on poles) on 5.51. “State Houses” had the lowest MIDCS, at 5.08, and “State Houses” in rental tenure were lowest of all, on 5.05. Only “Post-war bungalows” and “State Houses” had a significant difference in MIDCS between rented and non-rented properties.

Table 8. Mean MIDCSs by house type and tenure categories.

	Total	**Non-rented**		**Rented**		**Rented vs non-rented**
House type	Mean MIDCS	n	Mean MIDCS	n	Mean MIDCS	RR (95%CI, p-value
Bach	5.23	22,354	5.24	2,512	5.20	0.99 (0.98-1.01, 0.499)
Contemporary	5.51	20,028	5.52	1,983	5.44	0.99 (0.97-1.01, 0.175)
Cottage	5.22	8,896	5.22	2,040	5.21	1.00 (0.98-1.02, 0.824)
Multi*	5.52	7,342	5.52	1,831	5.51	1.00 (0.98-1.02, 0.878)
Post-war Bungalow	5.35	610,481	5.36	141,689	5.30	**0.99 (0.99-0.99, 0.000)**
Pre-war Bungalow	5.18	63,638	5.19	14,248	5.15	0.99 (0.98-1.00, 0.053)
Quality Bungalow	5.40	81,778	5.40	9,500	5.38	1.00 (0.99-1.00, 0.332)

Arts & Crafts	5.30	4,975	5.31	470	5.24	0.99 (0.95-1.03, 0.528)
Spanish Bungalow	5.11	3,753	5.12	966	5.07	0.99 (0.96-1.02, 0.567)
State House	5.08	16,418	5.12	19,931	5.05	**0.99 (0.98-1.00, 0.009**)
Unit	5.45	1,185	5.51	574	5.11	0.97 (0.93-1.01, 0.141)
Villa	5.13	31,464	5.14	7,969	5.11	0.99 0.98-1.01, 0.290)

*"Multi" includes "Apartments", "Townhouses" and "Terraced Apartments".

"State Houses" (labelled by CoreLogic as "State Rentals") were most likely to be in rental tenure" (OR 5.52, 95%CI 5.40-5.63, p<0.001), followed by "Units" (OR 2.05, 95%CI 1.85-2.26, p<0.001), and homes built before 1950 in the post-war style, or updated after 1950 (ie "Post-war Bungalows" with an estimated construction date before 1950) (OR 1.41, 95%CI 1.38-1.44, p<0.001). "Villas", "Post-war Bungalows" built after 1970 and "Spanish Bungalows" were also more likely to be rental tenure than other housing types, while all other types except "Cottages" and "Multi" were significantly less likely to be in rental tenure. "Arts & Crafts" (labelled by CoreLogic as "Quality Old") were least likely to be in rental tenure (OR 0.40, 95%CI 0.36-0.44, p<0.001).

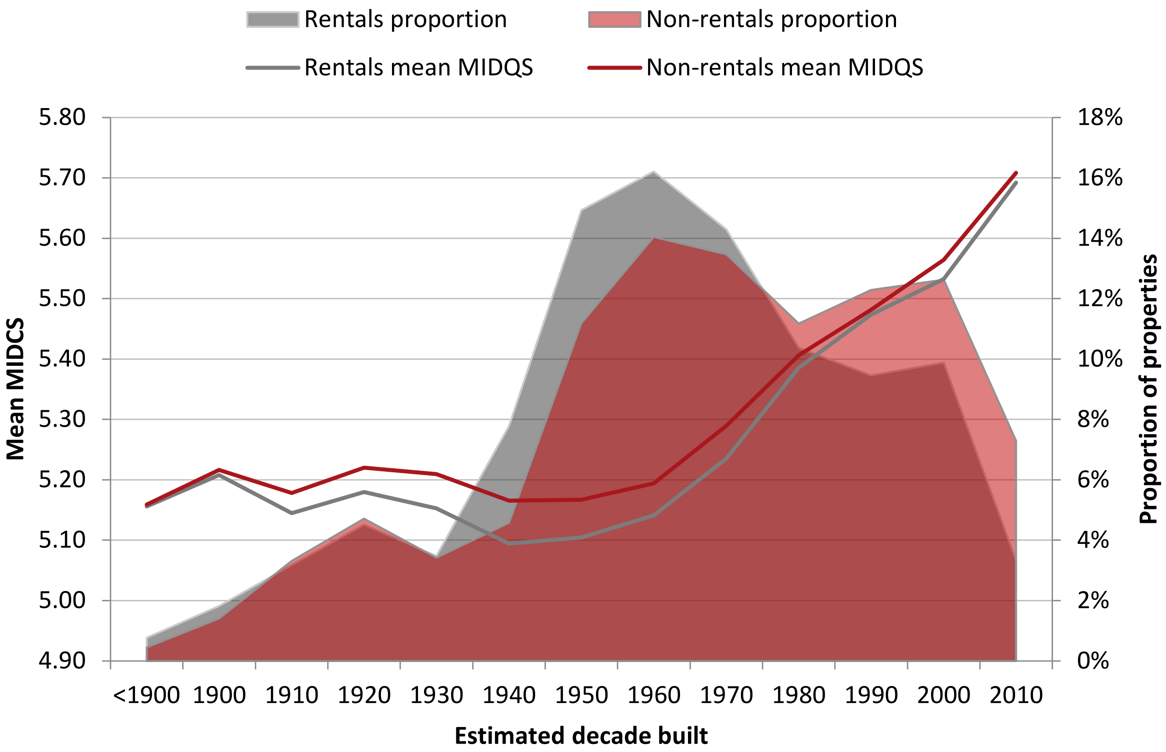
MIDCS and construction era

Mean MIDCS decreased as dwelling age increased. Differences in MIDCS between rented and non-rented properties were highest for properties built in the middle of the 20^{th} Century; the period which comprises the largest proportion of the rental housing stock.

Table 9. Mean MIDCSs by construction era and tenure categories.

	Total	Non-rented		Rented		Rented vs non-rented
Construction era	Mean MIDCS	n	Mean MIDCS	n	Mean MIDCS	RR (95%CI, p-value)
<1920	5.18	47,701	5.18	12,633	5.17	1.00 (0.99-1.00, 0.359)
1920-1949	5.18	117,266	5.20	34,607	5.13	0.99 (0.98-0.99 0.000)
1950-1979	5.21	357,026	5.22	99,749	5.16	0.99 (0.99-1.00, 0.000)
1980-2010	5.52	400,582	5.52	72,439	5.49	0.99 (0.99-1.00, 0.000)

Figure 6. Mean MIDCS and proportion of properties by estimated construction decade and tenure category.



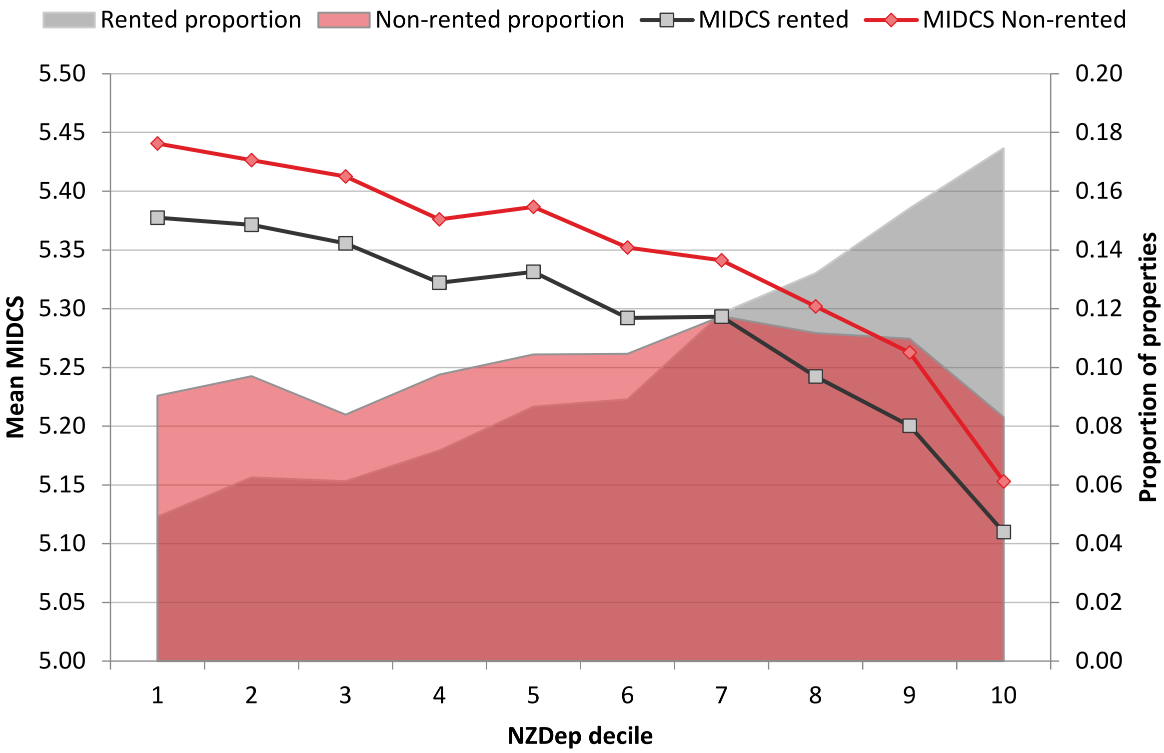
MIDCS and socio-economic deprivation

MIDCS varied by NZDep decile, and by tenure within deciles. Mean MIDCS decreased with increasing deprivation (Figure 7). However, there was least difference in MIDCS in the most deprived (NZDep10) Census Area Units (Table 10).

Table 10. Mean MIDCSs by NZDep decile and tenure category.

	Total	**Non-rented**		**Rented**		**Rental vs non-rental**
NZDep decile	Mean MIDCS	n	Mean MIDCS	n	Mean MIDCS	RR (95%CI, p-value)
(Least deprivation) 1	5.43	79,466	5.44	10,409	5.38	0.99 (0.98-1.00, 0.009)
2	5.42	85,272	5.43	13,268	5.37	0.99 (0.98-1.00, 0.011)
3	5.40	73,798	5.41	12,994	5.36	0.99 (0.98-1.00, 0.010)
4	5.37	85,789	5.38	15,192	5.32	0.99 (0.98-1.00, 0.008)
5	5.38	91,805	5.39	18,375	5.33	0.99 (0.98-1.00, 0.003)
6	5.34	91,979	5.35	18,899	5.29	0.99 (0.98-1.00, 0.001)
7	5.33	103,234	5.34	25,102	5.29	0.99 (0.99-1.00, 0.003)
8	5.29	98,235	5.30	28,007	5.24	0.99 (0.98-0.99, 0.000)
9	5.25	96,512	5.26	32,699	5.20	0.99 (0.98-0.99, 0.000)
(Most deprivation) 10	5.14	73,026	5.15	37,020	5.11	0.99 (0.99-1.00, 0.003)

Figure 7. Mean MIDCS and proportion of properties by NZDep decile and tenure category.



MIDCS and insulation status

The MIDCS was higher in properties known to be insulated under the WUNZ scheme than in properties identified as controls in its evaluation, but the difference was not statistically significant (RR1.09, 95%CI 0.99-1.20, p=0.074). We observed that properties insulated under the scheme were significantly less likely to be in rental tenure than were control properties (OR 0.76, 95%CI 0.73-0.78, p<0.001).

Discussion

CoreLogic potential quality measures had some associations with HWoF passes for functioning household hygiene amenities (stove top and oven, food preparation and storage, bath or shower, hot water); and safety measures (smoke alarms); and consistent associations with adequate indoor ventilation and the house being in a reasonable state of repair. However, CoreLogic potential quality measures had no or negative associations with most items indicating ability to maintain an adequate indoor temperature (fixed heating, underfloor and ceiling insulation, and ground vapour barriers). Better roof condition was associated with an absence of mould, dampness or mustiness; and all three variables were indicative of adequate ventilation in kitchens, bathrooms and bedrooms. In general, however, while external assessments were reasonably indicative of the superficial condition of the property (state of repair, but not structural soundness), and roof condition may provide some proxy for indoor damp and mould, the assessments were not otherwise strong indicators of the healthiness or safety of the properties. We would therefore say that external assessments, and their derived

MIDCS, may provide some indication of dwelling condition, but not of the broader dwelling quality.

Differences in MIDCS between tenures were small, but significant on a national scale, though not in all main centres. As the MIDCS distribution was tight, some variation between tenures may have been lost in data “noise”, and small differences in mean MIDCS may be interpreted as more meaningful than they would be across a larger distribution.

Given the poor model fit and few associations between CoreLogic fields and HWoF items, it would be fair to describe this study as investigative more than conclusive. Nevertheless, it is reasonable to interpret MIDCS as an index of housing condition. Findings that the MIDCS was higher in wealthier Census Area Units than in more deprived areas; in more expensive rental quartiles than in the least expensive quartiles; and in newer houses than in older houses; are no real surprise. Indeed, any other finding might suggest the index was not measuring what it should.

However, although there are economic reasons why the average condition of rental properties might be lower than that of non-rental properties[10], there is no functional reason why they should differ. In Auckland, properties in the highest rental quartile came close to matching non-rental properties for condition; and in Wellington non-rental housing conditions sat roughly in the middle of the distribution by rental quartile. In Christchurch and Dunedin, however, even the highest rental quartiles were well below the condition of non-rental properties.

Auckland and Christchurch also had significantly better condition housing stock overall than did Wellington and Dunedin. This likely reflects, at least in part, the difference in age of the housing stock in the respective cities, with Auckland and Christchurch properties having average ages of 1970 and 1967 respectively, compared with Wellington’s 1951 and Dunedin’s 1948.

Nationwide, older properties were more likely to be in poor condition, and new properties were less likely to be in rental tenure. This means better condition properties are not available to the rental market, and will be a large component of the lower overall condition of rental housing.

These differences matter because they indicate that in much of the country, only those who can afford the highest rents will be able to secure properties that are in as good condition as non-rental properties. The differences also indicate a greater maintenance deficit in Wellington and Dunedin.

Overall, the poorer condition of housing in Dunedin, in rental tenure, and in high deprivation areas, demonstrates that the “inverse housing law”[36] applies in New Zealand, in that those most in need of good quality housing, i.e. young families (who are more likely to be in rental tenure), those in socio-economic deprivation, and those living in cold climates, are least likely to have access to housing in good condition.

Limitations and methodological comment

The MIDCS is a modelled estimate, based on inspections of only a small fraction of New Zealand houses. Criteria for inclusion in the He Kainga Oranga studies for which the HHI inspections were carried out, and the fact they are concentrated in one region, may mean inspected properties were not representative of dwellings that were not eligible for inclusion in the study; or of dwellings in other regions.

Data matching left some properties unmatched. Previous studies have found some systematic bias in New Zealand address matching, with match rates lower for rural properties and multi-unit properties. HIPI HHI inspections included both multi-unit and rural properties in their sample, and manual matching mean these may have been more likely to be matched to qpids.

The model from which the MIDCS was derived also captured little of the variation in housing condition measures.

Conclusion

This study contributes to the body of evidence indicating that rental housing in New Zealand is in poorer condition than owner-occupier housing. It has also identified older housing, specific housing types, and housing in specific regions or in areas of greater socio-economic deprivation, as more likely to be in need of improvement.

The study has also shown that modelling has the potential to provide a useful aggregate measure of housing condition, but the narrow distribution of modelled condition scores and low R-values mean there is still room to improve the MIDCS as an individual-level condition or quality indicator; while the limited HWoF items associated with external measures mean the MIDCS likely reflects dwelling condition rather than presence of other elements necessary to occupant health and safety.

Recommendations

Future work to model housing quality could usefully include additional administrative measures, particularly:

- larger, more comprehensively sampled inspection datasets as the source of dependent variables; and
- additional nationwide independent variables which might be more likely to capture housing quality, e.g. census questions or other nationwide household surveys.

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1. Footnote:

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Appendix A - University of Otago *He Kainga Oranga/* Housing and Health Research Programme Housing Warrant of Fitness Checklist

1. Is there a functional, safe stove-top and oven? (Yes/no)
2. Is there adequate space for food preparation and storage? (Yes/no)
3. Is there an adequate supply of hot and cold potable water? (Yes/no)
4. Is the hot-water at the tap 55°C (±5°C?) (Yes/no)
5. Is there a functional toilet, which does not have a cracked or broken seat, cistern or bowl? (Yes/no)
6. Is there a suitably located bath or shower in good working order? (Yes/no)
7. Are there secure or high level cupboards or shelves for storing hazardous or toxic substances out of children's reach? (Yes/no)
8. Is there an adequate form of safe and effective space heating? (Yes/no)
9. Do the bathroom, kitchen and all bedrooms have some form of ventilation to outside? (Yes/no)
10. Is the house reasonably free of visible mould, i.e. the total area of mould is less than an A4 sheet of paper? (Yes/no)
11. Are power outlets, light switches and wiring safe and in good working order? (Yes/no)
12. Is there adequate indoor lighting? (Yes/no)
13. Does the house have adequate working smoke alarms? (Yes/no)
14. Have the windows got effective latches? (Yes/no)
15. Do high level windows have security stays to prevent falls? (Yes/no)
16. Are there curtains or blinds in the bedrooms and living area? (Yes/no)
17. Do glass doors have safety visibility strips? (Yes/no)
18. Does the house have ceiling insulation to WOF standards? (Yes/no)
19. Does the house have underfloor insulation to WOF standards? (Yes/no)
20. Is a ground vapour barrier installed under the ground floor? (Yes/no)
21. Is the house weathertight with no evident leaks, or moisture stains on the walls or ceiling? (Yes/no)
22. Is the house in a reasonable state of repair? (Yes/no)
23. Is the storm and waste water drainage being adequately discharged? (Yes/no)
24. Is there any water ponding under the house? (Yes/no)
25. Is there adequate outdoor lighting near entrance ways? (Yes/no)
26. Does the house appear to be structurally sound? (Yes/no)
27. Are there handrails for all internal stairs and all outdoor steps that access the house, and do balconies/decks have balustrades to the current Building Code? (Yes/no)

28. Is the address clearly labelled and identifiable? (Yes/no)
29. Are there securely locking doors? (Yes/no)

1222 Moonshine Rd,
RD1, Porirua 5381
Private Bag 50 908
Porirua 5240
New Zealand

branz.nz

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