RESERVE BANK
OF NEW ZEALAND
TE PŪTEA MATUA

DP2018/06

Housing Leverage and Consumption Expenditure - Evidence from New Zealand Microdata

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April 2018

JEL classification: D12, D14, E21, R2

www.rbnz.govt.nz

Discussion Paper Series

ISSN 1177-7567

DP2018/06

Housing Leverage and Consumption Expenditure - Evidence from New Zealand Microdata

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[1] The views expressed in the paper do not necessarily reflect those of the Reserve Bank of New Zealand. Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not Statistics NZ. We thank, without implication, Ashley Dunstan, Dean Hyslop, Christie Smith, Eric Tong, Dennis Wesselbaum, Martin Wong and seminar participants at the Reserve Bank of New Zealand, the University of Otago and the New Zealand Treasury for their helpful comments. We would also like to thank the Real Estate Institute of New Zealand for providing us with regional house price data. Shaar: Forecasting Team, New Zealand Treasury, 1 The Terrace, Wellington 6011, New Zealand. Tel: +64 4 472 2733; Email: karam.shaar@vuw.ac.nz . Yao: Economics Department, Reserve Bank of New Zealand, 2 The Terrace, Wellington 6011, New Zealand. Tel: +64 4 471 3696; Email: fang.yao@rbnz.govt.nz . ISSN 1177-7567

Abstract

This paper investigates how household debt affects the marginal propensity to consume out of housing wealth. We use New Zealand household-level data on spending, income, and debt over the period 2006-2016. The main empirical challenge is to identify exogenous variation in house prices to determine how consumption evolves with movements in household wealth. This identification problem is complicated by the presence of unobserved household characteristics that are correlated with housing wealth. We use a detailed house sale dataset to derive local average house prices and use it as an instrument. Our empirical results show that the estimated elasticity of consumption spending to housing wealth is about 0.22%. In dollar terms, the average marginal propensity to consume out of a one-dollar increase in housing wealth is around 2.2 cents. Furthermore, our empirical results also confirm that household indebtedness, especially via mortgage debt, acts as a drag on consumption spending, not only through the debt overhang channel, but also through influencing the collateral channel of the housing wealth effect.

Non-technical summary

Understanding household consumption spending is crucial for modelling business cycles and designing macroeconomic policy. This paper investigates how household debt affects the marginal propensity to consume out of housing wealth.

We use microdata from Statistics New Zealand's "Household Economic Survey" (HES) to investigate how household leverage affects the marginal propensity to consume (MPC) out of housing wealth. HES data provide detailed information on household spending, income and loans. Empirically, estimating the effect of housing wealth changes on household expenditure faces two types of endogeneity issues. First, any evidence of an association between housing wealth variations and consumption changes could be driven by unobservable confounding factors such as future income expectations or household preferences. Second, naive regressions with total household spending can suffer from reversed causality, in which high housing-related spending leads to higher property values. We combine HES data with Real Estate Institute of New Zealand (REINZ) micro house price data to address the endogeneity issues that arise from using household-level cross-sectional data.

In the empirical analysis, we first assess the validity of average local house prices as an instrument for individual house prices. The first stage regression suggests that the instrument can explain up to 22 percent of the variation in individual house prices reported in HES. We then run a benchmark regression of total household expenditure excluding housing-related spending on housing wealth. The IV estimation suggests that using household-level prices leads to downward bias, which is the result of various causes of endogeneity issues discussed above. The average MPC out of a one-dollar increase in exogenous housing wealth is around 2.2 cents. All regressions control for income, household characteristics, and regional and time fixed effects. We also split non-housing expenditure into durables and non-durables. In line with other studies in the literature, we find that durable consumption is more sensitive to changes in housing wealth than non-durables.

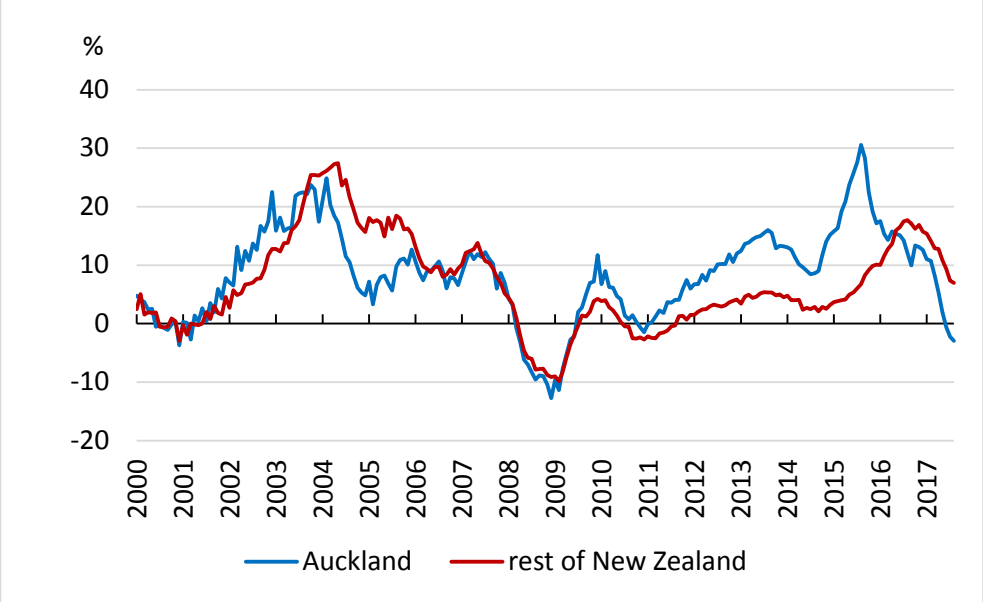
We then focus on the role of household leverage in determining the MPC out of housing wealth. In this analysis, we study how leverage measures, such as the loan-to-house-value ratio (LVR) and the DTI, affect the estimated MPC out of housing wealth. Overall, we find that household leverage weakens the MPC associated with housing. To examine the robustness of these findings, we investigate whether household spending responds differently depending on the age and type

of home ownership. The findings confirm that the consumption of mortgagors is less sensitive to housing wealth as compared to outright homeowners. The regression with an age-housing wealth interaction also shows that the response of younger households to changes in their housing wealth is weaker than the response of older households, which tend to be less leveraged.

1. Introduction

Understanding household consumption spending is crucial for modelling business cycles and designing macroeconomic policy. Traditional theories of consumption suggest that income and wealth are important determinants of household spending (see e.g. Fisher, 1930; Friedman, 1957). In New Zealand, housing wealth and housing mortgage debt represent a substantial proportion of household assets and liabilities, respectively. As a result, large swings in house prices have a significant impact on household balance sheets and may also have a material impact on consumption spending decisions. In this paper, we investigate the impact of housing wealth and housing debt on household consumption spending.

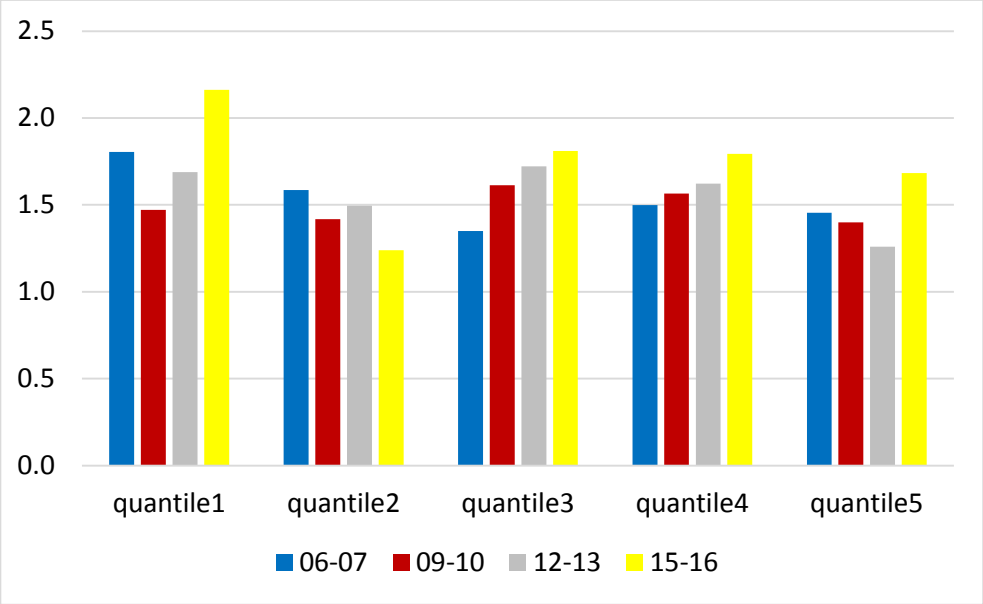
Figure 1: New Zealand house price inflation



Source: Reserve Bank of New Zealand

New Zealand house prices rose rapidly in the early 2000s. The country as a whole experienced double-digit house price inflation in the six years leading up to the Global Financial Crisis (GFC). After a brief, but significant, downward adjustment during the GFC, house price inflation increased again, especially in Auckland, the most populous city in the country. The increase in house prices corresponded with an increase in household debt over the same period. As shown in Figure 2, the mean debt-to-income ratio (DTI) has increased in most of the income quantiles over the last decade. The increase in DTIs has been particularly apparent for the quantile of households with the lowest income. Motivated by these observations, we investigate whether household leverage can help to explain the weakening housing wealth effect on consumption documented by Wong (2017) using New Zealand aggregate data.

Figure 2: Mean of DTI by income group



Note: The DTI is calculated from homeowners only. Source: HES

We use microdata from Statistics New Zealand's "Household Economic Survey" (HES) to investigate how household leverage affects the marginal propensity to consume (MPC) out of housing wealth. HES data provide detailed information on household spending, income and loans. We combine HES data with Real Estate Institute of New Zealand (REINZ) micro house price data to address the endogeneity issues that arise from using household-level cross-sectional data.

Empirically, estimating the effect of housing wealth changes on household expenditure faces two types of endogeneity issues. First, any evidence of an association between housing wealth variations and consumption changes could be driven by unobservable confounding factors such as future income expectations or household preferences. Second, naive regressions with total household spending can suffer from reversed causality, in which high housing-related spending leads to higher property values.

This paper seeks to address both endogeneity challenges. To deal with the endogeneity arising from confounding factors, we use local average house prices as an instrument for individual house prices. The instrumental variable (IV) estimation improves the estimated elasticity of housing wealth to expenditures through two channels. First, the instrument exploits cross-locality variation in house prices to extract the exogenous component of house price differences at the individual level. Cross-locality differences in house prices are mainly driven by local amenity differences. Those factors are arguably exogenous to household characteristics, such as risk aversion and housing preference. Second, the instrument also helps to reduce the estimation

bias caused by measurement errors in the house prices reported in the HES. The Household Economic Survey covers approximately 3000 households each quarter. In contrast, the REINZ housing sales data cover about 95 percent of all housing transactions in New Zealand and the house price data are highly accurate. To deal with the second cause of endogeneity, we take advantage of the detailed reporting on household expenditures in the HES and separate household spending from those related to housing improvements, maintenance and mortgage-related costs. These types of expenditures drive housing value higher and lead to reversed causality. We conduct our regressions on non-housing consumption expenditures.

In the empirical analysis, we first assess the validity of average local house prices as an instrument for individual house prices. The first stage regression suggests that the instrument can explain up to 22 percent of the variation in individual house prices reported in HES. We then run a benchmark regression of total household expenditure excluding housing-related spending on housing wealth. The IV estimation suggests that using household-level prices leads to downward bias, which is the result of various causes of endogeneity issues discussed above. The average MPC out of a one-dollar increase in exogenous housing wealth is around 2.2 cents.[2] All regressions control for income, household characteristics, and regional and time fixed effects. We also split non-housing expenditure into durables and non-durables. In line with other studies in the literature, we find that durable consumption is more sensitive to changes in housing wealth than non-durables.

We then focus on the role of household leverage in determining the MPC out of housing wealth. In this analysis, we study how leverage measures, such as the loan-to-house-value ratio (LVR) and the DTI, affect the estimated MPC out of housing wealth. Overall, we find that household leverage weakens the MPC associated with housing. To examine the robustness of these findings, we investigate whether household spending responds differently depending on the age and type of home ownership. The findings confirm that the consumption of mortgagors is less sensitive to housing wealth as compared to outright homeowners. The regression with an age-housing wealth interaction also shows that the response of younger households to changes in their housing wealth is weaker than the response of older households, which tend to be less leveraged.

Mian, Rao and Sufi (2013) (MRS hereafter) use county and zip code-level data from the United States (US) to estimate the MPC out of housing equity shocks. They obtain MPC estimates in

[2] Refer to section 4.1 for the calculations.

the range of 5 to 7 cents for every dollar change in housing net worth. This estimate is higher than our result. In addition, in contrast to our finding, MRS show that consumption responses to wealth shocks are stronger in highly indebted counties. There are several possible reasons why our results differ from those of MRS. First, MRS construct a pseudo panel of data by aggregating geographic areas into county-level data units. Conversely, while they estimate the aggregate MPC at the county level, our estimate is the MPC at the individual household level. As shown in Yao, Fagereng, and Natvik (2015), using detailed Norwegian household data, aggregating household level data into municipality or county levels magnifies estimated MPCs relative to their micro-level counterparts.

Second, MRS study the period 2006-2009, during which the US housing market experienced a severe down turn, while in our New Zealand sample, house price inflation was mostly positive. The difference in our estimated interaction coefficients could suggest that the role of leverage on the housing wealth effect is asymmetric, depending on whether house prices are increasing or decreasing.

More broadly, our paper is closely related to a growing literature on the housing wealth effect. A large housing wealth effect relative to non-housing wealth is documented by Case, Quigley and Shiller (2005) and Carroll, Otsuka and Slacalek (2011). Using aggregate data, the estimated MPC out of housing wealth in these studies range from 3 to 5 cents on a dollar gain in housing wealth. Studies that use microdata reveal a more detailed picture about the housing wealth effect. For example, Campbell and Cocco (2007) use the UK Family Expenditure Survey and show that the elasticity of consumption to house prices depends on age and tenure types. In line with our study, MPCs are larger for older homeowners, perhaps because lifetime horizon effects are at play.

Since the GFC, a new strand of papers has emerged focusing on the role of household leverage in shaping the housing wealth effect on consumption. Dynan (2012) studies the direct impact of debt on consumption using household-level panel data and shows that leverage lowers household consumption. Her study, however, does not investigate the moderating role of leverage in the impact of housing wealth on consumption.

Motivated by this US literature, international evidence has been fast accumulating, revealing additional insights. Yao, Fagereng, and Natvik (2015) use detailed Norwegian household data and find that housing leverage, measured by the loan-to-value ratio, amplifies the housing wealth effect by about 19-30 cents. Hviid and Kuchler (2017) use a large Danish household panel

dataset and document asymmetric MPCs out of positive and negative house wealth shocks. Household consumption appears more sensitive in response to negative housing wealth shocks than to positive ones. The asymmetric housing wealth effect was suggested earlier by Engelhardt (1996) and Skinner (1989, 1994) using US microdata. Our paper documents a different asymmetric housing wealth effect, when controlling for the household leverage ratio. As stated above, we find that New Zealand household spending is less sensitive to housing wealth when the leverage ratio is high. We provide micro evidence that rising household leverage has contributed to the declining MPC out of housing wealth that Wong (2017) observes in the aggregate data.

The present paper is organised as follows. Section 2 discusses the HES data. This is followed by a discussion of the empirical approach in Section 3. Section 4 presents our empirical results and robustness checks. We conclude in Section 5.

2. The Household Economic Survey in New Zealand

The HES collects comprehensive data on household residents living in permanent dwellings. The HES covers multiple aspects of household economics including highly disaggregate household expenditures, income, and loans. The survey also covers demographics, home ownership status, and house values. The data are stratified by different population benchmarks including age, sex, population per region, two-adult and non-two-adult households, and people of Maori ethnicity. This stratification guarantees proper weighting of households and a high degree of comparability across time since the data are cross-sectional rather than longitudinal. Data are collected in one-year waves extending from July to June.

In line with the literature, our study is primarily interested in non-housing expenditures. The focus on non-housing expenditure is to break the reverse causality between housing expenditures and house prices. The excluded housing expenditures are expenses on house maintenance, improvements, and mortgage repayment. The HES expenditure data are only disaggregated into housing and non-housing components triennially. We, therefore, focus our analysis on the four waves with detailed expenditure data only. These waves are 2006-2007, 2009-2010, 2012-2013, and 2015-2016. We also use the disaggregate expenditure data to break our non-housing expenditures into durables, and non-durable components. Appendix A lists the items of expenditures that fall into each of these categories.

The address of each household in the survey is reported at different levels of aggregation. The population of New Zealand is broken down into 47,062 meshblocks (MB), 2,020 area units (AU), and 65 territorial authorities (TA). In the empirical analysis, we control for regional fixed effects by using TA dummies and use the average house selling prices at the AU level.[3]

The HES does not report complete wealth-related data in the triennial waves which contain detailed expenditures. For the particular purpose of this paper, however, the HES reports the rateable value of the primary dwelling of the household and the year it was valued. The primary dwelling is the dwelling occupied by the respondents at the time of the interview. The rateable value of the dwelling is estimated by the territorial authority for levying rates. For the dwellings rated in years prior to the survey date, we use REINZ data on house price inflation to ensure all house values are up to date. We inflate house prices at the TA level.

Households fall into one of three housing tenures: renters; owners with a mortgage; and owners without a mortgage. Since this study is interested in homeowners only, we drop the renters from the study. As the house values are available for the primary property only, we exclude households with multiple properties from our analysis. This is done through two stages. First, we exclude any household that owns a house and receives rental income on another property. Second, we exclude the households with LVRs above 0.8. These exclusions lead to a 13 percent reduction of the total sample size, but make the LVR figure more sensible.[4] This is because it is most likely that only households with multiple properties can have LVRs higher than 0.8, especially after the Reserve Bank of New Zealand introduced LVR restrictions in 2013. The overall sample size used for the empirical analysis includes 4644 households.

To capture the actual income of each household, we use the gross disposable annual income data reported by the New Zealand Treasury, which is based on HES raw data. Finally, inflation-adjusted house prices, disposable income, and debt data are used to construct two different measures of household leverage. First, DTIs are constructed by using total household debt and disposable income. Second, LVRs are computed as the ratio of total household debt over the primary house value at the time of survey. Both measures are based on outstanding debt, rather than at the time of loan origination, to capture the actual level of leverage at the time of interview.

[3] For more information about geographic boundaries, visit: http://www.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas/digital-boundary-files.aspx.
[4] Before excluding those observations, the average LVR was 31.3, which means there are some extreme values in the sample.

2.1 Descriptive statistics

Table 1 reports the mean of the main variables in our regression. We first show them for the full sample and then present them for each wave. As our later analysis will focus mainly on households who own their homes, we only report the statistics with respect to homeowners in Table 1. In general, the age and the size of households are stable across waves.[5] Over time, expenditures have increased substantially, along with disposable income. However, during the same period, the increase in house prices resulted in a significant rise in debt as mortgages constitute the main share of household debt. Income growth has lagged behind the increase in debt over time, as illustrated by the upward trend in the DTI ratio. The average LVRs reported in table 1 are lower than those that are typical when loans are first originated because the averages here reflect borrowers who have paid down some of their debt, and also include households that are entirely debt free.

Table 1: Descriptive statistics for homeowners over time

	all waves	2006/07	2009/10	2012/13	2015/16
Sample size	4,644	1,201	1,180	1,196	1,067
Age of household head	57.2	56.2	57.0	58.0	57.7
Number of persons	2.3	2.4	2.3	2.3	2.4
Non-housing expenditure	41,841	37,152	38,546	44,060	49,128
Disposable income	66,024	51,402	62,062	71,856	82,605
Housing wealth (using the HES data)	418,784	357,868	352,661	405,461	592,396
Total debt	135,382	102,634	131,681	136,539	184,977
DTI	1.9	1.8	2.0	2.0	2.1
LVR	0.32	0.29	0.33	0.34	0.33

Notes: All nominal values are in New Zealand dollars. Homeowners include mortgagors and outright owners. Throughout the study, the number of reported observations is rounded up or down randomly to a multiple of three in compliance with Statistics New Zealand rules. Owners with multiple properties are dropped from the analysis.

Table 2 breaks down homeowners into mortgagors and outright owners. Owners with mortgages tend to be younger than outright owners; the latter tend to be closer to the age of retirement. Mortgagors also have more people in the household (their children), earn higher income, and have higher non-housing spending than outright owners. In per capita terms, however, outright owners still have higher income and expenditure. The two types of owners have similar (gross) housing wealth, but their debt levels are of course markedly different. Mortgage debt is the largest component of household debt, and mortgagors have debt levels that are typically 3 times higher than those of outright owners. As a result, their leverage ratios are also much higher.

[5] The main respondent to the survey is deemed to be the household head.

Table 3 presents the descriptive statistics for households in different age cohorts. From this table, we observe that most households fall in the oldest age cohort. Households with a head older than 60 year old are more than three times as common as households with a head younger than 40. This age composition potentially impacts on our quantitative results. Older households typically have lower income, consume less, and live in lower-value housing compared to households in young and prime cohorts. Most importantly for this study, the LVRs and DTIs tend to decline with age as older households tend to have paid down most of their debts.

Table 2: Descriptive statistics by tenure type

	Mortgagors	Outright homeowners
Sample size	1,670	2,974
Age of household head	44.4	63.3
Number of persons	2.9	2.0
Non-housing expenditure	45,847	39,447
Disposable income	77,129	59,388
Housing wealth	419,614	418,289
Total debt	144,350	44,759
DTI	2.1	0.6
LVR	0.34	0.11

Notes: All nominal values are in New Zealand dollars.

Table 3: Descriptive statistics by age groups

	Young (20 – 40)	Prime (40 – 60)	Old (60 – 80)
Sample size	610	1,702	2,183
Number of persons	3.14	2.68	1.62
Non-housing expenditure	45,968	50,601	31,477
Disposable income	79,618	80,857	44,937
Housing wealth	460,415	493,081	441,887
Total debt	174,132	128,953	51,070
DTI	2.46	1.82	1.3
LVR	0.43	0.29	0.16

Notes: All nominal values are in New Zealand dollars.

3. Empirical approach

Because our data are a series of repeated cross-sectional waves, we set up the following baseline regression equation:

$$logC_i = \beta_0 + \beta_1 log\ HP_i + \beta_2 log\ Y_i + \sum_{k=1}^{K} \beta_k Z_i^k + \mu_i,$$

Where C_i is non-housing expenditure, HP_i is housing wealth, and Y_i is disposable income. All regressions in this study include an N×K matrix of N observations and K control variables (i =1,…, N; k =1,…, K). The control variables are age, age squared, education dummies, number of people employed, household composition dummies (single-person, couple, couple with children), an ethnicity dummy, territorial authority dummies, and wave dummies.

If $log\ HP_i$ is truly exogenous, we can interpret the estimated coefficient β_1 as the MPC out of housing wealth. However, endogeneity issues are always a challenge to interpreting empirical results. The major concern is that confounding factors could be driving both the consumption expenditure and housing wealth of the household. With our cross-sectional data, we cannot control for all possible household characteristics. As a result, estimating β_1 directly using HES house prices would lead to biased results and the direction of the bias would depend on the correlation between the unobserved confounding factors and the variables in the regression. For this reason, we use house prices at the area unit (AU) level to identify the effect of house prices on the consumption of households in the HES.[6] We regard the cross-AU variations in average house prices as being exogenous relative to the characteristics of individual households. In particular, we use average house sale prices at the AU level as an instrument for household-level house prices from the HES. We derive the mean sales price of three-bedroom residential houses for each AU and each year between 2006 and 2016 using REINZ data which covers 95 percent of actual housing sales in New Zealand. We then use the address information and interview years in the HES to match each household to the corresponding mean house sale price in the AU. This, to a large extent, resolves the endogeneity problem due to unobservable household characteristics driving the empirical results. For example, in an AU, residences are typically mixed from different backgrounds, jobs and demographic characters. As a result, an individual household's preference or high-income expectation would be unlikely to be correlated with the average home selling prices in an AU, unless it was driven by region-specific economic factors, which should be captured by the regional dummies in the regression equation. In addition, the use of an IV approach also helps in overcoming the measurement error in the HES house price data, which are based on the capital values estimated for city councils periodically.

Regressing the log of HES house prices on the log of local average house prices yields an intercept coefficient of 0.78. The coefficient is statistically significant at the 1 percent level and

[6] AUs are roughly comparable to zip-codes in the US. For more information about geographic definitions in New Zealand refer to section 2.

the regression has a goodness of fit of 22 percent. We use this first stage regression to obtain the fitted values which represent the exogenous component of the variation in individual house prices.

4 Results and discussions

4.1 Marginal propensity to consume out of housing wealth

Table 4 shows the estimation results for the baseline regression for three specifications. In specification i, housing wealth is measured at a household-level and it is sourced from the HES as described in Section 2. The estimated coefficient β_1 is 0.09 and it is statistically significant. In column ii, we report the estimate based on average house prices at the AU geographic level. In this case, AU house prices are used as a proxy for exogenous variations in individual housing wealth. Specification iii uses the instrumental variable approach described in the previous section.

Table 4: Baseline regression results using different measures of housing wealth

Dependent variable	Log non-housing expenditures		
	i	ii	iii
Log housing wealth (HES)	0.09*** (0.03)	-	-
Log housing wealth (AU average)	-	0.17*** (0.02)	-
Log housing wealth (IV)	-	-	0.22*** (0.03)
Log income	0.40*** (0.02)	0.40*** (0.02)	0.40*** (0.02)
Other controls	✓	✓	✓
Observations	4,644	4,644	4,644
Adjusted R^2	0.57	0.57	0.57

Note: The control variables are listed in section 2. The standard errors are reported in parentheses. *** indicates significance at 1 percent.

The estimated MPC using AU prices is almost twice as large as the estimate obtained from HES housing wealth. As we discussed before, the regression based on HES housing value might suffer from multiple problems, which might lead to bias in different directions. In particular, the endogeneity due to unobservable confounding factors might cause upward bias if the unobservable household characteristics are positively correlated with house prices. For example, a higher income expectation could be driving both consumption and the housing value of a household. Similarly, if a household is more impatient, they will also spend more and buy an

expensive house. On the other hand, measurement errors in HES house prices could lead to attenuation bias. As the estimated coefficients increase from regressions i to ii and iii, this suggests that the measurement error in the HES house prices has a stronger impact on the results than the endogeneity issue discussed above. Using average local house prices as a proxy variable in specification ii yields a smaller MPC as compared to the result reported in specification iii. This is largely because the local average house price variable cannot fully explain the changes in the HES house prices unless used as an instrument. We rely on the IV estimation for the rest of the paper.

The estimated elasticity of consumption spending to housing wealth is about 0.22. This means a one percent increase in housing wealth is associated with a 0.22 percent increase in consumption expenditure. In dollar terms, the average MPC out of a one-dollar increase in housing wealth is around 2.2 cents.[7]

In Table 5, we separate non-housing expenditure into durable and nondurable spending. Columns iii in Table 4 and i in Table 5 are identical. We present the results again in Table 5 to give a sense of how MPC differs from durables, to non-durables, to total expenditures. In line with MRS, durable expenditures respond more strongly to changes in income and housing wealth compared to non-durable spending.

Table 5: Baseline regression results using different definitions of non-housing expenditures

Dependent	Log non-housing Expenditures	Log non-durables	Log durables
	i	ii	iii
Log housing wealth (IV)	0.22*** (0.03)	0.17*** (0.03)	0.26*** (0.1)
Log income	0.40*** (0.02)	0.37*** (0.02)	0.60*** (0.05)
Other controls	✓	✓	✓
Observations	4,644	4,644	3,792
Adjusted R^2	0.57	0.56	0.14

Note: The control variables are listed in section 2. For the definition of durables and non-durables refer to Appendix A. The number of observations is not identical as we could not perfectly match the addresses reported in HES and REINZ. The last column of durables has fewer observations as not all households reported durable non-housing expenditures within the two-week period of the survey. When restricting the samples in regressions i and ii to the same sample of regression iii, the results remain unchanged to the second decimal place. The standard errors are reported in parentheses. *** indicates significance at 1 percent.

[7] As in Table 1, the average annual non-housing household expenditure (C) is $41,841 NZ dollars for homeowners. Using our house price sales data, the average house value (HP) at the AU level is $418,784 NZ dollars. The elasticity is $\Delta C/\Delta HP*HP/C = 0.22$, implying $\Delta C = 0.22*C/HP*\Delta HP$. Setting $\Delta HP=\$1$, 0.22*42,690/418,784 = $0.022 dollar, i.e.2.2 cents.

4.2 The effect of leverage

Table 6 summarises the regressions on homeowner spending, controlling for the effect of leverage using either LVRs or DTIs. For both measures, we report the results of three specifications. In the first specification, column i, we only include the leverage ratio as a new independent control variable. The coefficient is estimated to be negative and highly significant. It appears that, relative to outright owners, an increase in LVR by 1 percentage point reduces the consumption spending of borrowers by 0.25 percent. This result confirms the debt-overhang channel, highlighted by Dynan (2012): household debt is an independent driver of consumption spending.

Table 6: The role of leverage in determining MPC out of housing wealth for homeowners

Dependent variable	Log non-housing expenditures					
Leverage ratio	LVR			DTI		
	i	ii	iii	i	ii	iii
Log housing wealth (IV)	0.20*** (0.03)	0.21*** (0.03)	0.20*** (0.03)	0.22*** (0.03)	0.21*** (0.03)	0.22*** (0.03)
Leverage ratio	-0.25*** (0.04)	1.09 (1.18)	-	-0.03*** (0.01)	-0.15 (0.21)	-
Leverage × log housing wealth	-	-0.10 (0.09)	-0.02*** (0.003)	-	0.01 (0.02)	-0.003*** (0.0005)
Log income	0.40*** (0.02)	0.40*** (0.02)	0.40*** (0.02)	0.39*** (0.02)	0.39*** (0.02)	0.39*** (0.02)
Other controls	✓	✓	✓	✓	✓	✓
Observations	4,644	4,644	4,644	4,644	4,644	4,644
Adjusted R^2	0.57	0.57	0.57	0.57	0.57	0.57

Note: The control variables are listed in section 2. The standard errors are reported in parentheses. *** indicates significance at 1 percent.

In specification ii, we allow the leverage ratio to interact with house prices. This specification provides another channel through which the leverage ratio can affect consumption, namely the housing wealth channel. As discussed in MRS, collateral constraints are part of the mechanism that translate movements in housing wealth into movements in consumption. During a severe housing market downturn, as in 2008/9 in the US, highly leveraged households face a binding borrowing constraint and their consumption falls more sharply in response to declines in housing wealth. Interestingly, in our regression ii, the estimated coefficient on the interaction term is negative, but the coefficient on the leverage ratio is positive. Both estimates are statistically significant. A closer look at the correlation between these two independent variables shows that the leverage ratio is highly correlated with the interaction term between leverage and housing

wealth in the regression.[8] This collinearity problem causes the associated coefficients to be imprecisely estimated. This motivates us to run the third specification with only the interacted leverage ratio and housing wealth covariate. Column iii shows that once the collinearity issue is removed, the estimated coefficient becomes negative and statistically significant. Using a DTI as a measure of household indebtedness delivers similar results as seen in the right half of the table.

Taking all the regressions together, we conclude that household indebtedness affects consumption spending through two channels. First, the debt-overhang channel as highlighted by Dynan (2012). Second, household indebtedness, especially via mortgage debt, acts as a drag on consumption spending, not only through the level effect, but also by influencing the slope of the housing wealth effect. Because of the collinearity issue, our data cannot separately disentangle these two channels. However, our empirical results also confirm the existence of the house wealth channel through which household indebtedness affect consumption spending.

A particularly interesting aspect of our results is that the estimated interaction coefficient is negative, which suggests that households with high leverage are less sensitive to exogenous house price variations. This result contrasts strikingly with MRS, who show that the household spending response to housing wealth shocks is stronger in regions with highly indebted households. They argue that the finding confirms the collateral constraint channel, which is studied by Iacoviello (2005) and Kiyotaki and Moore (1997). In the light of our empirical result, we argue that the relationship between household indebtedness and consumption spending is more complex than implied by MRS. One possible explanation for the difference in the impact of household indebtedness is that US studies mainly focus on the period after the Great Recession, when the US housing market suffered from a severe downturn, while in the most of the sample period for our New Zealand dataset house prices were growing (See Figure 1). The effect of the leverage ratio might be asymmetric in terms of how the consumption spending of borrowers responds to increases or decreases in housing wealth. Therefore, more theoretical modelling of the interaction between household debt and consumption is desirable in future research.

4.2 Other robustness tests

According to descriptive statistics in Table 2 and 3, household leverage is correlated with tenure types and age. For example, mortgagors tend to be significantly more leveraged relative to

[8] See the cross-correlations table in the Appendix.

outright owners, because the main type of household debt is mortgage debt. Table 3 shows that older households tend to be less leveraged as they have paid most of their mortgages down. To confirm the robustness of the findings reported in section 4.1, in this section, we use age and tenure type as a proxy for leverage. This exercise overcomes the potential measurement errors in the household leverage data.

In Table 7, specification i allows the age of the household head to interact with housing wealth. We find that age has a small but significant impact on the marginal propensity to consume out of housing wealth, suggesting that the expenditure of older households is slightly more responsive to changes in housing wealth. Given that older households have lower leverage, this result is consistent with our finding in the previous section.

In column ii, we interact a mortgagor dummy with housing wealth. The dummy takes one for mortgagors and zero for outright owners. The result in column i in this table as well as those in Table 6, implies that mortgagors are less sensitive to changes in housing wealth relative to outright owners.

Table 7: Estimated MPC by age and tenure type for homeowners

Dependent variable	Log non-housing expenditures			
	Benchmark	i	ii	iii
Log housing wealth (IV)	0.22*** (0.03)	0.14*** (0.03)	0.20*** (0.03)	0.22*** (0.03)
Age×log housing wealth	-	0.001*** (0.0002)	-	-
Mortgagor dummy × log housing wealth	-	-	-0.01*** (0.002)	-
DTI× log housing wealth	-	-	-	-0.005*** (0.01)
Age×DTI× log housing wealth	-	-	-	0.00006** (0.00)
Log income	0.40*** (0.02)	0.40*** (0.02)	0.39*** (0.02)	0.39*** (0.02)
Other controls	✓	✓	✓	✓
Observations	4,644	4,644	4,644	4,644
Adjusted R^2	0.57	0.57	0.57	0.57

Notes: The control variables are listed in section 2. Standard errors are reported in parentheses. *** indicates significance at 1 percent.

In column iii, we re-estimate the regression equation as in Table 6, but add a three-way interaction term between age, DTI and housing wealth. The idea of this specification is to check if our estimate is driven by a life cycle pattern. Leverage is systematically high for younger compared to older households. If the housing MPC is also systematically correlated to the life

cycle, our interaction term in Table 6 will pick up this life cycle effect as well. The empirical result shows a small but positive estimate, suggesting that the spending of older households is more sensitive to changes in housing wealth, when they have higher leverage. More importantly, after controlling for this life cycle effect, the interaction between leverage and housing wealth is still negative with a similar magnitude.

For completeness, Table A3 reports the regression results when using AU average house prices as a proxy, instead of an instrument. All empirical findings do not change materially.

5. Conclusion

This paper conducts a microeconometric analysis exploring how changes in housing wealth impact household consumption in New Zealand once one controls for the role of leverage and other household characteristics. We find that household indebtedness plays a significant role in determining the wealth effects of housing. In contrast with the literature, we find that highly indebted households spend *less* out of increases in housing wealth than do less indebted households. The microeconometric evidence helps to explain the empirical finding of a weakening MPC out of housing wealth over time, as documented by Wong (2017) using New Zealand aggregate data. Our results point to rising household leverage as a significant driver behind the change in the MPC out of housing wealth in New Zealand since the 2000s.

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Appendix A

Table A1: classification of expenditures in HES data

	Type	**Description**	**NZHEC code**
Non-housing expenditures	Durables	Furniture, furnishings and floor coverings	5.1
		Household appliances	5.3
		Tools and equipment for house and garden	5.5
		Purchase of vehicles	7.1
		Audio-visual and computing equipment	9.1
		Major recreational and cultural equipment	9.2
		Jewellery and watches	11.3.01
	Non-durables	Fruit and vegetables	01.1
		Meat, poultry and fish	01.2
		Grocery food	01.3

		Non-alcoholic beverages	01.4
		Restaurant meals and ready-to-eat food	01.5
		Alcoholic beverages	02.1
		Cigarettes and tobacco	02.2
		Illicit drugs	02.3
		Clothing	03.1
		Footwear	03.2
		Actual rentals for housing	04.1
		Home ownership	04.2
		Household energy	04.5
		Household textiles	05.2
		Glassware, tableware and household utensils	05.4
		Other household supplies and services	05.6
		Medical products, appliances and equipment	06.1
		Out-patient services	06.2
		Hospital services	06.3
		Private transport supplies and services	07.2
		Passenger transport services	07.3
		Postal services	08.1
		Telecommunication equipment	08.2
		Telecommunication services	08.3
		Other recreational equipment and supplies	09.3
		Recreational and cultural services	09.4
		Newspapers, books and stationery	09.5
		Accommodation services	09.6
		Package holidays	09.7
		Miscellaneous domestic holiday costs	09.8
		Early childhood education	10.1
		Primary, intermediate and secondary education	10.2
		Tertiary and other post school education	10.3
		Other educational fees	10.4
		Personal care	11.1
		Prostitution	11.2
		Personal effects not elsewhere specified	11.3
		Insurance	11.4
		Expenditure incurred whilst overseas	13.5
		Sales of clothing and footwear	14.1
		Sales and trade-ins of property and materials for property improvement and maintenance	14.2

		Sales and trade-ins of household contents	14.3
		Sales, trade-ins and refunds for health (excluding insurance claims)	14.4
		Sales and trade-ins of vehicles, vehicle parts and accessories	14.5
		Sales and trade-ins for communication	14.6
		Sales, trade-ins and refunds of equipment for recreation and culture	14.7
		Refunds for education	14.8
		Sales, trade-ins and refunds of miscellaneous goods, cash receipts from insurance claims	14.9

Note: The complete New Zealand Household Economic Survey Classification (NZHEC) can be found at http://www.stats.govt.nz/browse_for_stats/people_and_communities/Households/household-economic-survey-classifications.aspx

Table A2: Cross correlations table

	Total expenditure	Durable	Non-durable	Disposable income	House wealth	DTI	(DTI)X (income)	(DTI)X (housing)
Total expenditure	1							
- Durable	0.53	1						
- Non-durable	0.95	0.30	1					
Disposable income	0.64	0.30	0.63	1				
Housing wealth	0.43	0.13	0.44	0.50	1			
DTI	-0.12	-0.11	-0.10	-0.15	0.25	1		
(DTI)X(income)	-0.09	-0.09	-0.07	0.09	0.28	0.99	1	
(DTI)X(housing)	-0.10	-0.10	-0.08	-0.12	0.29	0.99	0.99	1

Table A3: The role of leverage in determining MPC out of housing wealth for homeowners

Dependent variable	Log non-housing expenditures					
Leverage ratio	LVR			DTI		
	i	ii	iii	i	ii	iii
Log housing wealth (AU average)	0.15*** (0.03)	0.16*** (0.03)	0.16*** (0.03)	0.17*** (0.02)	0.17*** (0.03)	0.15*** (0.02)
Leverage ratio	-0.25*** (0.04)	0.77 (0.9)	-	-0.03*** (0.006)	-0.13 (0.16)	-
(Leverage) × (log housing wealth)	-	-0.08 (0.07)	-0.02*** (0.003)	-	0.00 (0.02)	-0.003*** (0.0005)
Log income	0.40*** (0.02)	0.40*** (0.02)	0.40*** (0.02)	0.39*** (0.02)	0.39*** (0.02)	0.39*** (0.02)
Other controls	✓	✓	✓	✓	✓	✓
Observations	4,644	4,644	4,644	4,644	4,644	4,644
Adjusted R^2	0.57	0.57	0.57	0.57	0.57	0.57

Note: These regressions are based on homeowners only, which includes both outright owners and mortgagors. The control variables are listed in section 2. The standard errors are reported in parentheses.