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# Impacts of macroeconomic policies on objective and subjective wellbeing: The role of housing tenure

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**Abstract:**
Between 2005 and 2021, New Zealand house prices rose by 142%, partly driven by inflationary macroeconomic policies. This paper explores the extent to which higher property prices (i.e. house prices and rents) affect measures of objective and subjective wellbeing, and how these effects vary by housing tenure. We measure objective wellbeing using non-housing consumption expenditure (NHE) and subjective wellbeing through life satisfaction. Housing tenure types include private renters, public renters, outright homeowners, and mortgaged homeowners. Our empirical strategy estimates the effect of property prices on each wellbeing indicator by tenure type. We also identify contributions of monetary policy to property price developments. Using survey data from 84,732 representative households collected by StatsNZ, we find that, relative to outright owners, higher property prices are associated with a decline in NHE for each of private renters, public renters and mortgaged homeowners. In addition, relative to homeowners, renters report significantly lower life satisfaction as house prices rise, with heterogeneous effects depending on age, income and local house price: rent ratios. Our results indicate that macroeconomic policies, operating through the property market, can exacerbate wellbeing inequalities associated with housing tenure.

**Keywords:** House prices, rents, monetary policy, subjective wellbeing, expenditure, housing tenure
**JEL codes:** D12, D31, E65, I31, R21, R31

**Disclaimer:**
These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), which is carefully managed by StatsNZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/. Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this presentation have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz. Any errors or omissions are our own.

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# 1. Introduction

Over the past decade, significant increases in house prices have coincided with expansionary monetary policy. While there is extensive research on the way in which monetary and fiscal policy affects house prices, comparatively less attention has been paid to the downstream consequences for individual wellbeing. This is an important gap in the literature. In New Zealand, homeownership remains a key aspiration and marker of social status. As property prices rise, existing homeowners may experience both economic benefits through wealth effects and improved access to credit, as well as psychological benefits associated with elevated social status. This may improve objective and subjective wellbeing amongst homeowners. However, for renters, first-home buyers, and low-income households, rising prices can reduce affordability, increase financial stress, and lead to perceived exclusion from the housing market. For these groups, the net effect on wellbeing may be negative. Consequently, understanding how the housing market affects wellbeing is essential to assess whether rising property prices (i.e. rising house prices and/or rents) improve or reduce subjective and objective wellbeing among New Zealand households.

To address these questions, we investigate how property prices, influenced by macroeconomic policy, affect both subjective and objective wellbeing in New Zealand.[1] We use repeated, representative cross-sectional survey data from the Statistics New Zealand (StatsNZ) Integrated Data Infrastructure. The data include: (i) non-housing expenditure of 17,763 households between 2006 and 2024 (our measure of objective wellbeing) and (ii) life satisfaction of 66,969 individuals between 2013 and 2024 (our measure of subjective wellbeing). For both outcomes, we estimate a series of OLS linear regression models that include an interaction term between tenure type and property prices, while controlling for individual, household, and regional characteristics. This empirical strategy allows us to isolate the relative effects of changes in property prices on wellbeing according to tenure type. Our measure of property prices is either (i) a quality-adjusted regional house price index (HPI) or (ii) the regional geometric mean rent. We also investigate how property price changes affect households' contributions to the government-backed retirement savings scheme (KiwiSaver).

Non-housing expenditure is our measure of objective wellbeing as we are particularly interested in how property price changes affect what households can spend on all other (non-housing) expenditures. Intuitively, an increase in property prices may increase total expenditure (implicitly through a run-down in savings) but decrease non-housing expenditures (as some expenditure must be diverted from NHE to fund existing housing costs). This decrease in NHE is more likely to be related to a household's overall wellbeing than is the increase in total expenditure. NHE is also referred to as 'post-housing income', a common measure of objective wellbeing in the literature (Dustmann et al., 2022; Western & Tomaszewski, 2016).

Our findings suggest that rising property prices have uneven effects on wellbeing, depending on housing tenure. For outright homeowners, a 10% increase in the regional HPI is associated with a 1.3% rise in non-housing expenditure. This association between house prices and NHE for outright homeowners may be due to factors unrelated to the housing market (e.g. broader macroeconomic conditions). Hence, our focus is instead on relative outcomes across tenure types with respect to property prices. Relative to outright owners, mortgaged homeowners, private renters, and public renters reduce non-housing expenditure by 1.6%, 1.3%, and 3.9%, respectively. We observe similar relative reductions in spending for these three tenure categories in response to a 10% increase in regional rents. For mortgaged owners, higher house

[1] New Zealand is also often referred to as Aotearoa or Aotearoa New Zealand.

prices likely demand larger mortgages with higher debt servicing costs while renters face higher rents.

Interestingly, public renters experience the most severe adverse effect on non-housing expenditure, despite many being partially insulated from property price changes due to income-related rents. This sensitivity is likely due to their low savings and wealth, making them vulnerable to even modest increases in housing costs. To explore this further, we analyse how rising property prices change annual KiwiSaver contributions. We find that a 10% rise in regional house prices corresponds to an average reduction of $114 NZD (9.3%) in annual retirement savings for public renters. This finding implies that not only do high property prices reduce short-term consumption, but they may also erode long-term financial security for low-income and economically constrained households.

In contrast to our objective wellbeing results, we find no statistically significant relationship between house prices and life satisfaction for homeowners, nor between rents and life satisfaction for renters. This result might suggest that direct housing costs are less important in predicting subjective wellbeing (SWB) than in predicting objective wellbeing. However, we do observe a large and statistically significant decline in SWB among renters in response to rising house prices. A 10% increase in regional house prices is associated with a decrease in life satisfaction of 0.046 points for public renters and 0.044 points for private renters (both in absolute terms and relative to homeowners). A 50% rise in real house prices (as occurred over the five years to October 2021) corresponds to an estimated deterioration in subjective wellbeing for renters of about a quarter of the effect of being unemployed (relative to being employed).

To understand the underlying mechanisms driving this result, we explore several possible transmission channels. Given the influence of inter-personal comparisons on life satisfaction (Easterlin, 2021; Layard, 2011), individuals assess their wellbeing not only against their current circumstances but also in relation to their aspirations and the circumstances of others. In a housing market where homeownership is both socially valuable and financially unattainable, renters (especially those who had expected to own a home) may feel a sense of perceived exclusion in response to high prices. We test for this possibility by re-estimating our primary model across different subgroups defined by age, household income, and regional price-to-rent ratios, to understand whether traditionally homeowning cohorts are most sensitive to price increases. Our results show that older renters, low-income households, and those living in high price-to-rent regions report the greatest declines in SWB following property price increases. Older renters belong to a cohort for whom homeownership is highly prevalent (StatsNZ, 2025). In contrast, low-income households and those living in regions with a high price-to-rent ratio are likely to face the greatest difficulties in entering homeownership.

To contextualise this analysis, the following section summarises relevant literature, structured around four interrelated themes: (1) monetary policy and asset prices, (2) housing and objective wellbeing, (3) housing and subjective wellbeing, and (4) New Zealand-specific housing and macroeconomic dynamics. Sections 3 and 4 report on our data and empirical strategy, respectively. We present our main results in Section 5 and conclude with a discussion in Section 6. In the Appendix (Section A1), we include an investigation of the long-run determinants of house prices in New Zealand to establish a *prima facie* case that the wellbeing consequences we see flowing from property price developments are driven, at least in part, by macroeconomic policies. Findings in subsequent sections that relate property prices to wellbeing outcomes, using the unit record data, can be interpreted in light of these

macroeconomic findings. Specifically, if property prices impact wellbeing, we can infer that macroeconomic policies are likely to have acted on wellbeing through the property price channel.

## 2. Literature Review

### 2.1 Monetary Policy and Asset Prices

There is a well-established body of literature confirming that monetary policy affects asset prices, particularly housing prices. Bernanke and Gertler (2000) and Mishkin (2007) outline how lower interest rates and quantitative easing (QE) increase asset prices by reducing borrowing costs and boosting liquidity. More recently, Jordà et al. (2015) provide long-run cross-country evidence that housing markets are particularly responsive to monetary loosening, often leading to credit-driven housing booms. This effect is strongest in areas with constrained or price-inelastic housing supply, where monetary policy shocks trigger sharp increases in house prices (Chadwick et al., 2022). Periods of sustained, expansionary monetary policy (such as during the COVID-19 pandemic or post-Global Financial Crisis) have drawn attention towards the role of central banks in influencing house prices (Diamond et al., 2025). The Reserve Bank of New Zealand's (RBNZ) use of unconventional monetary tools during the COVID-19 pandemic, such as the Large-Scale Asset Purchase (LSAP) programme and the Funding for Lending Programme (FLP), occurred concurrently with sharp increases in house prices. Over this period, property prices rose by 22%, leading the New Zealand Parliament (2021) to amend the Bank's Monetary Policy Committee's remit to require the Bank to consider "sustainable house prices…to help improve affordability for first-home buyers". Although the remit change was unusual, many central banks have similarly faced scrutiny over their role in housing price inflation.

### 2.2 Housing Wealth Effects on Objective Wellbeing

With the growth in housing wealth, there has been increased interest in how this wealth shapes household consumption, savings, and labour market decisions. Bostic et al. (2021) report that an increase in housing wealth leads to higher consumption among homeowners, a phenomenon known as the housing-wealth effect. The wealth effect associated with housing is significantly larger than that of increased financial wealth. However, increased house prices do not benefit all households equally. Mumtaz and Theophilopoulou (2017) report that most of the consumption response of higher house prices is driven by households with a mortgage, whose spending increases. Outright homeowners see no change in expenditure, and renters fall somewhere in the middle. Slacalek et al. (2020) extend this work to study how the composition of household balance sheets explains why some households' consumption expenditure responds more strongly than others. Higher house prices (driven by expansive monetary policy) contribute to a 1.8% increase in consumption expenditure for wealthy, financially constrained households. Meanwhile, poor, financially constrained households increase expenditure by 1%, and non-constrained households increase expenditure by 0.5%. The consumption behaviour of renters in response to higher property prices is more nuanced. Aladangady (2017) reports that a $1 increase in house prices causes a $0.047 increase in spending for homeowners, but no response for renters. Sheiner (1995) argues that young renters living in areas with high property prices will reduce their consumption and increase their savings to afford a larger downpayment. Higher house prices can also push rents upwards (Grimes & Hyland, 2015), reducing disposable income available for both consumption and saving. Given that housing-led expansions disproportionately benefit wealthier households, these asymmetries may amplify income and wealth disparities.

### 2.3 Housing and Subjective Wellbeing

The quality, affordability, and type of housing in which a person lives influence their subjective wellbeing (SWB). Homeowners often report higher SWB due to increased autonomy, security, status, and improved housing conditions (McCabe, 2018). However, the financial stress of servicing a mortgage (DeFusco, 2018; Will & Renz, 2023) and well-regulated rental markets can weaken the relationship between SWB and homeownership (Herbers & Mulder, 2017). Taylor et al. (2007) demonstrate that the inability to meet housing costs is associated with a significant reduction in SWB, and this effect is greatest amongst mortgaged homeowners. Older and low-income households can be especially exposed to housing unaffordability and volatility, emphasising the heterogeneity that exists even within tenure types (Ong ViforJ et al., 2024). In the New Zealand context, Grimes et al. (2024) find that homeowners and public renters report higher SWB than private renters in the same neighbourhood which they attribute, in part, to lower security of tenure for private renters.

There is comparatively less research on the effect of changing property prices on SWB. Atalay and Edwards (2022) report that higher house prices improve perceived financial wellbeing among homeowners, with the strongest effect for mortgaged homeowners. Similarly, Zhang and Zhang (2019) find that homeowners who believe their homes have appreciated in value, reported higher SWB. However, using similar survey data from representative households living in urban China, Pan et al. (2023) report that higher house prices are associated with lower SWB for homeowners. Even less research has been conducted into the effect of property prices on renters' SWB. Given that subjective wellbeing is not simply evaluated in absolute terms but in relation to one's peers, renters' subjective wellbeing may decline if they perceive their peers gaining housing wealth (Easterlin, 2021; Layard, 2011). Similarly, given that housing affordability and the perceived quality of an individual's living environment are positively correlated with SWB for renters, rental hikes that do not reflect improvements in housing quality or local amenities may reduce SWB (Zhan et al., 2022).

### 2.4 New Zealand Context

Supply constraints, population growth, tax settings, and monetary policy have all contributed to New Zealand's prolonged period of housing inflation. Post-GFC, there has been a secular decline in interest rates, with the OCR remaining below 2% for most of the 2010s and dropping to as low as 0.25 during the COVID-19 pandemic (van Rensburg, 2023). A structural undersupply of housing and high immigration pressures pushed the population:dwellings ratio to one of the highest in the OECD (Grimes & Aitken, 2010; Grimes & Hyland, 2015). We add to these studies of the macroeconomic determinants of house prices and rents in the Appendix (Section A1). We find strong evidence for New Zealand that house prices reflect the influences of income, the ratio of population to the dwelling stock, and exogenous financial market pressures (international asset prices and banks' non-performing loans). Furthermore, house prices are impacted by monetary policy via the mortgage rate and are also Granger-caused by the monetary/fiscal quantitative easing associated with the COVID-19 pandemic.

The consequence of housing booms (alongside appreciation in other assets) on inequality depends on the distribution of housing throughout the population. In most OECD countries, the highest-income households hold the largest share of housing wealth (Causa et al., 2019). However, in New Zealand, housing wealth is more equally allocated, with research from the New Zealand Treasury suggesting that higher house prices may reduce some measures of inequality by improving the balance sheets of middle-income households (StatsNZ, 2022).

Changes in house prices can also affect intergenerational equity and mobility as young, asset-poor individuals face worsening housing affordability, while older, property-owning cohorts benefit from windfall capital gains.

## 3. Housing and Wellbeing: Microeconomic Data

### 3.1 Sample Construction

We use data from the Household Economic Survey (HES) and the General Social Survey (GSS), two nationally representative, repeated cross-sectional surveys of New Zealand households. The HES provides detailed information on household expenditures and income, while the GSS collects data on subjective wellbeing, social connections, and other quality-of-life measures. Both surveys include data on housing tenure, life satisfaction and key demographic variables such as age, education, ethnicity, region, and household income. Our NHE measure of objective wellbeing is sourced from the HES Expenditure Module and consists of 17,763 unique households surveyed between July 2006 and July 2023. For subjective wellbeing, we construct a pooled dataset of 31,212 individuals from the GSS (waves 2014, 2016, 2018, and 2023) and 35,754 individuals from the HES (waves 2020-2023). We restrict the sample to survey waves that measured life satisfaction on an 11-point scale. All monetary variables are converted to constant September 2024 NZ dollars using the national Consumer Price Index (CPI) from StatsNZ. Summary statistics are presented in Table 1 and Table 2.

Table 1: Summary statistics for objective wellbeing sample

| | Tenure Type | | | | Total |
|---|---|---|---|---|---|
| | Private Renters | Public Renters | Mortgaged Owner | Outright Owner | |
| Age | 39.9 (15.2) | 50.5 (18.3) | 44.4 (12.8) | 64.2 (14.5) | 50.5 (17.7) |
| Female | 0.58 | 0.61 | 0.54 | 0.56 | 0.56 |
| **Ethnicity** | | | | | |
| European | 0.66 | 0.52 | 0.81 | 0.88 | 0.78 |
| Māori | 0.18 | 0.29 | 0.09 | 0.05 | 0.11 |
| Pacific | 0.08 | 0.21 | 0.03 | 0.01 | 0.05 |
| Asian | 0.15 | 0.04 | 0.10 | 0.05 | 0.09 |
| Other | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| **Education** | | | | | |
| No formal qualification | 0.18 | 0.43 | 0.11 | 0.25 | 0.20 |
| Certificate | 0.42 | 0.40 | 0.40 | 0.35 | 0.39 |
| Diploma | 0.15 | 0.10 | 0.17 | 0.20 | 0.17 |
| Bachelor's Degree | 0.15 | 0.04 | 0.18 | 0.11 | 0.14 |
| Post Graduate Degree | 0.09 | - | 0.12 | 0.08 | 0.10 |
| **Labour Force Status** | | | | | |
| Employed | 0.67 | 0.31 | 0.83 | 0.35 | 0.59 |
| Unemployed | 0.05 | 0.07 | 0.02 | 0.01 | 0.02 |
| Not in labour force (under 65) | 0.20 | 0.36 | 0.10 | 0.09 | 0.14 |
| Not in labour force (65+) | 0.09 | 0.26 | 0.06 | 0.55 | 0.25 |
| Total household income | 51,375 (37,494) | 30,870 (18,792) | 74,927 (51,731) | 63,233 (61,390) | 62,479 (169,408) |
| Observations | *4,593* | *942* | *6,111* | *6,288* | *17,763* |

*Notes:* This table presents summary statistics by tenure type for our objective wellbeing sample. Variable definitions are found in Appendix Table A4. We include household and individual characteristics and report the means and standard deviations (in parentheses) for each indicated subsample, and across the entire sample. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 since people can report having more than one ethnicity.

Table 2: Summary statistics for subjective wellbeing

| | Tenure Type | | | | |
|---|---|---|---|---|---|
| | Private Renters | Public Renters | Mortgaged Owner | Outright Owner | Total |
| Age | 42 (15.3) | 51 (18.0) | 45 (13.1) | 66 (14.5) | 51 (17.6) |
| Female | 0.57 | 0.67 | 0.55 | 0.57 | 0.57 |
| GSS | 0.47 | 0.45 | 0.46 | 0.47 | 0.47 |
| HES | 0.53 | 0.55 | 0.54 | 0.53 | 0.53 |
| **Ethnicity** | | | | | |
| European | 0.63 | 0.45 | 0.78 | 0.87 | 0.75 |
| Māori | 0.22 | 0.37 | 0.13 | 0.09 | 0.15 |
| Pacific | 0.09 | 0.24 | 0.04 | 0.02 | 0.06 |
| Asian | 0.16 | 0.05 | 0.13 | 0.05 | 0.11 |
| Other | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 |
| **Education** | | | | | |
| No formal qualification | 0.18 | 0.42 | 0.11 | 0.23 | 0.18 |
| Certificate | 0.42 | 0.41 | 0.38 | 0.36 | 0.38 |
| Diploma | 0.14 | 0.10 | 0.16 | 0.18 | 0.16 |
| Bachelor's Degree | 0.16 | 0.04 | 0.20 | 0.12 | 0.15 |
| Post Graduate Degree | 0.11 | 0.02 | 0.15 | 0.11 | 0.12 |
| **Labour Force Status** | | | | | |
| Employed | 0.68 | 0.27 | 0.82 | 0.33 | 0.60 |
| Unemployed | 0.05 | 0.07 | 0.02 | 0.01 | 0.03 |
| Not in labour force (under 65) | 0.18 | 0.39 | 0.08 | 0.08 | 0.13 |
| Not in labour force (65+) | 0.09 | 0.26 | 0.08 | 0.58 | 0.26 |
| Total household income | 51901 (39219) | 30300 (20837) | 73905 (50794) | 61156 (55888) | 61360 (49878) |
| Life satisfaction (0-10) | 7.26 (1.95) | 6.92 (2.3) | 7.73 (1.67) | 8.11 (1.75) | 7.68 (1.85) |
| Observations | 17,961 | 3,855 | 23,427 | 21,726 | 66,969 |

*Notes*: This table presents summary statistics by tenure type for our subjective wellbeing sample. Variable definitions are found in Table A4. We include household and individual characteristics and report the means and standard deviations (in parentheses) for each indicated subsample, and across the entire sample. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 since people can report having more than one ethnicity.

## 3.2 Objective Wellbeing

### 3.2.1 Total Expenditure

Our primary measure of objective wellbeing is total non-housing expenditure, defined as household consumption excluding mortgage and rental payments on a primary residence. As discussed in the Introduction, this measure represents what households judge they can spend on all other categories of consumption once they have met their accommodation expenses. Expenditure data are sourced from the HES Expenditure Module, which collects detailed records of household spending every three years. Each household member is asked to recall large payments made over the last 12-months and complete a 7-day expenditure diary[2].

We exclude non-housing debt servicing, negative expenses, diary purchases recorded outside the 7-day period, and any contributions to savings or investments. The remaining expenditures are annualised, equivalised, and combined at the household level to construct an annual measure of household expenditure. We have non-housing expenditure data for 17,763 households.

### 3.2.2 Housing and Non-Housing Costs

To calculate non-housing expenditure, first we define housing expenditure. We construct four measures of housing expenditure, varying by level of comprehensiveness:

1) **Basic Housing Costs:** Rent or mortgage payments (principal and interest) on a primary residence.
2) **Extended Housing Costs**: As for 1) plus rent or mortgage payments on additional properties (e.g. second home or investment properties).
3) **Comprehensive Housing Costs (StatsNZ definition):** As for 2) plus payments for property rates, electricity, insurance, water bills etc.
4) **Complete Housing Costs:** As for 3) plus expenses on additional properties.

Our primary specification uses the Basic Housing Costs measure, as these costs are expected to be most sensitive to change in property prices. Non-housing expenditure is then defined as total expenditure minus housing expenditure. Descriptive statistics for each housing measure by tenure type are presented in Table 3.

One notable feature of Table 3 is that whereas (outright and mortgaged) homeowners have approximately $40,000 in NHE, the expenditure left after housing costs have been deducted is much lower for private renters (approximately $25,000) and far lower still for public renters (approximately $16,000). Even a small absolute shift in rents could therefore have a material proportional impact on NHE for renters, and especially for public renters.

[2] The earliest survey waves (2006, 2009, and 2012) use a 14-day diary. To allow for comparison between waves, we take the expenditure from the first 7 days and multiply it by 52.2 to estimate annual expenditure.

Table 3: Annual housing expenditure, non-housing expenditure, and KiwiSaver contributions ($s)

| | Tenure Type | | | | |
|---|---|---|---|---|---|
| | Private Renters | Public Renters | Mortgaged Owner | Outright Owner | Total |
| Basic Housing Costs | 12755<br>(6418) | 5613<br>(3468) | 11933<br>(10396) | 141<br>(1575) | 7671<br>(9043) |
| Extended Housing Costs | 12938<br>(6659) | 5659<br>(3630) | 12707<br>(11066) | 396<br>(2768) | 8073<br>(9529) |
| Comprehensive Housing Costs (StatsNZ definition) | 13598<br>(6890) | 5889<br>(3693) | 15717<br>(11666) | 3848<br>(3484) | 10492<br>(9584) |
| Complete Housing Costs | 13639<br>(6967) | 5906<br>(3724) | 15806<br>(11730) | 4020<br>(3705) | 10597<br>(9632) |
| Non-Housing Expenditure | 25047<br>(15104) | 16527<br>(10850) | 40197<br>(20880) | 40088<br>(23542) | 30465<br>(17594) |
| KiwiSaver Contributions | 838<br>(1663) | 381<br>(1121) | 1852<br>(2468) | 1338<br>(3101) | 1335<br>(2535) |
| Observations | *4,593* | *942* | *6,111* | *6,288* | *17,763* |

*Notes*: This table presents summary statistics of different housing expenditure measures. We report the means and standard deviations (in parentheses) for each individual subsample, and across the entire sample. Means have been calculated using rounded counts, in line with StatsNZ IDI outputting rules. Counts are randomly rounded to base three.

#### 3.2.3 Equivalisation and Adjustments

To account for household size and composition, we apply an equivalisation scale. Our baseline specification uses a modified OECD scale (Creedy & Quy, 2022):

$$m = (n_a + \beta n_c)^{\delta} \; where \; \beta = 0.6 \; and \; \delta = 0.8$$

Here, $n_a$ is the number of adults and $n_c$ is the number of dependent children. A child is classified as a dependent if that person is under 18 years old. As robustness checks, we repeat our regressions using two alternative equivalence measures: (i) the square root of total household size and (ii) household size.

Total household expenditure per adult equivalent person is defined as total household expenditure divided by $m$. Table A15 shows that results are robust to the alternative equivalisation methods.

### 3.2.4 Trimming and Outliers

To reduce the influence of outliers with implausibly high or low expenditure, we exclude the top and bottom 2.5% of households by total expenditure within each tenure group and survey wave. This trimming slightly reduces regression coefficients relative to untrimmed results, but key patterns, trends, and statistical significance remain unchanged.

## 3.3 Subjective Wellbeing

Subjective wellbeing is measured using an 11-point self-reported life satisfaction question asked across multiple waves of the GSS and HES. Respondents are asked:

*"On a scale from 0 to 10, where 0 is 'completely dissatisfied', and 10 is 'completely satisfied', how do you feel about your life as a whole?"*

No individual is interviewed in both surveys, giving us a pooled sample of 66,969 between July 2013 and June 2024. Approximately, 0.01% of respondents have missing values for life satisfaction: these observations are excluded from all subjective wellbeing regressions.

Although question wording is consistent across surveys, average life satisfaction is slightly higher in the HES (mean = 7.71, sd = 1.86) than in the GSS (mean= 7.64, sd = 1.84). This discrepancy may reflect survey context and framing effects: GSS is a standalone, wellbeing-focused survey with the question asked early in the interview; HES respondents complete detailed financial questions before being asked about life satisfaction. To account for this, we include a survey-source dummy in all regressions.

## 3.4 Tenure

Tenure information is collected in both the HES and GSS and refers to an individual's housing situation at the time of the interview. We concord tenure responses across surveys into the following categories: (1) private renter, (2) public or social housing renter, (3) mortgaged homeowner, and (4) outright homeowner. Individuals living in a property owned by a family trust are treated as homeowners (with or without a mortgage depending on mortgage status).[3]

## 3.5 Property Prices

House price data are sourced from the Real Estate Institute of New Zealand (REINZ) and cover the period 2005-2025. We use a monthly, regional, quality-adjusted house-price index. Rental price data are sourced from the Tenancy Services rental bond dataset, which reports the monthly geometric mean rent by region. Each individual is matched to regional property prices based on their region of residence and the month of interview. To ensure sufficient sample size, we merge the Nelson-Tasman and West Coast regions. All prices are deflated using the national CPI and expressed in constant September 2024 NZ dollars.

## 3.6 Control Variables

We include a range of control variables to account for individual and household characteristics that may affect objective and subjective wellbeing. These include demographic factors (age,

[3] We have no information on past tenure changes for surveyed individuals so we cannot ascertain, for instance, whether an individual who has changed tenure status has a different wellbeing outcome (in relation to property prices) than a similar individual who has not changed tenure status.

gender, education level, household size), economic factors (employment status, income level), and geographic indicators (region). All controls are harmonised across surveys.

### 3.7 Descriptive statistics: Objective Wellbeing

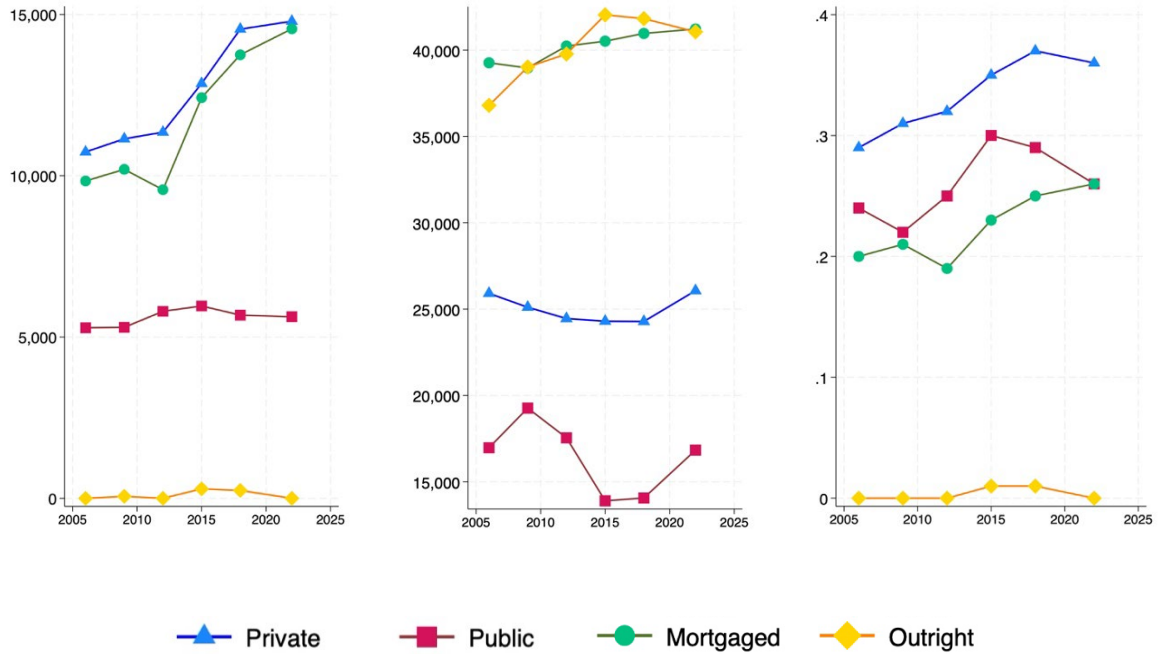
Housing costs vary substantially by tenure type. Mortgaged homeowners and private renters face the highest average annual housing costs, at $11,933 and $12,755, respectively. In contrast, public renters spend an average of $5613 per year, while outright owners report the lowest cost at $141. This low sum for outright owners reflects a lack of regular housing payments. Although mortgaged homeowners and private renters report similarly high housing costs, the burden of these costs differ relative to total household expenditure. For renters, expenditure on non-housing items fell in real terms from $25,912 in 2006 to $24,287 in 2018, before increasing to $26,069 in 2023, slightly above 2006 levels. This indicates that rising housing expenses have commanded a greater proportion of total household income for renters, at least to 2018.

Figure 1(a) displays a striking rise in housing expenditures for renters and mortgaged homeowners. For private renters, the sharp increase in housing expenditure (a 38% rise between 2006 and 2022) coupled with a sluggish rise of 0.01% in non-housing expenditure, saw the ratio of housing to non-housing expenditure increase from 29% to 37%. Similar trends of rising housing costs paired with stagnant non-housing expenditure left mortgaged homeowners increasing their expenditure share on housing from 20% to 26% and public renters increasing their share from 24% to 29%. Outright homeowners, by contrast, reported consistently low housing costs throughout this period, with their housing cost share remaining near zero.

These trends suggest that housing costs represent a growing burden for both renters and mortgaged homeowners. The housing cost ratio for renters peaked in 2018, while it continued to rise for mortgaged homeowners through to 2023, consistent with rising mortgage rates in the post-COVID period.

Figure 1: Equivalised Housing Expenditure and Non-Housing Expenditure

(a) Housing expenditure ($s) (b) Non-housing expenditure ($s) (c) Ratio of housing to non-housing expenditure




*Notes:* Housing expenditure refers to rental and/or mortgage expenditure. Non-housing expenditure includes total household expenditure (excluding debt servicing, negative expenses, diary purchases recorded outside the 7-day period, and any contributions to savings or investments) minus housing expenditure. Both housing and non-housing expenditure are equivalised using the modified OECD equivalance scale and assigned equally to all household members. Values are in September 2024 dollars and calculated from rounded counts.

### 3.8 Descriptive Statistics: Subjective Wellbeing

Subjective wellbeing similarly varies by tenure and across our observed period (Figure 2). Outright owners report the highest life satisfaction, followed by mortgaged homeowners, private renters, and public renters.

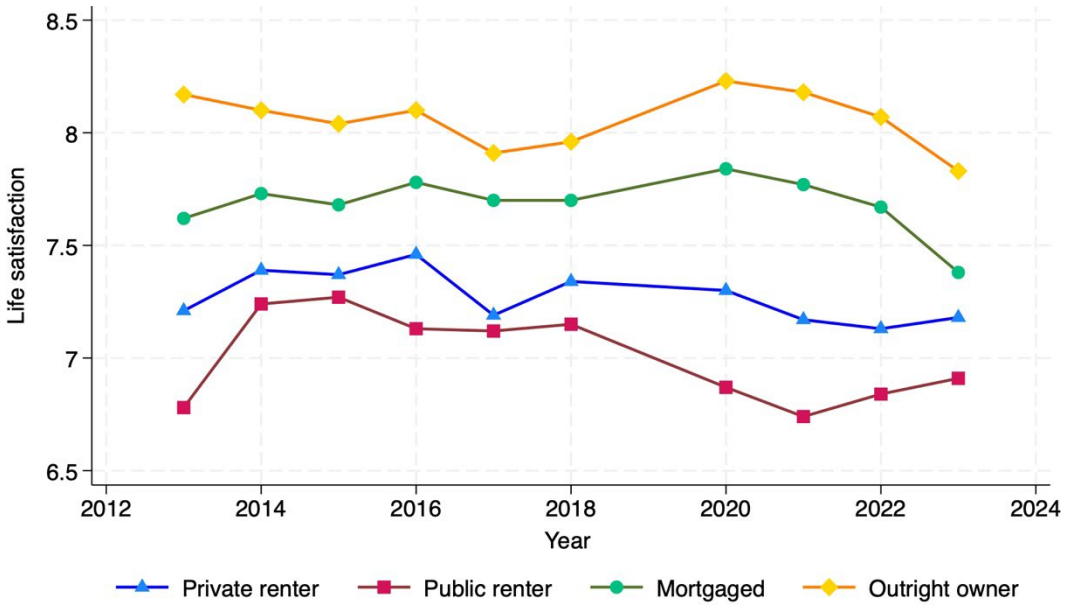
Homeowners, both mortgaged and outright, follow similar trends in SWB, increasing between 2017 and 2020, before falling to their lowest observed levels in 2023. Outright owners fall 0.42 points from their 2020 peak to 7.82 in 2023; mortgaged owners fall 0.47 points to 7.37.

SWB for renters falls between 2016 and 2021, before recovering slightly in the later survey waves. Public renters report a significant and prolonged decline of 0.5 points between 2015 and 2021. This result may partially reflect (unobserved) demographic shifts among public renters, as lengthy waiting lists for social housing have resulted in stricter requirements for deprivation to be met. As such, the decline in SWB may reflect how individuals in social housing, on average, face more dire circumstances in later survey periods. To test for this selection effect, we compare demographic differences by tenure type across the observed

period. There are some consistent demographic shifts across all tenure types: respondents become slightly older, more female, more educated, less European/Pākehā, and less likely to be unemployed. All tenure groups observe a significant decline in real household incomes in the final survey wave (likely capturing the high inflation during this period). There are also slight demographic shifts between tenure types, with outright owners and renters exiting the labour force, and an increase in the number of Māori and Asian respondents living in public housing. However, these demographic shifts operate relatively uniformly across the period and are unlikely to account for the different trends in observed life satisfaction across tenures after 2020.

The different trends in life satisfaction across tenures through the COVID-19 period also suggest that the pandemic cannot, by itself, account for the more recent variations in SWB by tenure. Regardless, we account for observable characteristics and include survey wave fixed effects to help control for COVID-19 effects in the subsequent regression analysis. We report tenure-specific characteristics over time in Appendix Tables A6-A13.

Figure 2: Life satisfaction, by tenure type




*Notes:* Means calculated from rounded counts. No interviews were conducted in the July 2019- June 2020 period. 0=not at all satisfied, 10=completely satisfied.

# 4. Methodology

## 4.1 Regression Modelling of Wellbeing Outcomes

We estimate the association between regional property prices and two wellbeing outcomes: non-housing expenditure and life satisfaction. Our maintained assumptions are that: (i) regional property price movements are exogenous to the household, (ii) households cannot change tenure status immediately (so cannot, for instance, switch from being a private renter to a homeowner with a mortgage within the same month that they observe a shift in local property prices), and (iii) households cannot change region immediately (so cannot switch their region of residence within the same month that they observe a shift in regional property prices). We recognise that these identifying assumptions may not hold for all individuals or at all times, so our estimates cannot be interpreted as necessarily indicating causality.

Our primary econometric specification uses an ordinary least squares (OLS) regression to estimate the following specification:

$$Y_{i,t} = \beta_0 + \beta_1 X_{i,t} + \beta_2 Tenure_{i,t} + \beta_3 PropertyPrice_{r,t} + \beta_4 \left(PropertyPrice_{r,t} * Tenure_{i,t}\right) + MortgageRate_t + \mu_r + \tau_t + \varepsilon_{i,t} \quad (5)$$

where $Y_{i,t}$ represents either the natural log of real, equivalized non-housing expenditure, or life satisfaction for individual $i$ in month-year $t$, $X_{i,t}$ is a vector of individual- and household-level characteristics including household income, employment status, household composition, age (quadratic), sex, ethnicity, and education. $Tenure_{i,t}$ captures housing tenure categories. $PropertyPrice_{r,t}$ is either the regional quality-adjusted, house price index (HPI) or the geometric mean, regional rent. $MortgageRate_t$ is the effective mortgage rate (as defined in Table A1) in month $t$; $\mu_r$ and $\tau_t$ represent region and survey wave fixed effects, and $\varepsilon_{i,t}$ is the error term. Robust standard errors are reported.

We interact regional property prices with tenure categories to estimate tenure-specific exposure to housing market conditions. The coefficients of interest are those in the vector, $\beta_4$, which capture the association between property prices and wellbeing outcomes for different tenure types relative to the base category of outright homeowners. Because regional property prices and rents are highly correlated, we estimate separate regressions for each (rather than jointly) to mitigate multicollinearity. We also report a specification which uses HPI for owners and rents for renters. Appendix Table A5 reports the correlation coefficients between rents and HPI, by region.

Our primary SWB specification in (5) treats life satisfaction, which is measured on an 11-step scale, as a cardinal variable (Ferrer-i-Carbonell & Frijters, 2004); other specifications that treat this variable as ordinal are reported for robustness. Specifically, we repeat our regression analysis for subjective wellbeing using three separate probit models. We generate a binary variable equal to 1 if an individual's life satisfaction is (i) above 5, (ii) above 6, or (iii) above 7 (and equal to 0 otherwise). This approach allows us to differentiate which individuals along the life satisfaction distribution are most sensitive to changes in life satisfaction.

### 4.2 Robustness checks

We conduct several further robustness tests, including an interaction between mortgage rates and tenure type (rather than between property prices and tenure type). We also estimate (5) using different objective wellbeing outcome variables (i.e. different measures of housing expenditure). To more fully investigate the effect of the property market on objective wellbeing, we repeat Equation (5) using contributions to KiwiSaver as our outcome variable[4]. This specification captures a measure of households' contributions towards their future consumption, providing context to the findings with respect to non-housing expenditure and tenure type.

[4] KiwiSaver is New Zealand's government-sponsored retirement income savings scheme whereby employees and employers both pay into an investment fund with accounts specific to each individual, payable as a lump sum when that individual reaches 65 years of age. Individuals have discretion over the proportion of their income (above a minimum threshold) that they contribute to KiwiSaver.

# 5. Results

## 5.1 Objective Wellbeing

To examine the relationship between regional property prices and objective wellbeing, we estimate Equation (5) using (ln) household-level non-housing expenditure (NHE) as the dependent variable, controlling for regional, individual, and household characteristics. Column (1) of Table 4 presents the baseline regression of NHE on tenure status without any controls or interactions. Column (2) adds a complete set of covariates. Column (3) further includes the regional house price index (HPI) and interacts HPI with tenure. Column (4) replaces house prices with regional rents, again interacted with tenure. Column (5) interacts regional house prices with tenure for homeowners and regional rents with tenure for renters. Finally, Column (6) interacts mortgage rates with tenure.

Our primary interest is not in the overall effect of property prices on NHE, as a range of factors may influence both property prices and expenditures concurrently. We control for region and wave fixed effects but cannot control fully for time-varying factors that may impact both expenditures and property prices (demographic and government policy changes, Covid-19, etc.). Instead, our focus is on the interaction effects between tenure and property prices, which indicate whether property price changes have differential effects on NHE according to the housing tenure status of the individual.

In our preferred specification based on the regional HPI (Column 3), control variables perform as expected. (Full regression results are reported in Appendix Table A14.) Sex is statistically insignificant, a predictable result given that NHE is measured at the household level. As might be expected, NHE is significantly higher among households headed by older individuals, of European/Pākehā ethnicity, employed, and in higher income brackets. Households located in major urban centres (Auckland and Wellington) also report higher levels of non-housing expenditure. We include tenure type as a categorical variable and find that, relative to outright owners, mortgaged homeowners, private renters and public renters spend less on non-housing expenditure.

The column (3) estimates indicate that, relative to outright owners, a 10% increase in regional house prices is associated with a decrease of 1.46% in NHE for mortgaged homeowners, 1.28% for private renters, and 3.68% for public renters. These results suggest that rising house prices crowd out non-housing expenditure among households with ongoing housing costs. Figure 3 plots NHE relative to the HPI. Here HPI is centred on the mean, with 0.45 being 45% (2 standard deviations) above the mean and -0.45 being 45% below the mean. The figure shows a slight increase in NHE amongst outright owners as HPI increases with a significant decline for public renters. We again emphasise, however, that we place more weight on the relative effects between tenure categories than on the absolute relationships.

Figure 3: NHE by HPI for different tenure types




Column (4) reports a similar pattern with respect to regional rents. A 10% increase in regional rents is associated with a 1.83% reduction in NHE for private renters and a 3.26% reduction for public renters, relative to outright owners. Mortgaged homeowners also reduce their NHE when regional rents rise, likely reflecting the co-movements between rents and house prices. When we interact homeowners with house prices and renters with rents in Column (5), we find similar results. Using different measures of housing expenditure and different equivalisation techniques does not change the nature of our results, as reported in Appendix Table A15, except for private renters when the 'Extended' and 'Complete' definitions of housing expenditure are used. In these cases, the interaction effects for private renters become insignificant, implying that some private renters may own houses for which they bear costs but in which they do not live.

In Column (6) of Table 4, we test whether a reduced form relationship exists between NHE (by tenure) and the mortgage interest rate, which Appendix A1 establishes is a determinant of house prices. The estimates indicate that when the mortgage interest rate is reduced (inducing a rise in house prices), NHE of mortgaged homeowners, private renters and public renters each fall relative to outright owners. These responses are consistent with the estimated responses in columns (3)-(5).

As a further robustness check, Appendix Table A15 presents our core results excluding wave fixed effects (Column 7). The previous regressions include monthly observations for house prices, rents and the mortgage rate, timed to coincide with the respondent's survey date (and the house price and rent variables are included at the regional level). Nevertheless, the wave fixed effects may disguise the influence of these three variables. The results in Column (7) of Appendix Table A15 show that our estimates are materially unaffected by the inclusion or exclusion of wave fixed effects.

Overall, the results are robust across specifications and suggest that changes in property prices have differential effects on objective wellbeing, depending on tenure type. Hence, property price movements contribute to changes in inequality (of NHE) by affecting individuals differently based on their tenure status. Put succinctly, property price rises are associated with an increase in non-housing expenditures of outright owners relative to all other tenure categories. At the same time, public renters who have very low expenditures once housing costs are deducted, suffer the greatest relative expenditure falls.

Table 4. Objective wellbeing regression results

| | Regression specification | | | | | |
|---|---|---|---|---|---|---|
| | (1) No controls | (2) With controls | (3) HPI interactions | (4) Rent interactions | (5) HPI & Rent interactions | (6) Mortgage Rate interactions |
| Private renter | -0.504*** | -0.449*** | -0.449*** | -0.451*** | -0.450*** | -0.747*** |
| | (0.012) | (0.013) | (0.013) | (0.013) | (0.0127) | (0.064) |
| Public renter | -0.956*** | -0.645*** | -0.651*** | -0.644*** | -0.643*** | -1.199*** |
| | (0.023) | (0.023) | (0.024) | (0.024) | (0.0230) | (0.125) |
| Mortgaged homeowner | 0.0235* | -0.086*** | -0.086*** | -0.089*** | -0.0884*** | -0.219*** |
| | (0.010) | (0.011) | (0.011) | (0.011) | (0.0105) | (0.052) |
| Mortgage rate | | -0.018 | -0.016 | -0.018 | -0.0157 | -0.021*** |
| | | (0.011) | (0.011) | (0.011) | (0.0106) | (0.006) |
| HPI | | | 0.131** | | 0.125*** | -0.041* |
| | | | (0.048) | | (0.0375) | (0.019) |
| Rents | | | | 0.630 | | |
| | | | | (0.673) | | |
| **Tenure x HPI** | | | | | | |
| Private renter | | | -0.135** | | | |
| | | | (0.044) | | | |
| Public renter | | | -0.393*** | | | |
| | | | (0.098) | | | |
| Mortgaged homeowner | | | -0.155*** | | -0.0299 | |
| | | | (0.037) | | (0.0368) | |
| **Tenure x Rents** | | | | | | |
| Private renter | | | | -0.194*** | -0.119** | |
| | | | | (0.049) | (0.0442) | |
| Public renter | | | | -0.348*** | -0.273** | |
| | | | | (0.100) | (0.0981) | |
| Mortgaged homeowner | | | | -0.112** | | |
| | | | | (0.040) | | |
| **Tenure x Mortgage Rate** | | | | | | |
| Private renter | | | | | | 0.049*** |
| | | | | | | (0.010) |
| Public renter | | | | | | 0.091*** |
| | | | | | | (0.020) |
| Mortgaged homeowner | | | | | | 0.022** |
| | | | | | | (0.008) |
| Controls | No | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | 0.198 | 0.402 | 0.403 | 0.403 | 0.403 | 0.403 |
| Count | *17,763* | *17,763* | *17,763* | *17,763* | *17,763* | *17,763* |

*Notes*: The dependent variable is ln(NHE). Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Definitions are reported in the Appendix Table A4. Robust standard errors are reported. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * p < 0.10, ** p < 0.05, *** p < 0.01. Full regression coefficients corresponding to column (3) are reported in Appendix Table A14.

### 5.2 Savings and Wealth

The models in Section 5.1 indicate that public renters are the most sensitive to changes in regional property prices. New Zealand's public housing agency, Kāinga Ora, houses most public renters who are eligible for income-related rents under the Income-Related Rent Subsidy (IRRS). This scheme is designed to protect vulnerable and low-income households from high rents by capping rent as a proportion of income. However, only 83% of public renters are covered by this scheme, leaving almost a fifth of public renters exposed to movements in the property market (Miller & Goodyear, 2025). Furthermore, public renters whose rents are less than the income-related cap are still subject to increases in market rents up to the capped amount. Figure 6(c) shows that rents as a ratio of NHE for public renters varied from an average of 24% to 29% through the sample period.

Given the very low incomes and minimal assets of most public renters, even small increases in housing costs can significantly reduce NHE. Due to the stringent criteria applied to enter public housing (Grimes et al., 2024), these households are likely to have limited capacity to smooth consumption due to low savings and limited access to credit. To explore this aspect further, we re-estimate Equation (5) using retirement savings contributions into the government-sponsored KiwiSaver Scheme, as the outcome variable.

Table 5 shows that, in response to a 10% increase in regional house prices, public renters reduce their retirement savings (relative to outright owners) by $48, indicating that consumption smoothing for public renters comes, at least in part, through reduced contributions to their retirement savings. Given that the average, annual contributions to KiwiSaver for public renters is $381, this is a substantial proportional decline. In contrast, private renters increase their savings by $61 ($p < 0.01$), potentially in response to rising deposit requirements to enter an increasingly expensive housing market. Mortgaged owners increase their contributions by $78 ($p<0.01$) per year compared to outright owners.

From column 3 in Table 4, outright homeowners appear to benefit most at times of rising local property prices, increasing their NHE by 1.26% when house prices rise by 10%. This may reflect a housing wealth effect, whereby higher property values translate into greater perceived wealth and, in turn, higher consumption. This effect is particularly relevant in New Zealand where residential housing accounts for the majority of household wealth (Ching et al., 2023). The wealth effect is even more pronounced for owners of multiple properties, who likely experience magnified (tax-free) capital gains from house price increases. We have repeated our primary specification to include an additional dummy variable to indicate whether a household (i) owns multiple properties or (ii) is a landlord. In both instances, the additional boost in NHE is 1.56%. These findings support a dual-channel mechanism, suggesting that rising house prices primarily benefit equity-rich households. In contrast, mortgaged households are more cash-flow constrained and unable to convert housing wealth gains into increased spending.

Table 5: KiwiSaver Contributions

| | (1)<br>Savings |
|---|---|
| Private renter | -446.5***<br>(43.24) |
| Public renter | -270.5***<br>(45.57) |
| Mortgaged homeowner | -111.6*<br>(49.11) |
| Mortgage rate | 56.28<br>(39.31) |
| HPI | -6.57***<br>(1.92) |
| **Tenure x HPI** | |
| Private renter | 6.06***<br>(1.46) |
| Public renter | -4.78**<br>(1.81) |
| Mortgaged homeowner | 7.84***<br>(1.63) |
| Controls | Yes |
| $R^2$ | 0.198 |
| Count | *17763* |

*Notes*: The dependent variable is (ln) of real equivalised KiwiSaver contributions. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Definitions are reported in the Appendix Table A4. Robust standard errors are reported. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * p < 0.10, ** p < 0.05, *** p < 0.01.

### 5.3 Subjective Wellbeing

We now turn to the results for subjective wellbeing. To examine the relationship between regional property prices and subjective wellbeing, we estimate Equation (5) with individual-level self-reported (cardinal) life satisfaction as the dependent variable, controlling for regional, individual, and household-level characteristics. Columns (1) to (6) of Table 6 correspond to the specifications estimated for NHE. We report the results of our probit models, using house prices, in Table 7; this table includes the baseline regression (assuming cardinality) in Column (1), and three probit models which estimate the probability that life satisfaction is (i) above 5 in Column (2), (ii) above 6 in Column (3), and (iii) above 7 in Column (4).

In our preferred specification (Column 3 of Table 6), control variables perform similarly to our objective wellbeing regressions. SWB increases with education, household income, employment, being female, and the number of children in the household. Māori, Pacific and Asian individuals report higher levels of SWB than Pākehā or Other ethnicities after controlling for other variables. Finally, SWB is U-shaped with age (higher for young and older people). Region is not strongly correlated with SWB. We include tenure type as a categorical variable: relative to outright owners, mortgaged homeowners are 0.322 points less satisfied, private renters are 0.607 points less satisfied and public renters are 0.688 points less satisfied (the difference in estimates for private and public renters is not statistically significant). Full regression results with house price interactions are reported in Appendix Table A14.

The column (3) estimates indicate that regional house prices are not associated with a discernible change in life satisfaction for either mortgaged or outright homeowners. Meanwhile, compared to outright owners, a 10% increase in regional house prices is associated with is a decline in life satisfaction of approximately 0.045 for both private and public renters. These results suggest that while the SWB of homeowners (with or without mortgage) is largely immune to property price changes, rising property prices are negatively associated with the SWB for renters. Estimates from the regression included in Column (3) of Table 6 show that, relative to someone in employment, an unemployed person has 0.737 points lower life satisfaction. A 50% increase in house prices (as occurred nationally in the 9 quarters through to November 2021) therefore has an effect on the SWB of renters that is equivalent to about a third of that associated with being unemployed.

Column (4) reports that changes to regional rents have a statistically insignificant association with SWB for all tenure groups. Nevertheless, the point estimate for public renters indicates that a 10% increase in rents is associated with a 0.0269 decline in life satisfaction for public renters relative to outright owners (with negligible effects on private renters and mortgaged owners). To understand these patterns, we run several heterogeneity tests, by age, household income, and the price-to-rent ratio. We discuss the implications of these tests in Section 6.

Given the ordinal nature of SWB, we report estimates (using house prices) from a series of probit regressions using three thresholds: whether an individual reports a score (i) above 5, (ii) above 6, and (iii) above 7. These coefficients are reported in Table 7. Results are most pronounced and statistically significant when using the lowest threshold (a cutoff of 5), suggesting that individuals with low levels of subjective wellbeing are more sensitive to changes in regional property prices. Individuals with higher SWB are less sensitive to changes in property prices both relative to outright owners and in total.

Table 6: Subjective wellbeing OLS regression results

| | Regression specification | | | | | |
|---|---|---|---|---|---|---|
| | (1) No controls | (2) With controls | (3) HPI interactions | (4) Rent interactions | (5) HPI & Rent interactions | (6) Mortgage Rate interactions |
| **Tenure** | | | | | | |
| Private renter | -0.849*** | -0.606*** | -0.607*** | -0.608*** | -0.607*** | -0.924*** |
| | (0.019) | (0.023) | (0.027) | (0.023) | (0.023) | (0.087) |
| Public renter | -1.181*** | -0.689*** | -0.688*** | -0.684*** | -0.686*** | -1.226*** |
| | (0.039) | (0.042) | (0.042) | (0.042) | (0.042) | (0.179) |
| Mortgaged homeowner | -0.374*** | -0.321*** | -0.322*** | -0.322*** | -0.322*** | -0.277*** |
| | (0.016) | (0.0120) | (0.019) | (0.019) | (0.012) | (0.0739) |
| Mortgage rate | | 0.035* | 0.027 | 0.036* | | -0.103*** |
| | | (0.017) | (0.018) | (0.018) | | (0.011) |
| HPI | | | 0.043 | | 0.297*** | -0.443*** |
| | | | (0.087) | | (0.070) | (0.041) |
| Rents | | | | -0.016 | | |
| | | | | (0.113) | | |
| **Tenure x HPI** | | | | | | |
| Private Renter | | | -0.438*** | | 0.0456 | |
| | | | (0.082) | | (0.086) | |
| Public Renter | | | -0.464*** | | -0.160 | |
| | | | (0.167) | | (0.193) | |
| Mortgaged homeowner | | | -0.054 | | 0.244*** | |
| | | | (0.071) | | (0.068) | |
| **Tenure x Rents** | | | | | | |
| Private Renter | | | | -0.062 | | |
| | | | | (0.098) | | |
| Public Renter | | | | -0.269 | | |
| | | | | (0.198) | | |
| Mortgaged homeowner | | | | -0.037 | | |
| | | | | (0.086) | | |
| **Tenure x Mortgage Rate** | | | | | | |
| Private Renter | | | | | | 0.064*** |
| | | | | | | (0.017) |
| Public Renter | | | | | | 0.109* |
| | | | | | | (0.035) |
| Mortgaged homeowner | | | | | | -0.009 |
| | | | | | | (0.014) |
| Controls | No | Yes | Yes | Yes | Yes | Yes |
| *R2* | 0.041 | 0.088 | 0.089 | 0.088 | 0.088 | 0.087 |
| Count | *66969* | *66969* | *66969* | *66969* | *66969* | *66969* |

*Notes*: The dependent variable is life satisfaction (0-10 scale). Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Definitions are reported in Appendix Table A4. Standard errors are robust. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Full regression coefficients corresponding to column (3) are reported in Appendix Table A14.

Table 7: Subjective wellbeing probit regression results

| | Regression specifications | | | |
|---|---|---|---|---|
| | (1) Cardinal Specification | (2) Probit 5 | (3) Probit 6 | (4) Probit 7 |
| **Tenure** | | | | |
| Private renter | -0.607*** | -0.420*** | -0.410*** | -0.391*** |
| | (0.027) | (0.0204) | (0.0180) | (0.0159) |
| Public renter | -0.688*** | -0.442*** | -0.428*** | -0.388*** |
| | (0.042) | (0.0286) | (0.0264) | (0.0249) |
| Mortgaged homeowner | -0.322*** | -0.205*** | -0.180*** | -0.194*** |
| | (0.019) | (0.0199) | (0.0173) | (0.0148) |
| Mortgage Rate | 0.027 | 0.0413* | 0.0167 | 0.0121 |
| | (0.018) | (0.0172) | (0.0152) | (0.0135) |
| HPI | 0.043 | 0.228** | 0.170* | -0.0225 |
| | (0.087) | (0.0840) | (0.0746) | (0.0652) |
| **Tenure x HPI** | | | | |
| Private Renter | -0.438*** | -0.329*** | -0.361*** | -0.164** |
| | (0.082) | (0.0733) | (0.0655) | (0.0582) |
| Public Renter | -0.464** | -0.321** | -0.295** | -0.191 |
| | (0.167) | (0.112) | (0.104) | (0.0989) |
| Mortgaged homeowner | -0.054 | -0.129 | -0.151* | -0.0943 |
| | (0.071) | (0.0734) | (0.0646) | (0.0553) |
| Controls | Yes | Yes | Yes | Yes |
| *R2* | 0.089 | 0.078 | 0.069 | 0.054 |
| Count | *66969* | *66969* | *66969* | *66969* |

*Notes*: The dependent variable is life satisfaction (0-10 scale). Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Columns (2)-(4) present the results of our probit models. We report coefficients from probit regressions using three thresholds: individual reports a score: (i) above 5 (Column 2), (ii) above 6 (Column 3), and (iii) above 7 (Column 4). Standard errors are robust. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## 6. Discussion and conclusions

The Reserve Bank of New Zealand Act 2021 (section 3) has, as one of its purposes, to 'promote the prosperity and well-being of New Zealanders'. If this aim is to be effectively achieved it is essential to understand how macroeconomic policy, particularly monetary policy, influences wellbeing including through its effect on the housing market. In the Appendix to this paper, we show that in New Zealand, as in other jurisdictions, property prices (house prices and rents) are, *inter alia*, impacted by domestic monetary policy. A reduction in interest rates and/or an expansion of liquidity through 'unconventional' monetary policy actions act to raise property prices. Given these impacts, we then focus on ascertaining the heterogeneous effects of rising property prices on non-housing expenditure and life satisfaction across tenure groups. The results have implications for developments in inequality associated with housing tenure status. Here, we provide additional discussion of the reasons why property prices might affect SWB, especially for renters, before presenting our broader conclusions.

A novel contribution of our research is the finding that even modest increases in house prices have a material impact on renters' objective and subjective wellbeing. We estimate that a 10% increase in local house prices is associated with a decrease in NHE of private and public renters of 1.28% and 3.68% respectively, relative to outright owners. In comparison, mortgaged owners experience a decrease in NHE of 1.46%.

While house prices have no statistically significant effect on the SWB of homeowners, house price changes do affect renters. A 10% house price increase is associated with a decline in life satisfaction of approximately 0.045 points for public and private renters, compared to outright homeowners. The effect on the SWB of renters from a 50% increase in house prices (as occurred nationally between August 2019 and November 2021) corresponds to one-third of the effect on SWB of being unemployed relative to being employed.

The asymmetry in SWB responses between renters and mortgaged homeowners (in contrast to their similar NHE patterns) highlights differential exposure of renters to the negative consequences of housing market inflation. While house prices have a clear and adverse effect on renters' wellbeing, we find no relationship between regional rents and life satisfaction. This result holds even as housing costs for renters have increased significantly (from $10,740 in 2006 to $14,790 in 2023) and have grown faster than wages, contributing to a decline in real non-housing expenditure over the period. The absence of a direct rent effect on subjective wellbeing suggests that the relationship between housing costs and wellbeing may be more nuanced than a simple affordability channel.

To explore this matter further, we consider whether one possible mechanism through which house prices affect renters' SWB is perceived exclusion from an inaccessible housing market. Rising prices may reduce the wellbeing of those increasingly unable to transition into homeownership. This sense of exclusion is likely strongest among older renters, who are demographically similar to the traditional home-owning cohort. Exclusion is also more likely to be experienced by renters who see the possibility of future homeownership becoming even more difficult as house prices rise; those on low incomes or who live in regions with high price-to-rent ratios may be especially affected. We investigate these possibilities below.

We have re-estimated Equation (5) for life satisfaction separately by age and find that the negative impact of house price increases on renters' subjective wellbeing is concentrated amongst renters aged 45 and above. For younger renters, regional house price changes have no statistically significant effect on life satisfaction. Private renters aged 45–54 report an effect

about three times larger than those aged 35–44, and five times larger than those aged 25–34. House price growth can harm the wellbeing of older renters, who may perceive non-ownership as a more persistent or even irreversible outcome. The results of this heterogeneity test are reported in Appendix Table A16.

We also investigate how the price-to-rent (PTR) ratio might act as a proxy for housing exclusion. The PTR ratio captures the relative cost of owning versus renting and serves as an indirect measure of housing market accessibility. New Zealand has one of the highest PTR ratios in the OECD, driven by high house prices relative to both income and rent (Fitchett & Jacob, 2022). These ratios vary substantially by region and over time, from a low of 14.2 in Gisborne (2012) to a high of 40.0 in Auckland (2021).

We find that the negative effect of house prices on renters' wellbeing is approximately five times greater in the top quartile of the PTR distribution relative to the bottom quartile. Private renters in the top quartile lose 0.1 life satisfaction points with a 10% rise in property prices ($p < 0.001$), while those in the bottom quartile see almost no change (–0.002 points, not significant). A similar effect is observed for public renters, as outlined in Appendix Table A17. Homeowners do not exhibit these differential effects, as the relationship between house prices and wellbeing remains flat and statistically insignificant along this distribution. This suggests that the effect of house prices on renters' SWB is mediated by the gap between renting and buying. A renter living in a region with higher rents relative to property prices reports higher SWB than a similar renter living in a region with lower rents relative to property prices. This also points to exclusion as an important mechanism through which property prices affect the SWB of renters.

Finally, we consider the role of household income in mediating the effect of house prices on SWB. Private renters in the lowest quintile report no effect. This quintile likely captures both wealthy renters with high wealth (but low income) and very poor renters, which may explain the null effect. Meanwhile, renters in the second-lowest quintile are more likely to be genuine low-income households. As observed in Appendix Table A18, this quintile reports the most significant decline in subjective wellbeing in response to rising property prices. This effect is significantly stronger than that observed for higher-income renters, who appear more insulated from local housing market dynamics. Rising house prices may deepen socioeconomic inequality not only between, but also within, tenures, by disproportionately reducing the wellbeing of renters with the lowest prospects of moving into homeownership.

Our results indicate that changes in house prices, including in response to monetary policy changes, generate uneven wellbeing outcomes across tenure groups, exacerbating both subjective and objective inequalities. Relative to outright homeowners (who experience modest gains in non-housing expenditure during property price booms), mortgaged homeowners experience a reduction in NHE, albeit with no changes in reported life satisfaction. Renters experience a relative reduction in both non-housing expenditures and life satisfaction when property prices rise. The adverse (absolute and relative) SWB effects for renters likely reflect a sense of exclusion from homeownership and the insecurity that accompanies it. Older, lower-income renters and those in higher price-to-rent regions are especially affected by high house prices, suggesting that the psychological and financial burdens of housing unaffordability fall hardest on those least able to respond. Public renters, despite some policy protections, remain vulnerable due to limited financial buffers, which also lead these households to reduce their contributions to retirement savings as rents increase.

These results underscore the significance of housing circumstances in shaping the distributional effects of macroeconomic policies. They suggest that rising property prices, while beneficial to outright owners (and especially to owners of multiple properties), may undermine the wellbeing of others. In particular, rising property prices undermine the wellbeing of the most vulnerable, exacerbating existing tenure-based inequalities.

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# Appendix: Section A1.

# Macroeconomic determinants of house prices and rents

## A1.1 Background

Prior New Zealand evidence indicates that the combined impacts of a global decline in interest rates, the tax system, and restrictions on urban land supply have led to large increases in house prices and to an increase in the ratio of house prices to rents (Housing Technical Working Group [HTWG], 2022). The HTWG analysis concluded that these increases in property prices (i.e. house prices and rents) have had an impact on the wellbeing of New Zealanders:

> "*Rising prices and rents have had a significant impact on wellbeing, home ownership rates, wealth inequality, homelessness and child poverty. These outcomes disproportionately affect low-income earners, Māori and Pacifica people and young people.*" (HTWG, 2022, p.7)

These findings are consistent with those in Grimes and Aitken (2010) who found that real house prices in New Zealand are determined by the ratio of population to dwellings (the 'dwelling ratio'), incomes and by the user cost of capital. Further evidence is provided in Grimes and Hyland (2015). Their theoretical approach (which also underpins the analysis in this section) incorporated a representative agent model in which each individual derives utility from non-housing consumption and from housing services which are proportional to the housing stock. The individual maximises lifetime utility subject to a budget constraint which incorporates the ability to invest in financial assets and housing. After aggregating across all individuals, the real price of housing is shown to be determined by aggregate per capita consumption (reflecting per capita incomes), the user cost of capital and the dwelling ratio; the housing stock (and hence the dwelling ratio) is influenced by building costs and by regulatory constraints.

In empirical modelling for New Zealand, Grimes and Hyland (2015) confirmed that long-run real house prices and rents are determined positively by income and by the dwelling ratio[5], and negatively by the user cost of capital. In addition, they found that credit market constraints (proxied by banks' non-performing loan ratios) acted to suppress house prices. While incorporating impacts of the user cost of capital and credit constraints, these prior studies did not account for any influence of exogenous asset market sentiment or for more recent 'unconventional monetary policies' involving central bank purchases of assets. We incorporate each of these influences in our modelling below. Specifically, we include the US share price index[6] as an exogenous representation of asset market sentiment and include a variable for the total assets of the Reserve Bank of New Zealand (RBNZ) reflecting the asset purchase activities of the central bank.

Our research is concerned with the long-run determinants of property prices (rather than short-run dynamics). We examine whether macroeconomic influences, including the dwelling ratio, bear a long run relationship with property prices by testing whether a cointegrating relationship exists between property prices and macroeconomic variables (each of which is non-stationary). In doing so, we evaluate whether there is a *prima facie* case that the estimated relationships between property prices and wellbeing outcomes reported in the main body of the paper reflect

[5] Nguyen et al. (2022) find, for New Zealand, that an increase in the dwelling ratio associated with inward migration leads to short-to-medium term increases in both rents and house prices.

[6] We include the US index rather than a NZ index to ensure that this sentiment variable is exogenous to the NZ economy; we include a share price index rather than a housing index to abstract from specific US housing market factors.

the overarching impacts of macroeconomic influences on property prices. If so, we can interpret impacts of property prices on wellbeing as reflecting, at least in part, the influence of macroeconomic factors. We begin by outlining the methods used in this appendix, before applying these methods to examine the relationship of macroeconomic factors with property prices.

**A1.2 Methods**

We test whether a cointegrating relationship exists between rents, house prices, and macroeconomic variables using an Engle-Granger Augmented Dickey-Fuller (EG-ADF) test (Engle & Granger, 1987); we also check for Granger causality from the residual of the cointegrating relationship to either house prices or rents. Subsequently, we provide tests of coefficient significance using the dynamic ordinary least squares (DOLS) estimator (Stock & Watson, 1993).

To test whether a cointegrating relationship holds, we first test whether the relevant variables have a unit root (with and without trend). If so, we include them in an OLS regression:

$$Y_t = \alpha_0 + \alpha_1 Trend + \theta X_t + e_t \quad \text{(A1)}$$

where $Y_t$ is the non-stationary [I(1)] dependent variable (rents or house prices), $Trend$ is a time trend (which is omitted if not required for cointegration), $X_t$ is a vector of non-stationary variables chosen in accordance with the studies cited above, $e_t$ is a stationary residual; $\alpha_0$, $\alpha_1$ and the vector $\theta$ are coefficients to be estimated. We run a Dickey-Fuller test on the estimated residuals, $\hat{e}_t$, with the null hypothesis that $\gamma = 0$ in equation (A2), using critical values given by MacKinnon (2010):

$$\Delta\hat{e}_t = \gamma\hat{e}_{t-1} + \varepsilon_t \quad \text{(A2)}$$

If we reject the null hypothesis in (A2), we conclude that the residuals of equation (A1) display mean reversion, so the variables exhibit a long run (cointegrating) relationship.[7] By itself, a cointegrating relationship does not necessarily imply that the dependent variable in equation (A1) is (Granger)-caused by the independent variables. To test whether this is the case, we estimate an error correction equation, (A3), and test whether the error correction coefficient, $\beta$, is negative and significantly different from zero. If the null hypothesis is rejected, $Y_t$ converges to the value predicted by the long-run relationship:

$$\Delta Y_t = \beta\hat{e}_{t-1} + \varepsilon_t \quad \text{(A3)}$$

Even when equation (A1) is a cointegrating relationship, we cannot directly use it for inference since the estimates have a non-normal distribution. Instead, we estimate a DOLS equation (using robust standard errors), which expands equation (A1) by including lag and lead $\Delta X_t$ variables, as in (A4):

$$Y_t = \alpha_0 + \alpha_1 Trend + \theta X_t + \sum_{j=-p}^{p} \delta_j \Delta X_{t-j} + u_t \quad \text{(A4)}$$

The standard errors from equation (A4) have a normal distribution in large samples, so standard inference can be applied to the $\theta$ vector. In our application, we use one lag and one lead value of $\Delta X_t$.

[7] This conclusion holds even in the presence of codetermination of the variables.

### A1.3 Macroeconomic data

Table A1 provides definitions and sources for the macroeconomic data; all prices are nominal and are at the national level. Each variable is tested for a unit root using an ADF test with results reported in Table A2. The null hypothesis of a unit root cannot be rejected for any of the variables, so each variable is treated as being non-stationary.

Table A1: Macroeconomic variable definitions and sources

| Variable | Definition | Source |
|---|---|---|
| Rents | Geometric mean of new rents lodged with tenancy bond services | MBIE |
| HPI | House Price Index (quality adjusted) | REINZ |
| Wages | Average weekly earnings (quarterly interpolated to monthly) | StatsNZ |
| Mortgage rate | 6-month lagged 2-year mortgage rate[8] | RBNZ |
| Dwelling ratio | Ratio of population to total dwellings (quarterly interpolated to monthly) | StatsNZ |
| RBNZ assets | Total assets of RBNZ | RBNZ |
| US shares | US Share price (reported by FRED from OECD database) | FRED |
| NPL ratio | Ratio of banks' non-performing loans to total bank assets[9] | RBNZ |

Table A2: ADF tests with and without trend: p-value for null of unit root

| Variable | No trend | With trend |
|---|---|---|
| ln(Rents) | 0.975 | 0.278 |
| ln(HPI) | 0.886 | 0.525 |
| ln(Wages) | 0.998 | 0.994 |
| Mortgage rate | 0.355 | 0.616 |
| ln(Dwelling ratio) | 0.589 | 0.916 |
| ln(RBNZ assets) | 0.803 | 0.812 |
| ln(US shares) | 0.844 | 0.220 |
| ln(NPL ratio) | 0.472 | 0.758 |

Notes: Each Augmented Dickey-Fuller (ADF) test include 3 lags; varying the lag length does not alter non-rejection of the null hypothesis. Variables are as defined in Table A1.

Figure A1 graphs the four price variables (HPI, rents, wages, US share prices) together with RBNZ assets, with each variable indexed to 1.0 in December 2004. The massive spike in RBNZ assets from December 2019 – November 2022 is apparent as is the concurrent (but much smaller) increase in house prices. Given the distorting nature of the RBNZ asset series on the scale, Figure A2 repeats the graph with the omission of RBNZ assets. It is apparent that the rise in rents outpaced wages but was considerably smaller than the increase in house prices. The figure also shows that major fluctuations in the US share price appear to be correlated (at least on some occasions) with fluctuations in New Zealand's house prices.

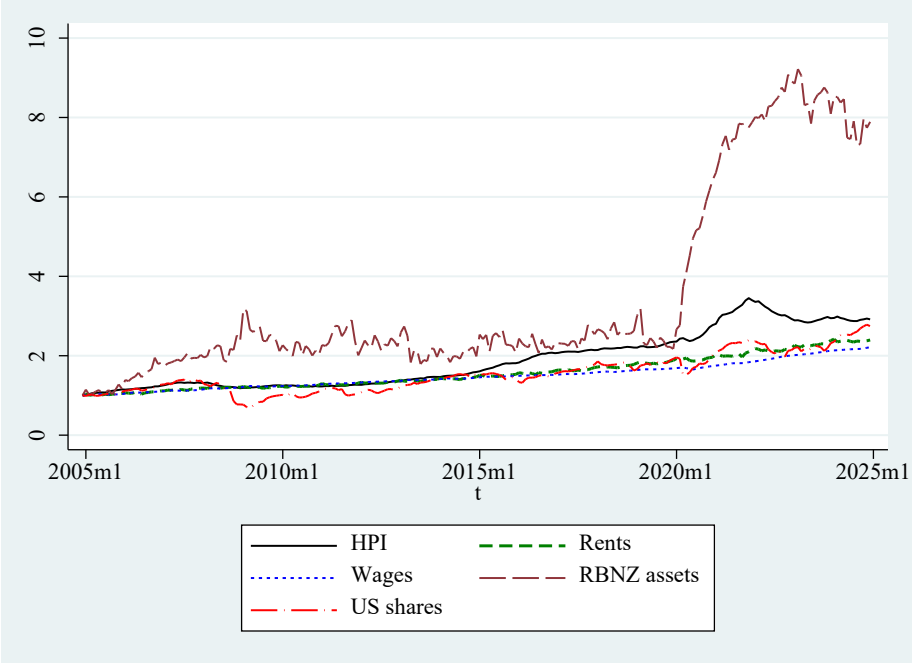
Figures A3-A5 graph the NPL ratio, mortgage rate, and dwelling ratio respectively. The rise in non-performing loans associated with the global financial crisis is evident as is its subsequent fall (Figure A3). The mortgage rate declined fairly steadily from 2008 through to late 2021,

[8] RBNZ reported an effective mortgage rate through to January 2017 when the series was discontinued. We tested which of the (current and lagged) individual mortgage rates of different tenures (floating, 6-month, 1-year, 2-year, 3-year, 4-year, 5-year) had the highest correlation with the effective mortgage rate for the period 2004(12)-2017(1) over which these rates overlapped with the effective mortgage rate. The 6-month lagged 2-year rate had the highest correlation coefficient (0.967) of all alternatives, so is used henceforth to represent the effective house mortgage rate.

[9] Source for 2008(12)-2024(12) is RBNZ series BSAQS.MAR2A4.P; source for 2004(12)-2008(12) is the quarterly series derived by Grimes and Hyland (2015) from prior RBNZ data, interpolated to monthly. The two series have identical data for the overlapping month, 2008(12).

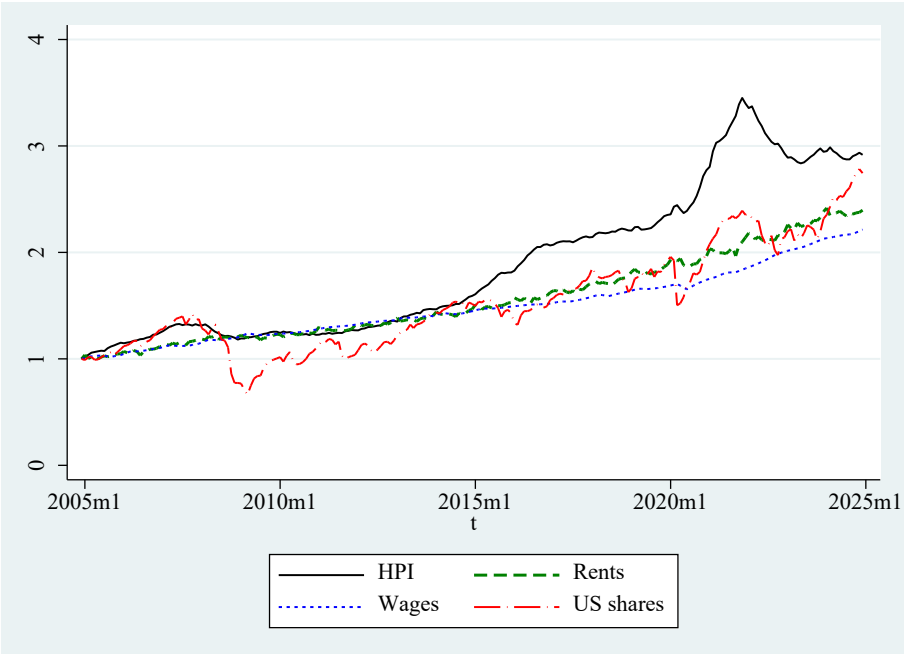
after which a tightening in monetary policy led to a rise in the rate (Figure A4). The dwelling ratio increased from 2013 to early 2020 reflecting high net inward migration not matched by similarly strong dwelling growth. Border closures during the COVID-19 pandemic, and subsequent tightening of immigration rules, has since led to a substantial fall in the dwelling ratio (Figure A5).

Figure A1: Price variables and RBNZ assets




*Note:* Values have been indexed to 1.0 at December 2004

Figure A2: Price variables




*Note:* Values have been indexed to 1.0 at December 2004

Figure A3: NPL ratio (%)

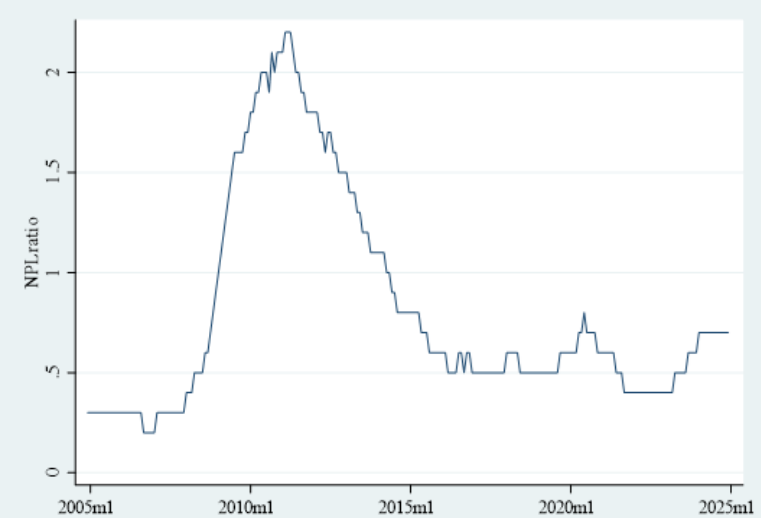



Figure A4: Mortgage rate (%)

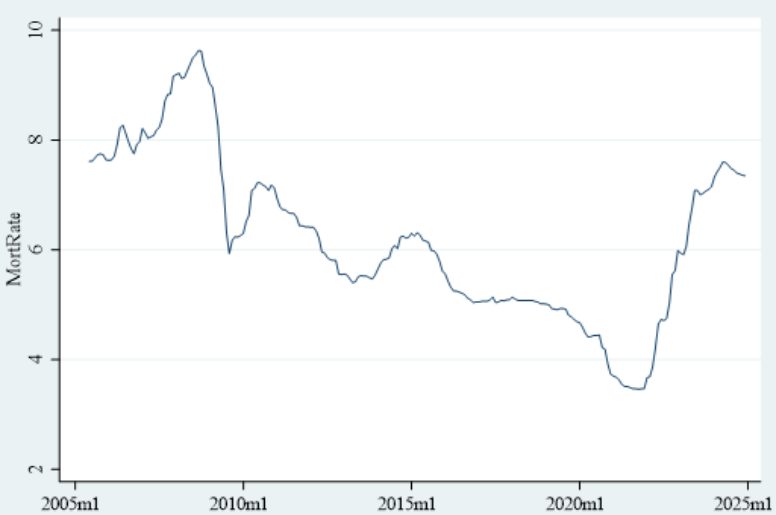



Figure A5: Dwelling ratio (population/dwellings)



### A1.4 Rent and house price estimates

First, we evaluate which macroeconomic variables predict New Zealand rental prices. The HTWG report and Figure A2 indicate that rents bear a closer long-run relationship with incomes than with house prices. The relationship of rents with incomes is as expected from the model outlined in Section A1.1. Nevertheless, supply factors which affect costs to landlords (e.g. house prices and interest rates) may also impact the real value of rents (Grimes & Hyland, 2015). Accordingly, we test for a cointegrating relationship between (ln) rents, (ln) wages, (ln) house prices, and the mortgage interest rate.[10]

Results for the cointegrating equation are presented in Table A3, column (1), in which a unit root in the residuals is rejected (i.e. cointegration holds).[11] The error correction term[12] shows that rents respond significantly (and quickly) to lagged disequilibrium; almost 30% of any disequilibrium is corrected within one month. The DOLS estimates in column (2) indicate that rents are significantly associated with both wages and house prices with elasticities of 0.82 and 0.24 respectively. Controlling for these influences, a one percentage point (pp) rise in the mortgage rate is associated with a 0.3% rise in rents.

House prices are modelled in two ways to test robustness. First, column (3) adopts the theoretical model derived by Grimes & Hyland (2015) in which house prices are a function of the dwelling ratio, incomes and the mortgage rate. These factors are supplemented by the three financial market factors outlined in Section A1.1: the proportion of banks' non-performing loans (reflecting credit constraints caused by a reluctance by banks to lend when their balance sheets are impaired), the US share price index (to reflect global asset market sentiment), and total RBNZ assets, i.e. the size of the RBNZ balance sheet (to reflect the influence of unconventional monetary policies implemented when interest rates approached the zero lower bound). In particular, through the COVID-19 pandemic, monetary authorities (including the RBNZ) engaged in quantitative easing designed to provide additional monetary stimulus over and above that channelled through interest rates. In New Zealand's case, as in several other countries, this quantitative easing reflected a monetisation of concurrent fiscal easing, so this term reflects a coordinated monetary and fiscal policy decision. As shown in Figure A1, RBNZ assets rose by 318% between December 2019 and November 2022 during this quantitative easing phase and then fell by 13% through to December 2024 (the end of our sample).

The estimates in column (3) show that this model rejects a unit root at $0.05 < p < 0.1$, i.e. a weak cointegrating relationship is apparent. The relationship remains cointegrated if either the US share price index or wages is omitted from the regression, though these variables are retained given their significance in the DOLS estimates (discussed below). Cointegration fails to hold if either the dwelling ratio or the mortgage rate is omitted and also fails to hold if either the NPL ratio or RBNZ assets is omitted. Thus, additional financial influences (NPL ratio and RBNZ assets) are required in addition to the core theoretical determinants (the dwelling ratio and the mortgage rate) to provide a valid explanation for the long run path of house prices.

The error correction estimate in column (3) shows that house prices react to a disequilibrium with approximately 10% of disequilibrium being corrected within a month. The DOLS estimates, column (4), show an elasticity of house prices with respect to the dwelling ratio of 3.55, and with respect to wages of 0.86. A 1pp fall in the mortgage rate is associated with a

[10] The use of logarithms means that estimated coefficients can be interpreted as elasticities. The mortgage interest rate is not logged since an interest rate is already approximately equal to the log of the gross interest rate. Results are similar if (ln) mortgage rate is used instead.

[11] See the row "Gamma ($\gamma$)" in Table 3 and the associated "Cointegration test statistic".

[12] See the row "Error correction estimate ($\beta$)" in Table A3.

3.3% rise in house prices. Each of the financial variables is significant at $p<0.01$. An increase in non-performing loans is associated with a reduction in house prices reflecting credit restrictions (with an elasticity of -0.11), an increase in US share prices is associated with an increase in New Zealand house prices (elasticity of 0.10), while the elasticity of house prices with respect to RBNZ assets is 0.17.[13]

The second approach to estimating house prices recognises that the house price should reflect the present discounted value of rents. In this specification, we replace the wage variable with rents (noting, from the estimates in columns (1) and (2) that wages and rents are highly correlated). Results are presented in columns (5) and (6). The cointegration relationship is now significant at $p<0.05$ and the error correction term remains significant at $p<0.01$. The estimated elasticity for the dwelling ratio falls to 2.0 in this specification, possibly because that ratio also influences rents. The influence of the mortgage rate and of the other financial variables remains similar to the estimates in columns (3) and (4).

If rents are a function of house prices, as in column (1), and house prices are a function of rents, as in column (5), then it follows that rents should be a function of the factors that determine house prices. Accordingly, we model rents as a function of the variables included in the house price specifications, excluding house prices themselves. The results are presented in columns (7) and (8). Cointegration holds ($p<0.01$) and the error correction coefficient is both large (-0.32) and highly significant ($p<0.01$). Other than the mortgage rate, each of the variables estimated to affect house prices also affects rents. The elasticity of rents with respect to wages is now almost exactly unity (1.02). An increase in the dwelling ratio, US share prices and RBNZ assets each has a positive effect on rents, while an increase in non-performing loans decreases rents. These results are consistent with the house price specification. The previous specifications indicate that the mortgage rate has offsetting effects on rents. A rise in the mortgage rate decreases house prices but, conditional on house prices, higher mortgage rates increase rents. The estimate in Column (8) implies that the net effect of interest rates on rents is either zero or slightly positive ($p=0.12$); the point estimate implies that a 1pp rise in interest rates leads to a 0.2% rise in rents.

Taking these estimates together, there is strong evidence for New Zealand that house prices reflect the influence of incomes, the ratio of population to the dwelling stock, and exogenous financial market pressures (international asset prices and banks' non-performing loans). Furthermore, house prices are impacted by monetary policy via the mortgage rate and are also Granger-caused by the monetary/fiscal quantitative easing associated with the COVID-19 pandemic. Findings in the main body of the paper that relate property prices to wellbeing outcomes, using the unit record data, can be interpreted in light of these macroeconomic findings. Specifically, given that property prices impact wellbeing, we can infer that macroeconomic policies are likely to have acted on wellbeing through the property price channel.

[13] Given the (more than) quadrupling in RBNZ assets between December 2019 and November 2022, this last channel is associated with a 27% increase in New Zealand house prices over this three-year period, which is identical to the actual increase in house prices over the same time. It is notable that over this period, net immigration – which is typically the major driver of short-term house price spikes in New Zealand – collapsed, so did not contribute to the surge in house prices during the COVID-19 pandemic.

Table A3: Rent and house price estimates

| | (1) ln(Rents) | (2) ln(Rents) | (3) ln(HPI) | (4) ln(HPI) | (5) ln(HPI) | (6) ln(HPI) | (7) ln(Rents) | (8) ln(Rents) |
|---|---|---|---|---|---|---|---|---|
| ln(HPI) | 0.2341*** | 0.2381*** | | | | | | |
| | (0.0091) | (0.0102) | | | | | | |
| ln(Wages) | 0.8262*** | 0.8207*** | 0.8490*** | 0.8631*** | | | 0.9727*** | 1.0237*** |
| | (0.0142) | (0.0154) | (0.0423) | (0.0477) | | | (0.0199) | (0.0241) |
| Mortgage rate (%) | 0.0035*** | 0.0034*** | -0.0293*** | -0.0319*** | -0.0326*** | -0.0337*** | 0.0040*** | 0.0020[+] |
| | (0.0008) | (0.0008) | (0.0025) | (0.0028) | (0.0025) | (0.0024) | (0.0012) | (0.0013) |
| ln(Rents) | | | | | 0.8506*** | 0.8474*** | | |
| | | | | | (0.0401) | (0.0460) | | |
| ln(Dwelling ratio) | | | 3.6528*** | 3.5545*** | 1.9868*** | 1.9976*** | 2.0257*** | 1.8216*** |
| | | | (0.2928) | (0.3371) | (0.3192) | (0.3453) | (0.1376) | (0.1395) |
| ln(RBNZ assets) | | | 0.1773*** | 0.1677*** | 0.1350*** | 0.1326*** | 0.0537*** | 0.0382*** |
| | | | (0.0095) | (0.0128) | (0.0105) | (0.0137) | (0.0045) | (0.0055) |
| ln(US shares) | | | 0.0984*** | 0.0978*** | 0.0713*** | 0.0747*** | 0.0421*** | 0.0277** |
| | | | (0.0227) | (0.0227) | (0.0226) | (0.0228) | (0.0107) | (0.0117) |
| ln(NPL ratio) | | | -0.1111*** | -0.1114*** | -0.0995*** | -0.0998*** | -0.0113*** | -0.0125*** |
| | | | (0.0063) | (0.0067) | (0.0058) | (0.0057) | (0.0030) | (0.0029) |
| Lag & lead differences | No | Yes | No | Yes | No | Yes | No | Yes |
| $R^2$ | 0.995 | 0.995 | 0.991 | 0.993 | 0.992 | 0.993 | 0.996 | 0.997 |
| N | 235 | 233 | 235 | 233 | 235 | 233 | 235 | 233 |
| Gamma ($\gamma$) | -0.3017*** | | -0.1696* | | -0.2054** | | -0.3907*** | |
| Cointegration test statistic | -6.428 | | -4.654 | | -5.173 | | -7.514 | |
| Error correction estimate ($\beta$) | -0.2853*** | | -0.1036*** | | -0.0894*** | | -0.3151*** | |
| | (0.0538) | | (0.0217) | | (0.0260) | | (0.0600) | |

Notes: Constant included but not reported; gamma is the coefficient on the lagged residual, $\gamma$, from equation (2); cointegration test statistic is the 't-value' on $\gamma$ in equation (2); error correction estimate (with robust standard error reported) is the coefficient on the lagged residual, $\beta$, in equation (3); coefficients in odd numbered columns correspond to estimates from equation (1), with no significance levels reported owing to the non-standard distribution; coefficients in even numbered columns (with significance levels reported) correspond to estimates from equation (4); robust standard errors reported in parentheses; significance levels: ***p<0.01, **p<0.05, *p<0.1, [+ p=0.12]. The full sample period, using monthly data, is June 2005 - December 2024.

## Appendix: Section A2.

## Supplementary materials

Table A4: Variable descriptions

| Variable | Description |
|---|---|
| Tenure | Tenure type during month of interview. Categories are: (1) private renter, (2) public renter, (3) mortgaged homeowner, (4) outright homeowner |
| Sex | Female dummy |
| Age | Age (in years, and age squared/100) |
| Education | Highest qualification achieved: categories are (1) no qualifications, (2) high school qualification/certificate, (3) post-school qualification, (4) undergraduate qualification, (5) postgraduate qualification |
| Ethnicity | Categories are: (1) European/Pākehā, (2) Māori, (3) Pacific, (4) Asian, (5) Middle Eastern/Latin American/African, European-MELAA, or Other |
| Labour force status | Labour force status of respondent, based on last 7 days. Categories are: (1) employed, (2) unemployed, (3) out of labour force and under 65, (4) out of labour force and over 65 |
| Income | Annual self-reported household income from all sources |
| House Price Index | Regional, quality-adjusted house price index, deflated to September 2024 dollars |
| Rents | Regional, geometric mean rents, deflated to September 2024 dollars. |
| Region | Regional council associated with household address |
| Mortgage rate | Proxied by the 6-month lagged, average 2-year mortgage rate |
| Survey wave 20XX/20YY | Interview conducted in the year between 1st July 20XX, and 31st June 20YY |
| Adults | Number of adults living in the home |
| Children | Number of children living in the home |

Table A5: Correlations between regional rents and HPI

| | Correlation between mean rents and HPI | Observations |
|---|---|---|
| **Region** | | |
| Northland Region | 0.9573 | 2,646 |
| Auckland Region | 0.7825 | 17,556 |
| Waikato Region | 0.9184 | 6,588 |
| Bay of Plenty | 0.9376 | 4,599 |
| Gisborne | 0.823 | 1,023 |
| Hawke's Bay | 0.9414 | 2,322 |
| Taranaki | 0.9082 | 2,142 |
| Manawatū-Whanganui | 0.9081 | 4,152 |
| Wellington | 0.8645 | 8,256 |
| Nelson + West Coast | 0.8919 | 1,116 |
| Tasman | 0.8766 | 1,164 |
| Marlborough | 0.9167 | 891 |
| Canterbury | 0.2769 | 9,321 |
| Southland region | 0.9589 | 1,755 |
| Otago | 0.7967 | 3,441 |
| National | 0.9338 | 66,972 |

*Note:* This table displays the correlation between the geometric mean rent and quality-adjusted HPI, for each region and at the national level.

Table A6: Summary statistics for private renters in objective wellbeing sample

| | Survey Wave | | | | | |
|---|---|---|---|---|---|---|
| | 2006 | 2009 | 2012 | 2015 | 2018 | 2023 |
| Age | 37.0 | 38.0 | 39.6 | 41.1 | 42.0 | 42.2 |
| Female | 0.58 | 0.57 | 0.57 | 0.59 | 0.57 | 0.59 |
| **Ethnicity** | | | | | | |
| European | 0.68 | 0.70 | 0.68 | 0.67 | 0.60 | 0.66 |
| Māori | 0.17 | 0.16 | 0.16 | 0.16 | 0.19 | 0.22 |
| Pacific | 0.07 | 0.07 | 0.08 | 0.08 | 0.10 | 0.08 |
| Asian | 0.11 | 0.11 | 0.13 | 0.16 | 0.18 | 0.15 |
| Other | 0.05 | 0.05 | 0.03 | 0.02 | 0.05 | 0.04 |
| **Education** | | | | | | |
| No formal qualification | 0.17 | 0.15 | 0.21 | 0.20 | 0.20 | 0.17 |
| Certificate | 0.46 | 0.47 | 0.43 | 0.40 | 0.39 | 0.39 |
| Diploma | 0.18 | 0.16 | 0.14 | 0.14 | 0.14 | 0.16 |
| Bachelor's Degree | 0.11 | 0.12 | 0.14 | 0.15 | 0.16 | 0.19 |
| Post Graduate Degree | 0.09 | 0.08 | 0.08 | 0.10 | 0.11 | 0.09 |
| **Labour Force Status** | | | | | | |
| Employed | 0.68 | 0.65 | 0.63 | 0.67 | 0.68 | 0.67 |
| Unemployed | 0.03 | 0.05 | 0.06 | 0.06 | 0.04 | 0.04 |
| Not in labour force (under 65) | 0.23 | 0.23 | 0.23 | 0.18 | 0.17 | 0.20 |
| Not in labour force (65+) | 0.06 | 0.06 | 0.08 | 0.10 | 0.10 | 0.10 |
| Total household income | 47,663 | 48,853 | 47,619 | 51,287 | 54,695 | 57,494 |
| Observations | 630 | 747 | 714 | 783 | 933 | *771* |

*Notes:* This table presents summary statistics for our objective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A7: Summary statistics for public renters in objective wellbeing sample

| | Survey Wave | | | | | |
|---|---|---|---|---|---|---|
| | 2006 | 2009 | 2012 | 2015 | 2018 | 2023 |
| Age | 48.3 | 47.0 | 48.4 | 53.0 | 54.0 | 53.9 |
| Female | 0.63 | 0.60 | 0.53 | 0.58 | 0.61 | 0.70 |
| **Ethnicity** | | | | | | |
| European | 0.56 | 0.51 | 0.58 | 0.56 | 0.49 | 0.45 |
| Māori | 0.23 | 0.32 | 0.23 | 0.26 | 0.32 | 0.41 |
| Pacific | 0.17 | 0.19 | 0.21 | 0.18 | 0.26 | 0.25 |
| Asian | 0.06 | 0.04 | 0.07 | 0.06 | 0.04 | S |
| Other | 0.08 | 0.06 | S | S | 0.04 | 0.05 |
| **Education** | | | | | | |
| No formal qualification | 0.40 | 0.40 | 0.37 | 0.56 | 0.45 | 0.43 |
| Certificate | 0.42 | 0.47 | 0.47 | 0.28 | 0.39 | 0.45 |
| Diploma | 0.12 | 0.09 | 0.12 | 0.08 | 0.10 | 0.07 |
| Bachelor's Degree | 0.06 | S | S | 0.06 | 0.03 | 0.05 |
| Post Graduate Degree | S | S | S | S | S | S |
| **Labour Force Status** | | | | | | |
| Employed | 0.38 | 0.36 | 0.33 | 0.28 | 0.26 | 0.23 |
| Unemployed | S | 0.04 | 0.09 | 0.08 | 0.07 | 0.09 |
| Not in labour force (under 65) | 0.35 | 0.36 | 0.40 | 0.30 | 0.36 | 0.43 |
| Not in labour force (65+) | 0.23 | 0.25 | 0.21 | 0.32 | 0.30 | 0.27 |
| Total household income | 29,635 | 32,023 | 30,613 | 29,751 | 30,319 | 34,499 |
| Observations | 156 | 159 | 129 | 150 | 207 | *132* |

*Notes:* This table presents summary statistics for our objective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A8: Summary statistics for mortgaged homeowners in objective wellbeing sample

| | Survey Wave | | | | | |
|---|---|---|---|---|---|---|
| | 2006 | 2009 | 2012 | 2015 | 2018 | 2023 |
| Age | 42.6 | 43.5 | 44.8 | 45.5 | 45.0 | 45.6 |
| Female | 0.52 | 0.51 | 0.54 | 0.54 | 0.56 | 0.59 |
| **Ethnicity** | | | | | | |
| European | 0.84 | 0.84 | 0.85 | 0.81 | 0.76 | 0.77 |
| Māori | 0.06 | 0.09 | 0.08 | 0.10 | 0.11 | 0.12 |
| Pacific | 0.03 | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 |
| Asian | 0.07 | 0.08 | 0.07 | 0.13 | 0.13 | 0.14 |
| Other | 0.05 | 0.05 | 0.04 | 0.02 | 0.05 | 0.03 |
| **Education** | | | | | | |
| No formal qualification | 0.12 | 0.13 | 0.10 | 0.11 | 0.14 | 0.10 |
| Certificate | 0.46 | 0.45 | 0.44 | 0.43 | 0.34 | 0.33 |
| Diploma | 0.21 | 0.18 | 0.18 | 0.15 | 0.17 | 0.15 |
| Bachelor's Degree | 0.12 | 0.14 | 0.16 | 0.19 | 0.21 | 0.27 |
| Post Graduate Degree | 0.10 | 0.11 | 0.12 | 0.13 | 0.14 | 0.14 |
| **Labour Force Status** | | | | | | |
| Employed | 0.84 | 0.82 | 0.79 | 0.81 | 0.82 | 0.86 |
| Unemployed | 0.01 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 |
| Not in labour force (under 65) | 0.11 | 0.11 | 0.10 | 0.10 | 0.10 | 0.06 |
| Not in labour force (65+) | 0.04 | 0.05 | 0.09 | 0.08 | 0.08 | 0.07 |
| Total household income | 66,158 | 67,743 | 69,695 | 79,419 | 80,687 | 86,430 |
| Observations | 987 | 969 | 882 | 1,002 | 1,221 | *1,023* |

*Notes:* This table presents summary statistics for our objective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A9: Summary statistics for outright owners in objective wellbeing sample

| | Survey Wave | | | | | |
|---|---|---|---|---|---|---|
| | 2006 | 2009 | 2012 | 2015 | 2018 | 2023 |
| Age | 62.3 | 63.2 | 64.4 | 64.5 | 66.0 | 65.9 |
| Female | 0.54 | 0.55 | 0.59 | 0.58 | 0.55 | 0.59 |
| **Ethnicity** | | | | | | |
| European | 0.89 | 0.88 | 0.91 | 0.88 | 0.87 | 0.86 |
| Māori | 0.05 | 0.03 | 0.04 | 0.05 | 0.06 | 0.10 |
| Pacific | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| Asian | 0.03 | 0.04 | 0.04 | 0.06 | 0.07 | 0.06 |
| Other | 0.04 | 0.06 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Education** | | | | | | |
| No formal qualification | 0.28 | 0.25 | 0.24 | 0.29 | 0.25 | 0.21 |
| Certificate | 0.39 | 0.38 | 0.38 | 0.31 | 0.35 | 0.34 |
| Diploma | 0.20 | 0.22 | 0.20 | 0.19 | 0.20 | 0.19 |
| Bachelor's Degree | 0.08 | 0.09 | 0.09 | 0.11 | 0.10 | 0.17 |
| Post Graduate Degree | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 | 0.10 |
| **Labour Force Status** | | | | | | |
| Employed | 0.39 | 0.36 | 0.36 | 0.35 | 0.35 | 0.32 |
| Unemployed | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Not in labour force (under 65) | 0.11 | 0.12 | 0.08 | 0.09 | 0.08 | 0.09 |
| Not in labour force (65+) | 0.49 | 0.52 | 0.55 | 0.56 | 0.56 | 0.59 |
| Total household income | 66,158 | 62,451 | 66,024 | 67,547 | 66,443 | 62,331 |
| Observations | 987 | 990 | 1,056 | 1,191 | 1,116 | *1,014* |

*Notes:* This table presents summary statistics for our objective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A10: Summary statistics for private renters in subjective wellbeing sample

| | Survey Wave | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2020 | 2021 | 2022 | 2023 |
| Age | 39.0 | 39.8 | 39.0 | 39.0 | 40.9 | 40.8 | 42.1 | 41.9 | 42.3 | 40.4 |
| Female | 0.54 | 0.55 | 0.55 | 0.55 | 0.57 | 0.55 | 0.60 | 0.59 | 0.59 | 0.55 |
| **Ethnicity** | | | | | | | | | | |
| European | 0.66 | 0.64 | 0.62 | 0.62 | 0.64 | 0.64 | 0.63 | 0.61 | 0.63 | 0.59 |
| Māori | 0.22 | 0.24 | 0.21 | 0.21 | 0.16 | 0.20 | 0.23 | 0.23 | 0.23 | 0.18 |
| Pacific | 0.08 | 0.09 | 0.07 | 0.07 | 0.08 | 0.09 | 0.23 | 0.09 | 0.08 | 0.11 |
| Asian | 0.11 | 0.11 | 0.15 | 0.15 | 0.17 | 0.16 | 0.16 | 0.17 | 0.16 | 0.20 |
| Other | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 |
| **Education** | | | | | | | | | | |
| No formal qualification | 0.17 | 0.22 | 0.13 | 0.13 | 0.16 | 0.14 | 0.21 | 0.18 | 0.18 | 0.12 |
| Certificate | 0.51 | 0.46 | 0.48 | 0.48 | 0.49 | 0.47 | 0.38 | 0.37 | 0.39 | 0.47 |
| Diploma | 0.08 | 0.11 | 0.13 | 0.13 | 0.13 | 0.13 | 0.14 | 0.16 | 0.15 | 0.13 |
| Bachelor's Degree | 0.14 | 0.13 | 0.16 | 0.16 | 0.13 | 0.15 | 0.15 | 0.18 | 0.18 | 0.16 |
| Post Graduate Degree | 0.10 | 0.07 | 0.10 | 0.10 | 0.10 | 0.12 | 0.11 | 0.12 | 0.09 | 0.13 |
| **Labour Force Status** | | | | | | | | | | |
| Employed | 0.71 | 0.66 | 0.73 | 0.73 | 0.69 | 0.70 | 0.67 | 0.66 | 0.68 | 0.69 |
| Unemployed | 0.07 | 0.06 | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 | 0.03 | 0.03 | 0.04 |
| Not in labour force (under 65) | 0.16 | 0.19 | 0.15 | 0.15 | 0.18 | 0.16 | 0.18 | 0.20 | 0.18 | 0.17 |
| Not in labour force (65+) | 0.07 | 0.08 | 0.05 | 0.05 | 0.09 | 0.09 | 0.10 | 0.11 | 0.10 | 0.10 |
| Total household income | 45,200 | 41,650 | 44,599 | 44,599 | 45,786 | 49,702 | 55,979 | 55,979 | 58,231 | 37,137 |
| Observations | 501 | 1,626 | 492 | 492 | 456 | 1,683 | 4,491 | 2,403 | 3,639 | 981 |

*Notes:* This table presents summary statistics for our subjective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A11: Summary statistics for public renters in subjective wellbeing sample

| | Survey Wave | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2020 | 2021 | 2022 | 2023 |
| Age | 51.0 | 49.8 | 48.0 | 48.6 | 49.9 | 47.4 | 51.6 | 50.7 | 54.3 | 51.0 |
| Female | 0.56 | 0.66 | 0.58 | 0.62 | 0.61 | 0.65 | 0.70 | 0.68 | 0.69 | 0.65 |
| **Ethnicity** | | | | | | | | | | |
| European | 0.50 | 0.50 | 0.45 | 0.46 | 0.42 | 0.47 | 0.40 | 0.47 | 0.43 | 0.55 |
| Māori | 0.28 | 0.31 | 0.36 | 0.30 | 0.39 | 0.35 | 0.40 | 0.38 | 0.41 | 0.43 |
| Pacific | 0.22 | 0.23 | 0.24 | 0.26 | 0.21 | 0.27 | 0.24 | 0.25 | 0.24 | 0.16 |
| Asian | 0.06 | 0.05 | S | 0.06 | S | 0.04 | 0.05 | 0.03 | 0.03 | 0.04 |
| Other | 0.06 | 0.04 | S | 0.03 | S | 0.04 | 0.03 | 0.03 | 0.04 | S |
| **Education** | | | | | | | | | | |
| No formal qualification | 0.52 | 0.45 | 0.36 | 0.36 | 0.39 | 0.37 | 0.45 | 0.42 | 0.43 | 0.33 |
| Certificate | 0.36 | 0.44 | 0.45 | 0.50 | 0.50 | 0.50 | 0.37 | 0.38 | 0.38 | 0.53 |
| Diploma | 0.06 | 0.06 | 0.12 | 0.10 | 0.08 | 0.09 | 0.10 | 0.12 | 0.12 | 0.08 |
| Bachelor's Degree | S | 0.02 | S | 0.03 | S | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 |
| Post Graduate Degree | S | 0.04 | S | S | S | 0.03 | 0.03 | 0.03 | 0.01 | S |
| **Labour Force Status** | | | | | | | | | | |
| Employed | 0.28 | 0.27 | 0.27 | 0.31 | 0.37 | 0.33 | 0.24 | 0.30 | 0.24 | 0.33 |
| Unemployed | 0.08 | 0.08 | 0.09 | 0.07 | 0.05 | 0.08 | 0.08 | 0.07 | 0.06 | 0.06 |
| Not in labour force (under 65) | 0.36 | 0.37 | 0.42 | 0.37 | 0.26 | 0.37 | 0.43 | 0.39 | 0.39 | 0.37 |
| Not in labour force (65+) | 0.24 | 0.27 | 0.21 | 0.26 | 0.29 | 0.22 | 0.26 | 0.24 | 0.31 | 0.27 |
| Total household income | 22,996 | 24,102 | 23,363 | 24,766 | 28,242 | 26,535 | 32,827 | 32,827 | 34,522 | 22,901 |
| Observations | 150 | 393 | 99 | 282 | 114 | 339 | 1,068 | 516 | 744 | 147 |

*Notes:* This table presents summary statistics for our subjective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A12: Summary statistics for mortgaged homeowners in subjective wellbeing sample

| | Survey Wave | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2020 | 2021 | 2022 | 2023 |
| Age | 45.0 | 44.8 | 45.0 | 45.6 | 46.5 | 44.8 | 46.3 | 46.2 | 46.3 | 45.5 |
| Female | 0.55 | 0.52 | 0.53 | 0.52 | 0.53 | 0.53 | 0.57 | 0.57 | 0.57 | 0.51 |
| **Ethnicity** | | | | | | | | | | |
| European | 0.83 | 0.80 | 0.80 | 0.78 | 0.77 | 0.76 | 0.77 | 0.78 | 0.76 | 0.75 |
| Māori | 0.09 | 0.11 | 0.11 | 0.09 | 0.12 | 0.10 | 0.14 | 0.14 | 0.15 | 0.12 |
| Pacific | 0.04 | 0.03 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 |
| Asian | 0.07 | 0.09 | 0.10 | 0.12 | 0.12 | 0.14 | 0.13 | 0.13 | 0.14 | 0.15 |
| Other | 0.02 | 0.02 | 0.01 | 0.03 | 0.03 | 0.04 | 0.02 | 0.02 | 0.03 | 0.04 |
| **Education** | | | | | | | | | | |
| No formal qualification | 0.14 | 0.13 | 0.12 | 0.12 | 0.13 | 0.11 | 0.12 | 0.10 | 0.10 | 0.08 |
| Certificate | 0.47 | 0.46 | 0.42 | 0.41 | 0.41 | 0.42 | 0.36 | 0.34 | 0.34 | 0.36 |
| Diploma | 0.14 | 0.13 | 0.14 | 0.15 | 0.14 | 0.15 | 0.15 | 0.17 | 0.17 | 0.16 |
| Bachelor's Degree | 0.14 | 0.16 | 0.16 | 0.17 | 0.20 | 0.18 | 0.19 | 0.23 | 0.25 | 0.20 |
| Post Graduate Degree | 0.11 | 0.13 | 0.15 | 0.15 | 0.12 | 0.15 | 0.17 | 0.16 | 0.14 | 0.20 |
| **Labour Force Status** | | | | | | | | | | |
| Employed | 0.81 | 0.81 | 0.82 | 0.80 | 0.77 | 0.82 | 0.82 | 0.83 | 0.83 | 0.82 |
| Unemployed | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 |
| Not in labour force (under 65) | 0.10 | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | 0.07 | 0.08 |
| Not in labour force (65+) | 0.07 | 0.08 | 0.08 | 0.09 | 0.12 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 |
| Total household income | 58,204 | 60,213 | 60,589 | 64,147 | 62,544 | 64,211 | 81,698 | 81,698 | 83,789 | 51,153 |
| Observations | 684 | 1,953 | 675 | 2,073 | 609 | 2,154 | 6,048 | 3,264 | 4,764 | 1,203 |

*Notes:* This table presents summary statistics for our subjective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A13: Summary statistics for outright owners in subjective wellbeing sample

| | Survey Wave | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2020 | 2021 | 2022 | 2023 |
| Age | 66.0 | 64.3 | 63.0 | 64.4 | 63.4 | 64.1 | 65.5 | 65.9 | 66.2 | 65.9 |
| Female | 0.60 | 0.57 | 0.55 | 0.54 | 0.58 | 0.55 | 0.57 | 0.57 | 0.57 | 0.58 |
| **Ethnicity** | | | | | | | | | | |
| European | 0.89 | 0.88 | 0.87 | 0.88 | 0.88 | 0.87 | 0.86 | 0.88 | 0.87 | 0.84 |
| Māori | 0.07 | 0.08 | 0.09 | 0.06 | 0.07 | 0.07 | 0.11 | 0.10 | 0.10 | 0.08 |
| Pacific | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 |
| Asian | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.05 | 0.05 | 0.07 |
| Other | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.04 |
| **Education** | | | | | | | | | | |
| No formal qualification | 0.27 | 0.28 | 0.26 | 0.24 | 0.21 | 0.21 | 0.23 | 0.22 | 0.20 | 0.17 |
| Certificate | 0.40 | 0.38 | 0.43 | 0.41 | 0.42 | 0.39 | 0.33 | 0.34 | 0.34 | 0.38 |
| Diploma | 0.15 | 0.15 | 0.15 | 0.16 | 0.18 | 0.16 | 0.20 | 0.20 | 0.21 | 0.17 |
| Bachelor's Degree | 0.09 | 0.11 | 0.09 | 0.10 | 0.08 | 0.12 | 0.12 | 0.12 | 0.15 | 0.14 |
| Post Graduate Degree | 0.10 | 0.09 | 0.07 | 0.10 | 0.11 | 0.12 | 0.12 | 0.12 | 0.11 | 0.14 |
| **Labour Force Status** | | | | | | | | | | |
| Employed | 0.36 | 0.34 | 0.37 | 0.36 | 0.38 | 0.35 | 0.33 | 0.32 | 0.31 | 0.31 |
| Unemployed | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Not in labour force (under 65) | 0.08 | 0.08 | 0.09 | 0.08 | 0.09 | 0.08 | 0.09 | 0.09 | 0.08 | 0.07 |
| Not in labour force (65+) | 0.55 | 0.56 | 0.53 | 0.55 | 0.51 | 0.56 | 0.57 | 0.59 | 0.60 | 0.62 |
| Total household income | 53,967 | 51,906 | 53,790 | 55,633 | 55,677 | 57,708 | 68,062 | 68,062 | 67,133 | 40,964 |
| Observations | 597 | 1,929 | 645 | 1,857 | 588 | 2,046 | 5,277 | 3,039 | 4,530 | 1,218 |

*Notes:* This table presents summary statistics for our subjective wellbeing sample, by survey wave. Variable definitions are found in Appendix Table A4. We report the means and standard deviations (in parentheses) for each variable. Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. Ethnicity ratios sum to >1 as respondents can identify with more than one ethnicity.

Table A14: Complete regression results with HPI interactions

| | Non-housing expenditure | | Subjective wellbeing | |
|---|---|---|---|---|
| Variables | Coef. | S.E | Coef. | S.E |
| Private renter | -0.449*** | (0.0127) | -0.607*** | (0.0229) |
| Public renter | -0.651*** | (0.0236) | -0.688*** | (0.0417) |
| Mortgaged owner | 0.0860*** | (0.0105) | -0.322*** | (0.0194) |
| House Price Index (HPI) | 0.131** | (0.0478) | 0.0426 | (0.0871) |
| Private renter ## HPI | -0.135** | (0.0442) | -0.438*** | (0.0819) |
| Public renter ## HPI | -0.393*** | (0.0979) | -0.464** | (0.167) |
| Mortgaged owner ## HPI | -0.155*** | (0.0367) | -0.0540 | (0.0713) |
| School qualification | 0.136*** | (0.0115) | 0.0519* | (0.0223) |
| Postschool qualification | 0.216*** | (0.0131) | 0.0377 | (0.0258) |
| Undergraduate qualification | 0.265*** | (0.0150) | 0.126*** | (0.0259) |
| Postgraduate qualification | 0.268*** | (0.0167) | 0.119*** | (0.0274) |
| Female dummy | -0.008 | (0.00772) | 0.082*** | (0.0141) |
| Age | 0.010*** | (0.00146) | -0.046*** | (0.00263) |
| Age squared | 0.0122*** | (0.00157) | 0.0507*** | (0.00280) |
| Māori | 0.0918*** | (0.0133) | 0.0562** | (0.0216) |
| Pacific Peoples | -0.216*** | (0.0226) | 0.0514 | (0.0344) |
| Asian | -0.142*** | (0.0156) | 0.109*** | (0.0239) |
| Other | -0.00642 | (0.0197) | -0.0114 | (0.0461) |
| Unemployed | -0.143*** | (0.0279) | -0.737*** | (0.0561) |
| Not in labour-force (under 65) | 0.0909*** | (0.0137) | -0.350*** | (0.0262) |
| Not in labour-force (over 65) | -0.00928 | (0.0186) | 0.275*** | (0.0319) |
| Northland region | 0.0527* | (0.0263) | -0.0994* | (0.0391) |
| Waikato region | 0.0422 | (0.0282) | -0.00679 | (0.0425) |
| Bay of Plenty region | 0.0459 | (0.0287) | 0.0269 | (0.0449) |
| Gisborne region | -0.0146 | (0.0421) | 0.199** | (0.0693) |
| Hawke's Bay region | 0.0476 | (0.0319) | -0.0383 | (0.0522) |
| Taranaki region | 0.0286 | (0.0322) | 0.0408 | (0.0559) |
| Manawatū-Whanganui region | 0.0244 | (0.0287) | 0.0430 | (0.0469) |
| Wellington region | 0.0856** | (0.0267) | -0.0721 | (0.0412) |
| Canterbury region | 0.0405 | (0.0261) | -0.0839* | (0.0409) |
| Otago region | 0.0427 | (0.0285) | 0.107* | (0.0463) |
| Southland region | 0.0150 | (0.0312) | 0.0159 | (0.0559) |
| Tasman region | 0.0761* | (0.0372) | 0.125* | (0.0634) |
| Nelson + West Coast region | 0.0360 | (0.0355) | -0.0795 | (0.0670) |
| Marlborough region | 0.00578 | (0.0403) | -0.0636 | (0.0730) |
| Household income | 0.279*** | (0.0102) | 0.303*** | (0.124) |
| Survey Wave 2009/2010 | -0.0136 | (0.0212) | | |
| Survey Wave 2012/2013 | -0.0267 | (0.0299) | | |
| Survey Wave 2014/2015 | | | 0.0857 | (0.0482) |
| Survey Wave 2015/2016 | -0.0490 | (0.0285) | 0.0875 | (0.0600) |
| Survey Wave 2016/2017 | | | 0.128* | (0.0522) |
| Survey Wave 2017/2018 | | | -0.0589 | (0.0637) |
| Survey Wave 2018/2019 | -0.0969** | (0.0350) | -0.00221 | (0.0544) |
| Survey Wave 2020/2021 | | | 0.148* | (0.0670) |
| Survey Wave 2021/2022 | | | 0.0416 | (0.0695) |
| Survey Wave 2022/2023 | -0.0611* | (0.0308) | -0.125* | (0.0589) |
| Survey Wave 2023/2024 | | | -0.264*** | (0.0692) |
| Number of children | 0.0622*** | (0.00408) | 0.0594*** | (0.00739) |
| Number of adults | 0.0621*** | (0.00438) | 0.0242*** | (0.00678) |
| Mortgage Rate | -0.0160 | (0.0107) | 0.0273 | (0.0183) |
| R-squared | 0.403 | | 0.089 | |
| Observations | *17,763* | | *66969* | |

Table A15: Objective wellbeing regression robustness checks

| | Regression specification | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) Original | (2) Equiv2 | (3) Equiv3 | (4) Extended | (5) StatsNZ | (6) Complete | (7) No Wave Fixed Effect |
| **Tenure** | | | | | | | |
| Private renter | -0.449*** | -0.442*** | -0.461*** | -0.373*** | -0.447*** | -0.371*** | -0.449*** |
| | (0.013) | (0.0128) | (0.0128) | (0.0134) | (0.0127) | (0.0134) | (0.0127) |
| Public renter | -0.651*** | -0.631*** | -0.674*** | -0.538*** | -0.649*** | -0.536*** | -0.652*** |
| | (0.024) | (0.0236) | (0.0238) | (0.0241) | (0.0235) | (0.0240) | (0.0236) |
| Mortgaged homeowner | -0.086*** | -0.0860*** | 0.0896*** | 0.0971*** | -0.0943*** | -0.0949*** | -0.0868*** |
| | (0.011) | (0.0106) | (0.0106) | (0.0114) | (0.0105) | (0.0114) | (0.0105) |
| Mortgage rate | -0.016 | -0.00271 | -0.0174 | -0.0240* | -0.0182 | -0.0242* | 0.00280 |
| | (0.011) | (0.0108) | (0.0108) | (0.0115) | (0.0107) | (0.0115) | (0.00398) |
| HPI | 0.131** | 0.141** | 0.129** | 0.0889 | 0.123** | 0.0908 | 0.0634* |
| | (0.048) | (0.0482) | (0.0480) | (0.0517) | (0.0476) | (0.0517) | (0.0280) |
| **Tenure x HPI** | | | | | | | |
| Private Renter | -0.135** | -0.141** | -0.131** | -0.0492 | -0.134** | -0.0494 | -0.137** |
| | (0.044) | (0.0444) | (0.0447) | (0.0467) | (0.0440) | (0.0467) | (0.0442) |
| Public Renter | -0.393*** | -0.424*** | -0.380*** | -0.282** | -0.399*** | -0.280** | -0.400*** |
| | (0.098) | (0.0986) | (0.0990) | (0.0990) | (0.0979) | (0.0989) | (0.0982) |
| Mortgaged homeowner | -0.155*** | -0.162*** | -0.148*** | -0.110** | -0.120*** | -0.109** | -0.156*** |
| | (0.037) | (0.0368) | (0.0370) | (0.0404) | (0.0365) | (0.0405) | (0.0367) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *R2* | 0.403 | 0.501 | 0.399 | 0.350 | 0.399 | 0.347 | 0.402 |
| Count | *17,763* | *17,763* | *17,763* | *17,763* | *17,763* | *17,763* | *17,763* |

Notes: Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. This table presents the results of OLS regression models. Objective wellbeing is measured as the real, logged, equivalised, demeaned non-housing expenditure by household. Column (1) repeats column (3) of Table 4. Equiv2 equivalises by the square root of household size. Equiv3 equivalises by household size. 'Extended', 'StatsNZ' and 'Complete' use the definitions of housing expenditure corresponding to Table 3. Robust standard errors are reported. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A16: Subjective wellbeing heterogeneity test results, age bands

| | Regression specification | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) Original | (2) 18-24 | (3) 25-34 | (4) 35-44 | (5) 45-54 | (6) 55-64 | (7) 65+ |
| **Tenure** | | | | | | | |
| Private renter | -0.607*** | -0.420*** | -0.153 | -0.374*** | -0.628*** | -0.850*** | -0.653*** |
| | (0.027) | (0.111) | (0.0793) | (0.0599) | (0.0516) | (0.0561) | (0.0545) |
| Public renter | -0.688*** | -0.564*** | -0.216 | -0.557*** | -0.739*** | -0.825*** | -0.609*** |
| | (0.042) | (0.171) | (0.117) | (0.114) | (0.102) | (0.109) | (0.0757) |
| Mortgaged homeowner | -0.322*** | -0.189 | 0.0781 | -0.136* | -0.341*** | -0.362*** | -0.455*** |
| | (0.019) | (0.114) | (0.0795) | (0.0548) | (0.0394) | (0.0375) | (0.0471) |
| Mortgage rate | 0.027 | -0.00352 | 0.0519 | 0.0243 | 0.0856 | 0.0104 | -0.0112 |
| | (0.018) | (0.0867) | (0.0442) | (0.0416) | (0.0437) | (0.0457) | (0.0361) |
| HPI | 0.043 | 0.533 | -0.252 | 0.0479 | 0.555* | -0.0618 | -0.0666 |
| | (0.087) | (0.523) | (0.349) | (0.272) | (0.230) | (0.212) | (0.159) |
| **Tenure x HPI** | | | | | | | |
| Private Renter | -0.438*** | -0.586 | -0.158 | -0.282 | -0.874*** | -0.733** | -0.776** |
| | (0.082) | (0.470) | (0.328) | (0.257) | (0.223) | (0.250) | (0.238) |
| Public Renter | -0.464** | -1.402* | -0.342 | -0.823 | -0.600 | -0.338 | -0.0341 |
| | (0.167) | (0.658) | (0.469) | (0.457) | (0.420) | (0.457) | (0.314) |
| Mortgaged homeowner | -0.054 | -0.264 | 0.132 | -0.219 | -0.468** | 0.0255 | 0.133 |
| | (0.071) | (0.493) | (0.328) | (0.237) | (0.179) | (0.162) | (0.204) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *R2* | 0.403 | 0.059 | 0.069 | 0.097 | 0.109 | 0.347 | 0.040 |
| Count | *66,966* | *3,588* | *10,569* | *11,544* | *12,156* | *11,949* | *17,160* |

Notes: Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. This table presents the results of subjective wellbeing robustness tests. Column (1) repeats our preferred specification of column (3) of Table 6. Columns (2) – (7) represent different age bands. Robust standard errors are reported. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A17: Subjective wellbeing heterogeneity test results, price-to-rent ratio

| | Regression specification | | | | |
|---|---|---|---|---|---|
| | (1) Original | (2) Bottom quartile | (3) 2nd quartile | (4) 3rd quartile | (5) Top quartile |
| **Tenure** | | | | | |
| Private renter | -0.607*** | -0.541*** | -0.596*** | -0.566*** | -0.641*** |
| | (0.027) | (0.0659) | (0.0518) | (0.0511) | (0.0555) |
| Public renter | -0.688*** | -0.425** | -0.632*** | -0.816*** | -0.572*** |
| | (0.042) | (0.130) | (0.105) | (0.0948) | (0.0990) |
| Mortgaged homeowner | -0.322*** | -0.245*** | -0.308*** | -0.323*** | -0.433*** |
| | (0.019) | (0.0558) | (0.0430) | (0.0437) | (0.0492) |
| Mortgage rate | 0.027 | 0.0840 | 0.00384 | -0.0265 | -0.0818 |
| | (0.018) | (0.0782) | (0.0445) | (0.0428) | (0.0664) |
| HPI | 0.043 | 0.119 | 0.0682 | -0.258 | -0.286 |
| | (0.087) | (0.232) | (0.323) | (0.432) | (0.516) |
| **Tenure x HPI** | | | | | |
| Private Renter | -0.438*** | -0.208 | -0.525** | -0.157 | -1.032*** |
| | (0.082) | (0.172) | (0.188) | (0.207) | (0.297) |
| Public Renter | -0.464** | 0.124 | -0.184 | 0.118 | -1.965*** |
| | (0.167) | (0.366) | (0.406) | (0.397) | (0.576) |
| Mortgaged homeowner | -0.054 | 0.0936 | -0.194 | -0.0303 | 0.280 |
| | (0.071) | (0.147) | (0.159) | (0.184) | (0.256) |
| Controls | Yes | Yes | Yes | Yes | Yes |
| *R2* | 0.403 | 0.087 | 0.090 | 0.092 | 0.098 |
| Count | *66,966* | 16,743 | 16,743 | 16,740 | *16,740* |

Notes: Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. This table presents the results of subjective wellbeing robustness tests. Column (1) repeats our preferred specification of column (3) of Table 6. Column (2) is the bottom quartile of price-to-rent ratio and Column (5) is the top quartile. Robust standard errors are reported. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A18: Subjective wellbeing heterogeneity test results, household income

| | Regression specification | | | | | |
|---|---|---|---|---|---|---|
| | (1) Original | (2) 1st quintile | (3) 2nd quintile | (4) 3rd quintile | (5) 4th quintile | (6) Top quintile |
| **Tenure** | | | | | | |
| Private renter | -0.607*** | -0.679*** | -0.616*** | -0.667*** | -0.599*** | -0.645*** |
| | (0.027) | (0.0611) | (0.0592) | (0.0525) | (0.0461) | (0.0430) |
| Public renter | -0.688*** | -0.812*** | -0.845*** | -0.880*** | -0.959*** | -1.165*** |
| | (0.042) | (0.108) | (0.101) | (0.0901) | (0.0928) | (0.0933) |
| Mortgaged homeowner | -0.322*** | -0.320*** | -0.149** | -0.154*** | -0.151*** | -0.265*** |
| | (0.019) | (0.0515) | (0.0563) | (0.0452) | (0.0391) | (0.0356) |
| Mortgage rate | 0.027 | 0.0326 | 0.0167 | 0.00320 | 0.0797* | 0.0511 |
| | (0.018) | (0.0515) | (0.0438) | (0.0415) | (0.0378) | (0.0349) |
| HPI | 0.043 | 0.0604 | 0.00596 | -0.201 | 0.271 | 0.338 |
| | (0.087) | (0.207) | (0.210) | (0.193) | (0.189) | (0.175) |
| **Tenure x HPI** | | | | | | |
| Private Renter | -0.438*** | 0.0668 | -0.793*** | -0.407* | -0.507** | -0.495** |
| | (0.082) | (0.185) | (0.195) | (0.189) | (0.177) | (0.169) |
| Public Renter | -0.464** | -0.369 | -0.257 | -1.250*** | 0.0468 | -0.130 |
| | (0.167) | (0.373) | (0.366) | (0.360) | (0.439) | (0.435) |
| Mortgaged homeowner | -0.054 | 0.0305 | -0.0264 | -0.242 | -0.181 | 0.0336 |
| | (0.071) | (0.163) | (0.170) | (0.155) | (0.155) | (0.151) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| *R2* | 0.403 | 0.080 | 0.094 | 0.088 | 0.066 | 0.078 |
| Count | *66,966* | *13305* | *13302* | *13317* | *13290* | *13299* |

Notes: Counts randomly rounded to base 3 to comply with StatsNZ microdata rules. This table presents the results of subjective wellbeing robustness tests. Column (1) repeats our preferred specification of column (3) of Table 6. Columns (2) – (7) represent different income quintiles. Robust standard errors are reported. The omitted category for tenure is outright owners. Regional property prices are expressed in real, log form. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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