KŌTĀTĀ INSIGHT

BEHAVIOURAL ECONOMIC & SOCIAL ANALYSIS

Valuing Wellbeing Outcomes

Cost-wellbeing analysis of housing outcomes in the New Zealand General Social Survey

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Disclaimer

The results in this paper are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) managed by Statistics NZ.

The opinions, findings, recommendations, and conclusions expressed in this paper are those of the author(s), not Statistics NZ.

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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.

Note: All figures presented in this paper have been rounded to protect confidentiality.

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EXECUTIVE SUMMARY

In this paper, we use a wellbeing valuation approach to estimate the value associated with housing and other non-market outcomes in New Zealand. In particular, we estimate the compensating and equivalent surplus of non-market outcomes for vulnerable households supported by Kāinga Ora (previously known as Housing New Zealand) as well as for the general population. This paper builds on a discussion paper recently published by Kāinga Ora on the "Wellbeing Valuation of Social Housing Provision" (Davies, 2018).

The value that a person places on a good or service is referred to by economists as the compensating or equivalent surplus depending on whether the point of reference is the person's position before receiving the good or service (compensating surplus) or after receiving it (equivalent surplus). These measures reflect the amount that a good or service is "worth" to an individual. Measuring compensating or equivalent surplus is useful for decision makers as cost-benefit analyses that include the full value of outcomes to people (rather than only including income and costs) can better determine whether an investment will have a net positive impact on community and individual wellbeing.

The wellbeing valuation approach adopted here takes life satisfaction as a proxy measure for utility and then uses regression analysis to estimate the compensating or equivalent surplus for non-market outcomes (referred to hereafter as non-market values). We use the 2014 and 2016 waves of the New Zealand General Social Survey (NZGSS) and adapt Fujiwara's (2013) three-stage valuation approach to estimate the equivalent monetary value of objective non-market outcomes, such as housing conditions; discrimination, and crime; health outcomes; loneliness and the ability to express one's own culture.

Separate regressions are run to identify the relationship between income and life satisfaction and the impact of non-market outcomes on life satisfaction. The ratio between the two is then used to calculate the compensating surplus for welfare gains, and equivalent surplus for welfare losses for different non-market outcomes.

Table 1 below summarises the estimates of non-market value for the Kāinga Ora tenant population and for the New Zealand general population. We have provided estimates of compensating or equivalent surplus using both the NZGSS income coefficient from this paper and the income coefficient from Fujiwara (2013). This identifies a range of plausible values between the high (Smith and Davies) and low (Fujiwara) estimates. The use of a range of values has two important advantages.

First, it provides a direct signal to users of the value estimates that there is a degree of uncertainty around the listed values and provides some idea of the magnitude of this uncertainty. This is preferable to false and potentially misleading precision when applied to real-world decisions.

Second, it is possible to use the lower and upper estimates in different ways. If the cost of providing the relevant non-market outcome is less than the lower estimate of non-market value then the case that the proposal raises overall wellbeing can be considered strong. Alternatively, if the cost of provision is above the upper estimate of non-market value then this provides evidence that the costs of the project exceed the benefits even under relatively generous assumptions.

The values in table 1 should be interpreted as the compensating surplus for each welfare improving non-market outcome, which is the portion of household income that an individual would be willing to forego in exchange for the outcome in question, and the equivalent surplus for each welfare reducing non-market outcome, which is the portion of household income that an individual would need to receive to be rendered willing to adopt the outcome in question. These measures are directly comparable to values calculated through willingness to pay or similar approaches, including the "value of statistical life" currently used in the New Zealand Treasury CBAx cost-benefit tool.

Table 1. Summary of valuation estimates

Wellbeing outcomes		Wellbeing Valuation: Other Outcomes for Kāinga Ora Tenants			
		NZGSS General Population Coefficients (M^0 = $26,200)		NZGSS Kāinga Ora Tenant Proximity Group Coefficients (M^0 = $26,200)	
		Fujiwara Estimate	Smith and Davies Estimate	Fujiwara Estimate	Smith and Davies Estimate
Housing outcomes					
Good Condition	House Condition: Minor Problems	-$2,173	-$6,776	(-$4,462)	(-$12,458)
	House Condition: Some Problems	-$4,044	-$11,521	(-$4,180)	(-$11,830)
	House Condition: Very Bad/Extreme Problems	-$6,638	-$16,654	(-$7,561)	(-$18,123)
None	House Mould: Some	-$2,164	-$6,749	(-$306)	(-$1,041)
	House Mould: Very Bad	-$3,353	-$9,878	-	-
No Cold	House Cold: Sometimes	-$3,591	-$10,458	-$7,621	-$18,213
	House Cold: Often/Always	-$5,429	-$14,457	-$7,961	-$18,707
Non-housing outcomes					
Unemployment		-$6,493	-$16,407	-$4,837	-$13,258
Victim of Discrimination		-$5,517	-$14,627	-$6,761	-$16,860
Victim of a Crime		-$2,863	-$8,637	-$6,480	-$16,386
Member of a Volunteering Group		$2,140	$6,683	($5,250)	($15,186)
Physical Health (0-100 Scale)		$243	$831	($68)	($235)
Mental Health (0-100 Scale)		$1,151	$3,767	$1,113	$3,650
Drugs or Alcohol Problem in Neighbourhood		-$1,463	-$4,719	(-$2,465)	(-$7,578)
Cultural Expression (0-5 Scale)		$2,962	$8,891	$4,077	$11,596
Lonely (0-5 Scale)		-$2,350	-$7,267	(-$1,668)	(-$5,328)

Valuations in parentheses are not statistically significant.

M_0 is the reference income at which values are calculated.

Positive values are compensating surplus, negative values are equivalent surplus.

The values in table 1 for the Kainga Ora tenant proximity group are based on a smaller sample size

than the estimates for the general population and many of them are therefore not statistically significant. The results for living in a house with very bad mould were suppressed as they were a clear outlier based on a very small number of observations.

Estimates of non-market value provide a useful tool for considering the social or wellbeing impact of investment decisions. These values can be used to estimate the "social return on investment" (SROI) for an intervention or program *if* it is possible to establish strong causal evidence between the intervention and the non-market outcome in question.

This paper does not directly consider the policy implications of the analysis as the primary aim is to produce credible wellbeing valuations for input into social cost-benefit analysis and social policy decision-making more broadly. Two general points are worth making, however.

First, even the minimum estimates of the non-market value of most of the non-market outcomes considered here are sizable. This highlights the inherent risk in evaluating policy options based purely in terms of net fiscal impact. A purely fiscal approach to cost-benefit analysis is likely to risk significant misallocation of resources. Second, the values presented here provide a starting point for building a more comprehensive suite of non-market values for New Zealand. Ongoing investment in improving the quality of these non-market values has the potential to contribute to better public policy decision-making. In particular, intelligent use of the wider IDI alongside the NZGSS and similar surveys has the ability to further improve the quality of wellbeing valuations for New Zealand.

1. INTRODUCTION

In this paper, we use a wellbeing valuation approach to estimate the value to people of housing and other non-market outcomes in New Zealand. In particular, we focus on the estimation of wellbeing values for vulnerable households supported by Kāinga Ora (previously known as Housing New Zealand) as well as for the general population.

Motivation

This paper builds on a discussion paper recently published by Kāinga Ora on the "Wellbeing Valuation of Social Housing Provision" (Davies, 2018). This earlier paper applied wellbeing valuation techniques to estimate the compensating or equivalent surplus associated with housing, social and economic outcomes, using data from the 2014 wave of the New Zealand General Social Survey (NZGSS). Wellbeing valuation draws on an extensive literature on the use of wellbeing valuation measures to value non-market outcomes (e.g. Clark and Oswald, 2002; Fujiwara, 2013; OECD, 2013).

Following the publication of the 2018 discussion paper by Kāinga Ora (Davies, 2018), wellbeing values from the paper have been used in the context of social cost-benefit analysis as input to government policy proposals. This represents a significant step forward from omitting non-market values altogether from social cost-benefit analysis. However, the estimates from the 2018 discussion paper have scope for improvement in a number of areas.

This paper builds on the 2018 discussion paper to improve the quality of the values for non-market outcomes of interest to Kāinga Ora. More specifically, the aim of this paper is to update the estimates of value from Davies (2018) and place these on a more robust empirical footing. It is aimed primarily at identifying estimates of compensating or equivalent surplus for non-market outcomes that can be used in the context of social cost-benefit analysis rather than reaching specific conclusions about housing policy. While the values estimated in this paper can be used to inform policy decisions, the paper itself does not present specific conclusions on policy issues.

The key research questions to be addressed are:

- What is the compensating or equivalent surplus associated with the different housing outcomes measured in the NZGSS?
- What is the compensating or equivalent surplus associated with other social outcomes measured in the NZGSS?
- How sensitive are these values to different estimates of the relationship between household income and life satisfaction?

This paper makes four key improvements to the value estimates in Davies (2018). First, it doubles the effective sample size by using two waves of the NZGSS (2014 and 2016) rather than one (2014). Second, the larger sample size and the use of Kāinga Ora data in Statistics New Zealand's Integrated Data Infrastructure (IDI) allows for analysis, although limited, of how values for social housing clients vary compared to the average for New Zealand as a whole.

The third improvement is a more systematic treatment of the issue of shared method variance. This provides reassurance that valuations for subjectively measured outcomes are not biased upwards due to the impact of personality on how people respond to survey questions. Finally, the paper improves on the estimate of the relationship between income and life satisfaction both through a formal literature review on the income/life satisfaction relationship and through a better regression strategy. Given the importance of the income/life satisfaction relationship to the size of values obtained through wellbeing valuation this materially improves the robustness of the final results.

The paper is organised in seven sections. Following this introduction (section 1), section 2 of the paper provides a brief literature review covering the different conceptual approaches to valuing

non-market outcomes as well as summarising the available evidence on the size of the income coefficient on life satisfaction and on estimated values from New Zealand for non-market outcomes associated with housing. Section 3 then details the methodology adopted in the paper to calculate values for non-market outcomes using life satisfaction data. Our approach builds on recent developments in wellbeing economics (Fujiwara 2013, OECD, 2013) to calculate meaningful estimates of the compensating and equivalent surplus associated with non-market outcomes.

The data used in our analysis is discussed in section 4. While the 2014 and 2016 waves of the New Zealand General Social Survey (NZGSS) form the core of our dataset, use is also made of administrative data on Kāinga Ora tenants from the IDI. Section 5 outlines the main results of our analysis, and the implications of these are discussed in section 6. A short conclusion summarising the main point and identifying potential opportunities for further work is provided as section 7.

2. LITERATURE REVIEW

In this section, we briefly outline the main approaches to valuing non-market outcomes before discussing existing evidence for the size of the income coefficient on life satisfaction and summarising estimates of the compensating or equivalent surplus associated with housing amenities.

Approaches to valuing non-market outcomes

The value that a person places on a good or service is referred to by economists as compensating or equivalent surplus depending on whether the point of reference is the person's position before receiving the good or service (compensating surplus) or after receiving it (equivalent surplus). Compensating or equivalent surplus reflects the amount that a good or service is "worth" to an individual and is equivalent to the complete impact that the good or service has on the person's utility or wellbeing[1]. Measuring compensating or equivalent surplus is useful for decision makers, as cost-benefit analyses that includes these values (rather than only including income and costs) can determine whether an investment will have a net positive impact on community and individual wellbeing.

It is particularly useful to measure the compensating or equivalent surplus of a good or service if it is not explicitly provided in a market context (i.e. actually bought or sold). In an efficiently functioning market the compensating or equivalent surplus of something is equal to the maximum amount that a consumer would be willing to pay for this good. Paying any price *higher* than a good's compensating or equivalent surplus means that the cost to the consumer exceeds the total benefit that they will receive, and the consumer would be worse off for purchasing the good than not doing so. This means that the market price of the good or service reveals the *lower bound* for an estimate of compensating or equivalent surplus.

Non-market outcomes are not (commonly or individually) traded, and therefore do not have unique prices that can reveal whether the compensating or equivalent surplus of the outcome is sufficient to warrant its production at any given level of costs. These outcomes include a wide range of different things of relevance to public policy including outcomes such as physical health, discrimination, a warm house, and household crowding. Each of these outcomes has a value that reflects peoples' utility, but because these outcomes are not traded in a market, the price that an individual would be willing to pay cannot be directly observed.

Cost-benefit analyses have traditionally focused on market costs and benefits. However, for the reasons discussed above, it is important to try and include non-market outcomes in cost-benefit analyses. If a social cost-benefit analysis *excluded* non-market outcomes, and these generated a positive level of utility that was not reflected in the market price, then activities or outcomes may be underprovided. For example, a community renewal project that costs $100,000 and returns a total income of $40,000 to the investor would appear to have costs that exceed benefits. However, there may be positive compensating or equivalent surplus to the community associated with non-market outcomes that is *more* than $100,000 indicating that the benefits of the project exceed the costs.

There are a number of approaches that can be used to estimate the compensating or equivalent surplus of non-market outcomes including contingent valuation, hedonic pricing, and wellbeing valuation. The general methodology associated with each of these approaches is described below.

[1] In the body of this paper we use the terms utility and wellbeing as synonyms. Subjective wellbeing refers to self-reported estimates of wellbeing such as responses to life satisfaction questions which we take to be a (noisy) proxy for the respondent's overall wellbeing.

Contingent Valuation

Contingent valuation is the most widely used technique for valuing non-market outcomes. Estimates of compensating or equivalent surplus are calculated from responses to survey questions that directly ask respondents for their willingness-to-pay for the outcome in question or their willingness-to-accept compensation for forgoing the outcome. For example, a household may be asked how much they would be *willing* to pay (rather than how much they have *actually* paid) every year to ensure that their house was insulated, warm, and dry. These survey results would then reveal the equivalent "value" of a warm house to decision makers who could then justify a costly home improvement intervention by referencing the non-financial *wellbeing* gains to these households. New Zealand's Housing and Health Research Programme (He Kāinga Oranga) performed such a willingness-to-pay study between 2005 and 2006, estimating willingness to pay for heating systems over a sample of 360 low-income households (Chapman, 2006).

This method of valuing non-market outcomes has, however, several limitations. Social desirability bias (OECD, 2013) means that respondents may be more likely to provide the socially approved answer when questioned about the desirability of a project. In the context of valuing non-market outcomes this can potentially bias estimates of value upwards if the respondent is unwilling to be seen to assign a low value to a socially approved good.

Because contingent valuation studies are often used in the cost-benefit decision about actual projects, people may have a strategic incentive to report higher or lower values than their real willingness to pay. If a person is surveyed about their willingness to pay to avoid having an airport built next to their house it is relatively costless for them to report a much higher valuation than they would be prepared to pay in reality. In addition, peoples' valuations are affected by their actual incomes meaning that these surveys tend to give lower weighting to respondents with lower incomes.

Choice experiments – sometimes referred to as conjoint analysis – are conceptually related to contingent valuation techniques. However, rather than asking a respondent directly about their willingness to pay, choice experiments present respondents with a variety of hypothetical trade-offs between different states of the world including the non-market outcome of interest, income levels, and a number of other outcomes. A well-structured choice experiment can be shown to be incentive compatible and is not prone to strategic responding in the same way that contingent valuation techniques are (Benjamin, Heffetz, Kimball, and Szembrot, 2014). The primary concern with choice experiments is the cost-effectiveness of this approach – which requires a dedicated survey.

Hedonic pricing

Hedonic pricing extracts the compensating or equivalent surplus of non-market outcomes by using regression or similar statistical analyses to extract the portion of the price for a "parent" market good that can be attributed to the "child" non-market good. For example, although the compensating or equivalent surplus of living in a neighbourhood with safety concerns is not traded in the market, these values are included in the price of the "parent" good, which is the house itself. Therefore, it is possible to compare house prices in different suburbs to determine the portion of house prices which reflect neighbourhood safety.

The main challenge with hedonic pricing, of course, is the limited range of non-market outcomes in which the value for the outcome can be identified in pricing information for the "parent" good or service. Hedonic pricing is also unable to capture non-use values (such as existence value) and will not reflect the value of a non-market outcome to someone who does not purchase the relevant "parent" good such as a visitor to a house. Beyond this, hedonic pricing also relies on strong assumptions around the existence of a competitive market so that the market price for the good or service in question can be assumed accurately reflects the implicit prices associated with different characteristics. Transaction costs to buying and selling or asymmetries in information between buyers and sellers will bias the estimated hedonic prices with respect to the underlying non-market values.

Wellbeing Valuation

The wellbeing valuation approach takes life satisfaction as a proxy measure for utility and then uses regression analysis to estimate the compensating or equivalent surplus of non-market outcomes. More specifically, the wellbeing valuation approach estimates the marginal wellbeing impact of both income and non-market outcomes from the coefficients in life satisfaction regressions and then directly compares these coefficients to calculate the marginal rate of substitution between the non-market outcome and equivalised household income. This method can be used to express the value of non-market outcomes, such as housing quality or physical health, in terms of household income, and therefore estimates a "shadow price" for non-market outcomes that reflects the compensating or equivalent surplus of the non-market outcome in question.

Early examples of wellbeing valuation include Oswald and Clark (2002), who use a simple linear regression model to extract the wellbeing values of unemployment and health among other non-market outcomes. The literature on wellbeing valuation was extended by Fujiwara (2013; 2014; 2018) to include better causal analysis of the income/life satisfaction relationship and thus a more robust income coefficient, which is crucial for the reliable estimation of compensating or equivalent surplus. Fujiwara's approach to estimating the wellbeing impact of non-market outcomes is known as the "three-stage" wellbeing valuation method and is discussed in greater detail in section 3 of this paper under methodology.

The benefits of using wellbeing valuation – as compared to other non-market valuation techniques – include fewer assumptions about peoples' understanding of causal processes[2], the ability to provide estimates for non-use values (i.e. the wellbeing gains and losses experienced by people other than the direct user of a good or service), and the relative ease of calculating values from existing data on life satisfaction (which lowers costs). Despite the differences in method, Dolan and Fujiwara (2012) show that estimates of non-market values calculated through wellbeing valuation and the contingent valuation provide similar estimates of compensating or equivalent surplus.

Evidence on the Income Coefficient

Wellbeing valuation is heavily dependent on the size of the income coefficient on life satisfaction, which describes the marginal impact of household income on the overall level of personal wellbeing (or the additional impact that $1 of household income will have on an individual's life satisfaction). As such, successful modelling of the relationship between income and life satisfaction is essential to obtaining realistic and unbiased results.

The existing literature largely agrees that the marginal relationship between income and wellbeing is non-linear with income having a diminishing impact on life satisfaction as income increases. This means, for example, that the impact of $1,000 on wellbeing will be larger for a low-income household than for a high-income household. It also means that the wellbeing impact of *losing* $1,000 (and falling to a lower income level, where income generates more wellbeing per dollar) is larger than the wellbeing impact of *gaining* $1,000 (and rising to a higher income level, where income generates less wellbeing per dollar). This relationship is usually modelled as a logarithmic relationship between income and life satisfaction (Deaton, 2008), a treatment which has a long tradition in welfare and inequality economics (such as Dalton, 1920).

The non-linear relationship between income and wellbeing is investigated by Layard, Nickell and Mayraz (2008), who not only confirm the existence of diminishing marginal wellbeing from income, but also find that this marginal relationship diminishes slightly faster than is seen in the log treatment of income. Stevenson and Wolfers (2008, 2013) also find support for the

[2] Unlike contingent valuation, for wellbeing valuation it is not necessary for respondents to understand how a particular non-market outcome affects their overall wellbeing for it to be possible to calculate a meaningful valuation. All that is required is that people are able to provide a valid response to a question about their overall life satisfaction.

diminishing marginal utility of income, although Grimes and Reinhardt (2015) note that these results have been critiqued on account of insufficient consideration of personal and country characteristics.

A key issue with any estimate of the income coefficient, however, is capturing the causal impact of income on subjective wellbeing rather than just the correlation between the two. True causal estimates are difficult to obtain as natural experiments that affect income and for which it is possible to measure subjective wellbeing are rare. Of particular importance for this study is that it is not generally possible to obtain a robust causal estimate of the impact of income on subjective wellbeing from cross-sectional surveys such as the NZGSS. While the regression analysis used here attempts to provide the best estimate possible with NZGSS data, it is useful to benchmark this against other studies with stronger identification strategies.

The findings from a range of key studies of the relationship between income and life satisfaction are summarised in table 2 below. These are organised into two groups: New Zealand studies and international studies. We normalise the income coefficients for each of these studies by a linear transformation in the final column of Table 2 for comparison purposes. The identification strategy column distinguishes between studies that estimate an income coefficient using a cross-sectional regression, as in Carver and Grimes (2016); an instrumental variable approach, as in Fujiwara (2013); a plausible natural experiment, as in Frijters et al. (2004); or a fixed-effects regression, as in Winkelmann et al. (2011). Given the constraints of the NZGSS, the approach to estimating the relationship between income and life satisfaction followed in this paper is necessarily based off a cross-sectional regression.

Table 2. Income coefficient estimate

Study	Country	Identification Strategy	Life Satisfaction Scale	Notes on Income Data	Original Income Coefficient	Normalised Income Coefficient
International Estimates						
Frijters et al. (2004)	Germany	Natural experiment	0 to 10	Equivalised post-tax monthly household income	0.855 (males) 0.717 (females)	0.86 0.72
Powdthavee (2010)	UK	Cross-sectional	1 to 7	Equivalised gross annual household income	0.105	0.17
Winkelmann, Oswald, and Powdthavee (2011)	Germany	Fixed effects	0 to 10	Equivalised gross annual household income	0.659	0.66
Fujiwara (2013)	UK	Lotto wins	1 to 7	Equivalised gross annual household income	1.103	1.73
Murtin et al. (2017)	OECD	Cross-country regression	0 to 10	Equivalised post-tax average annual household income by country	0.48	0.48
New Zealand Estimates						
Brown, Woolf, and Smith (2012)	**NZ**	Cross-sectional	1 to 5	Equivalised gross annual household income	0.16868	0.37
Carver and Grimes (2016)	**NZ**	Cross-sectional	1 to 5	Equivalised gross annual household income	0.2655	0.58
Jia and Smith (2016)	**NZ**	Cross-sectional	1 to 5	Equivalised gross annual household income	0.04	0.09
Davies (2018)	**NZ**	Cross-sectional	0 to 10	Equivalised gross annual household income	0.30	0.30

Evidence on the Value of Housing Outcomes

Yao and Kaval (2007) present a useful and thorough summary of New Zealand non-market valuations between 1974 and 2005, identifying 92 separate studies. Of these, the majority use contingent valuation (66%), or else some other hedonic or choice theory approach. The results of these studies focus mainly on recreation (53%), water resource improvements (25%), and other environmental outcomes such as pest control or land quality. A handful of contingent valuation studies have been carried out more recently within New Zealand that examine housing amenities – particularly warmth of the house. These are summarised below in table 3.

As discussed earlier, a willingness-to-pay survey was performed under the umbrella of He Kāinga Oranga's Housing, Heating and Health study, which found that the median willingness-to-pay for house heating ranges from $300 for low income households, to between $1,001-$2,000 for high income households (Chapman, 2006). Importantly, this result is consistent with the diminishing marginal utility of income, where higher income households with lower marginal values of income therefore need to "give up" or "pay" a larger amount in order to generate the same wellbeing effect as is caused by the non-market outcome.

The responses to the Housing, Heating and Health study have been more thoroughly examined by Vujcich (2008), who confirms the willingness-to-pay for heating solutions in low income households ($391 in 2005 and $681 in 2006); medium income households ($628 in 2005 and $1,257 in 2006); and high income households ($1,250 in 2005 and $1,815 in 2006). A useful extension by Vujcich is a comparison of willingness-to-pay according to housing tenure. Vujcich compares the willingness-to-pay for those who own their home, those who rent privately, and those who rent from Kāinga Ora (who comprised 59 of the total sample of 340). Homeowners have the highest wellbeing valuation of heating, between $851 and $1,287, while Kāinga Ora tenants have the lowest wellbeing valuation of heating, between $283 and $325 per year. In testing the differences between these means, Vujcich finds that the difference between the wellbeing values for homeowners and those for tenants is statistically significant.

Phillips and Scarpa (2010) later estimate the willingness-to-pay for warm homes in a survey of 768 Waikato homes, and find a different range in survey responses between owner-occupiers, landlords, and tenants, possibly reflecting differences in income levels between groups. In one example, Phillips and Scarpa find that the willingness-to-pay for heating ranges from $1,741-$3,739 per installation for owner-occupiers; $2,489-$2,771 per installation for landlords; and approximately $1.98 per week for renters.

Table 3. Selected valuations of wellbeing outcomes

Study	Country	Wellbeing Outcome	Valuation Method	Non-market value	Equivalent Q1:2019 NZD Non-market value
Chapman (2006)	NZ	In-house heating	WTP, 2005 NZD	$300 for low income $1,001-$2,000 for high income	$396 for low income $1,321-$2,639 for high income
Phillips and Scarpa (2010)	NZ	In-house heating	WTP, 2010 NZD?	$1,741-$3,739 for owner-occupiers $2,489-$2,771 for landlords $1.98/week ($102/year) for renters	$1,996-$4,287 for owner-occupiers $2,854-$3,177 for landlords $2.27/week ($118/year) for renters
Vujcich (2008)	NZ	In-house heating	WTP, 2005 NZD	$391 for low income $628 for medium income $1,250 for high income $283-$325 for Kāinga Ora tenants	$516 for low income $829 for medium income $1,649 for high income $373-$429 for Kāinga Ora tenants

3. METHODOLOGY

This section describes the wellbeing valuation approach in general terms and details how we have adapted the approach for New Zealand data. The first part of the section outlines wellbeing valuation in general. We then discuss Fujiwara's (2013) three-stage wellbeing valuation which we use as the basis for the values calculated in this paper. The paper also discusses the issue of shared method variance (Schimmack, Schupp, and Wagner, 2008; OECD, 2013) which has the potential to bias the coefficients on subjectively measured outcomes in life satisfaction regressions and outline a strategy for minimising the impact of this issue on the values estimated using the NZGSS.

Wellbeing Valuation

The wellbeing valuation method estimates the compensating or equivalent surplus of wellbeing outcomes by calculating the portion of household income that would lead to the same impact on subjective wellbeing as the change in the non-market outcome in question. For example, if an improvement in physical health caused a respondent's subjective wellbeing to increase by one point, then we can obtain an estimate of the compensating or equivalent surplus of the respondent's change in wellbeing by calculating the change in household income required to increase subjective wellbeing by one point. This amount of income is the highest "price" that the respondent would be willing to pay in order to experience this higher level of physical health, and therefore expresses a monetary equivalent of the compensating or equivalent surplus associated with the change physical health.

At its simplest level wellbeing valuation requires a regression with a measure of subjective wellbeing – such as life satisfaction – as the dependent variable, and household income, demographic variables, and non-market outcomes of interest as the explanatory variables. The marginal relationship between life satisfaction and household income is identified (the income coefficient), along with the marginal relationship between life satisfaction and the non-market outcome that is being evaluated. These coefficients are then transformed to find the equivalent size of household income that would cause the same wellbeing impact as the non-market outcome.

Life satisfaction is typically used as the wellbeing measure for these types of analysis (OECD, 2013), although some studies have used items from the General Health Questionnaire (GHQ) or other measures of mental state to describe overall wellbeing (e.g. Gardner and Oswald, 2007). A key assumption underpinning this approach is that the dependent wellbeing variable can be treated as cardinal and interpersonally comparable insofar as that self-reported wellbeing by one respondent can be usefully compared to the self-reported wellbeing of another.

Sandvik, Diener, and Seidlitz (1997) find a high correlation between self-reported levels of happiness and the level of happiness for the same individual as suggested by third parties who have observed a report of the individual, suggesting that life satisfaction exhibits a relatively monotonic transformation, and that self-reported life satisfaction can reasonably be used as a proxy measure for "true" utility. Ferrer-i-Carbonell and Frijters (2004) test the impact of treating life satisfaction data as cardinal and as ordinal in regression analyses and find no important effects. This is commonly taken as evidence that life satisfaction data can be used as if it were cardinal[3].

[3] Recent work by Bond and Lang (2018) showing that many regression relationships in life satisfaction regressions do not hold or can be reversed by applying a log-normal transformation to the life satisfaction data have been argued to undermine the view that life satisfaction can be treated "as if" it were cardinal. Kaiser and Vendrik (2019) plausibly argue that the proposed transformations imply that respondents

Two-Stage Wellbeing Valuation

The modern application of wellbeing valuation begins with Clark and Oswald (2002) in a model that uses a measure of mental strain and also a measure of overall happiness as proxies for overall wellbeing. In this model, where γ is the income coefficient in a linear regression on wellbeing and β_i is the coefficient on a binary non-market outcome, the compensating or equivalent surplus of an outcome is calculated using:

$$CS/ES = \frac{\beta_i}{\gamma}$$

Using this method, Clark and Oswald estimate values for unemployment, marital status, and health status. We colloquially refer to this method as "two-stage" wellbeing valuation due to the contrast with later work by Fujiwara, who uses "three-stages" to estimate compensating or equivalent surplus for non-market outcomes. The two stages here refer to the first stage of a single regression of wellbeing against income and other non-market outcomes, and the second stage of comparing the coefficients to derive compensating or equivalent surplus.

Three-Stage Wellbeing Valuation

The single-regression wellbeing valuation technique demonstrated by Clark and Oswald (2002) has been extended into a "three-stage" approach by Fujiwara (2013; 2014; 2018). Fujiwara approaches this by modelling the relationship between income and the non-market outcome of interest in three stages:

1. Lottery wins are used as an instrument to identify the causal impact of income changes on life satisfaction in a reduced form model that accounts for not only income changes and demographics, but also an estimate of the bias on the income coefficient due to endogeneity and any bias due to heterogeneity in the population with respect to the income coefficient;
2. The linear relationship between wellbeing and non-market outcomes is estimated using an expanded model (including household income and demographic variables as well as non-market outcomes); and,
3. The ratio of the income coefficient from model (1) and the non-market outcomes from model (2) is used to estimate the compensating or equivalent surplus of these outcomes.

For this paper we adopt Fujiwara's general approach but adapt it to the NZGSS which is a cross-sectional survey and does not collect lottery wins.

We estimate a reduced form income model, $f(M)$, in the first stage of our wellbeing valuation approach:

$$f(M) = LS_i = \alpha + \beta_1 \ln(M_i) + \beta_2 X + \varepsilon$$

where LS_i denotes life satisfaction; β_1 is the income coefficient; $\ln(M_i)$ is logged household income; X is a vector of demographic control variables; α is a constant; and ε is the error term.

We then estimate an expanded model that includes non-market outcomes, $g(M, Q)$, given by:

$$g(M, Q) = LS_i = \alpha + \beta_1 \ln(M_i) + \beta_2 X + \beta_3 Q_i + \varepsilon$$

where $Q_i$is the non-market outcome for which we are estimating compensating or equivalent surplus, and β_3 is the coefficient that corresponds to the relationship between this outcome and the dependent wellbeing variable, life satisfaction. Departing from Fujiwara, we also estimate several intermediate models that exclude certain non-market outcomes when estimating the full wellbeing model. This, as we later explain, is intended to help identify the degree to which the

answer subjective wellbeing questions in a way that is contradicted by previous empirical research and we follow their view that Bond and Lang's evidence provides little justification for scepticism of subjective wellbeing data.

coefficients on some non-market outcomes are potentially biased due to shared method variance and because the estimated values are likely to be used in a context where the partial impact of the outcome on wellbeing is more appropriate than the full impact.

Finally, following Fujiwara's third-stage transformation, we estimate the compensating (CS) or equivalent (ES) surplus of each non-market outcome using compensating surplus for welfare gains, and equivalent surplus for welfare losses, as this yields the most conservative estimate for each outcome. In the case of a welfare gain this is calculated using:

$$CS = M^0 - e^{\left[\ln(M^o) - \frac{g'_Q}{f'_M}\right]}$$

and in the case of a welfare loss:

$$ES = M^0 - e^{\left[\frac{g'_Q}{f'_M} + \ln(M^o)\right]}$$

where M^0 is median income, f'_M is the marginal wellbeing value of income, and g'_Q is the marginal wellbeing value of the non-market outcome.

Shared Method Variance

For survey data such as NZGSS, it is not uncommon for subjective measures such as mental health or loneliness to correlate with each other through the shared impact of individual factors such as personality as well as through causal relationships. Shared personality characteristics such as optimism or pessimism encourages respondents to answer subjective questions in a similar way regardless of substantive content. More formally this is known as shared method variance (Schimmack, Schupp and Wagner, 2008; OECD, 2013). If panel data is available (as in Winkelmann et al., 2011) a regression can overcome this concern using fixed effects[4] but this is not possible with the NZGSS which is cross-sectional in design.

Instead, we propose to manage shared variance in our analysis by progressively adding "categories" of variables, with the "least" subjective measures considered first, and the "most" subjective measures considered last. More specifically, we consider four variations on the wellbeing regression in order to tease out meaningful results, by sequentially adding:

1. Objective variables
2. Physical health (and not mental health)
3. Mental health (and not physical health)
4. Other subjective variables

This approach does not allow us to eliminate any bias due to shared method variance but it does allow us to potentially observe its impact by comparing the coefficients in the full model (4), which includes subjective variables, to those in prior models. For example, a comparison of models (2) and (3) will allow us to more closely identify the impact of adding a variable very closely associated conceptually with subjective wellbeing (mental health) on the size of the coefficients on housing condition or housing coldness. This, in turn, allows us to examine the compensating or equivalent surplus that is generated by housing conditions and attribute some portion of the value to the correlation between housing condition and physical health.

[4] Winkelmann et al. (2011) find that including fixed effects does change the magnitude and significance of a number of coefficients.

4. DATA

This section of the paper describes the data used as the basis for calculating compensating or equivalent surplus. After providing a brief outline of the NZGSS, we provide a detailed description of the treatment of household income in the analysis. This reflects the importance of the income coefficient on life satisfaction for the size of the estimates of compensating or equivalent surplus. Attention is also given to the identification of Kāinga Ora tenants in the IDI as they form one of the key focal groups for which values are to be estimated.

The New Zealand General Social Survey

The data used to estimate compensating or equivalent surplus in this paper draws from the 2014 and 2016 waves of the NZGSS. The New Zealand General Social Survey (NZGSS) collects responses from approximately 8,500 New Zealanders every two years on a range of different wellbeing measures including housing, socio-economic status, and outcomes related to culture, social contact, health and security. After dropping respondents who did not respond to questions on life satisfaction or household income (which are essential for wellbeing valuation), the usable sample size for both waves combined is 17,178 respondents.

The survey was accessed through the Integrated Data Infrastructure (IDI), which collates a number of survey and administrative datasets and allows researchers to conduct analysis using individual microdata in a safe environment that preserves the confidentiality of respondents and prevents any individuals being identified

Household Income

An unbiased measure of household income is essential to estimate a meaningful income coefficient for the calculation of compensating or equivalent surplus. The household income measure within the NZGSS is calculated by the sum of self-reported personal income of all individuals within a single household. To minimise respondent burden the NZGSS collects household income in broad bands. We have converted each of these bands to the “mid-point” (for example, a household that earns between $40,001 and $50,000 is converted to a nominal income of $45,000), while the respondents who have indicated upper income band (which specifies that household income could be “greater than $150,000”) are assigned an annual household income of $150,000. Households with zero or negative income are dropped.

We equivalise unadjusted NZGSS measure of household income using the square root of household size to account for the impact of household economies in consumption as household size increases. The equivalisation also increase the number of household income values in the dataset compared to the original number of income bands. We also adjust household income for inflation according to the quarter in which the survey took place to equivalent quarter 1 (Q1) 2019 New Zealand dollars.

Household Income: Turning Point Analysis

Income data from surveys such as the NZGSS is subject to reporting error, and this is particularly severe for low reported incomes. The NZGSS includes a considerable number of individuals who report low or no household income for the year and yet have reasonably good outcomes when indicators of consumption are examined. This finding is not unusual (e.g. Perry, 2019), and reflects that, below a certain point, reported survey income may not be a credible measure of resources available for consumption. The gap between reported low incomes and actual consumption may represent self-employed people reporting a net loss for the year, people whose income is effectively disguised through trusts or the like, or simple under-reporting. If our model were to include respondents with implausibly low income, these individuals (who have higher life satisfaction than would normally be implied by a low level of household income) would introduce

a downward bias to the income coefficient.

To test the relationship between low levels of household income and life satisfaction we perform a turning point analysis by regressing logged household income and logged household income squared along with demographic controls on life satisfaction. This regression is restricted to the lowest quartile of household income (less than $24,000 per year), and identifies the "U-shape" between household income and life satisfaction with a turning point at $9,999 (i.e. at or below a household income of $9,999 a decrease in income is associated with an increase in life satisfaction while above $9,999 the reverse is true).[5]

Carver and Grimes (2016) provide supporting evidence for the existence of a turning point by identifying this "U-shape" in a graph of average household income against life satisfaction. In this study, the turning point visually corresponds to a household income of $8,103 (or, $8,756 when adjusted to Q1:2019 dollars) which is similar to the turning point calculated here.

Given the issues identified with low reported household incomes in the NZGSS we exclude the 378 respondents who have an equivalised household income of $9,999 or less from the dataset. In doing so, the total sample group for the New Zealand general population group is reduced from 17,178 to 16,800 individuals.

Kāinga Ora Sample Groups

In order to calculate the compensating or equivalent surplus of non-market outcomes for Kāinga Ora tenants we must reliably identify Kāinga Ora tenants within the NZGSS. Previous work (Davies, 2018) used a self-identification question from the NZGSS where respondents could identify their landlord as Kāinga Ora. However, this question has the potential to misidentify respondents who are either not aware of their actual landlord because they are not the leaseholder themselves or who conflate Kāinga Ora housing with social housing in general.

In order to circumvent this issue, we use a unique identification code (at both the individual and household level) to match respondents from the NZGSS against individuals from the monthly database of Kāinga Ora tenants inside the IDI.[6] This method reveals that, of the 717 respondents who self-selected Kāinga Ora as their landlord in the NZGSS survey, 168 had incorrectly indicated that they were Kāinga Ora tenants. In addition, there were 48 respondents who were identified as Kāinga Ora tenants in the administrative data but did not identify themselves as such in the NZGSS.

In addition to the first group of tenants who self-reported Kāinga Ora tenancy (group 1) and the group of tenants who were identified through matching in the IDI (group 2), we also look at NZGSS respondents who appear in the Kāinga Ora database within six months of their NZGSS interview date (group 3). Group 3 captures tenants who may have entered Kāinga Ora tenancy soon after taking the NZGSS interview as well as tenants who undertook the NZGSS interview within six months of leaving a Kāinga Ora residence. This group comprises 657 individuals and is the sample group that is used to represent the Kāinga Ora population during the subsequent analysis.

A comparison of demographic characteristics for the three potential subgroups of Kāinga Ora tenants (table 4 below) reveals that while there is some difference between group 1 and group 2, there is little difference between group 2 and group 3. In the following regressions we therefore use the third group of Kāinga Ora tenants, which includes "proximity" tenants who entered or exited Kāinga Ora tenancy within 6 months of their NZGSS survey. This increases the sample size and the fit of the regressions compared to the smaller group 2.

Table 4 also allows for a comparison of the NZGSS total population with Kāinga Ora tenants.

[5] The p-values are p = 0.09 for income and p = 0.01 for income squared. The full regression can be found in appendix one.

[6] Please note that the sample group sizes here have been randomly rounded to the nearest multiple of 3, in line with confidentiality requirements in the IDI environment.

Compared to the NZGSS general population group, Kāinga Ora tenants generally have a lower self-reported life satisfaction score, a lower equivalised level of household income, and are more likely to be female. Table 4 also suggests that Kāinga Ora tenants have higher average household sizes, are more likely to report Maori and Pacific ethnicities, and are less likely than the NZGSS general population to have continued their education beyond high school.

Table 4. Descriptive statistics for social housing tenant groups

Variables		**(Group 1) Self-Reported NZGSS Tenants** (n = 717)	**(Group 2) Kāinga Ora current Tenants** (n = 597)	**(Group 3) Kāinga Ora Proximity Tenants** (n = 657)	**NZGSS General Population** (n = 16,800)
Life Satisfaction (0-10 Scale)		7.045 (6.87-7.21)	7.08 (6.9-7.3)	7.09 (6.92-7.27)	7.73 (7.71-7.76)
Normalised Household Income		$24,757 ($23,716-$25,797)	$24,825 ($23,682-$26,022)	$26,201 ($24,932-$27,470)	$51,335 ($50,898-$51,772)
Male		37% (0.34-0.4)	36% (0.32-0.4)	36% (0.33-0.4)	46% (0.45-0.47)
Age in Years		46.3 (45-47.7)	47.12 (45.6-48.59)	46.8 (45.4-48.2)	49.42 (49.13-49.7)
Household Size		2.9 (2.7-3.0)	2.74 (2.59-2.88)	2.78 (2.63-2.92)	2.56 (2.54-2.58)
Ethnicity	European	43% (0.39-0.47)	45% (0.41-0.49)	45% (0.42-0.49)	77% (0.76-0.77)
	Maori	32% (0.29-0.35)	34% (0.3-0.38)	31% (0.30-0.37)	14% (0.13-0.14)
	Pacific	28% (0.25-0.32)	24% (0.2-0.27)	24% (0.20-0.27)	6% (0.05-0.06)
	Asian	5% (0.03-0.06)	5% (0.04-0.07)	6% (0.04-0.07)	9% (0.09-0.09)
	MELAA	s	s	s	1% (0.01-0.01)
	Other	s	s	s	2% (0.02-0.02)
Highest Education	High School	35% (0.32-0.39)	35% (0.31-0.38)	37% (0.3-0.37)	30% (0.30-0.30)
	Certificate	16% (0.14-0.19)	17% (0.14-0.2)	17% (0.14-0.20)	25% (0.24-0.26)
	Bachelor's Degree	s	s	s	12% (0.12-0.13)
	Post-Graduate Degree	s	s	s	10% (0.09-0.10)

Means are rounded to 2 d.p. with 95% confidence intervals in parentheses; values that relate to a group of less than 20 individuals have been suppressed for confidentiality.

5. RESULTS

This section reports the key results of the analysis. More specifically, it outlines the derivation of the income coefficient, the identification of the coefficients for the different wellbeing outcomes, and finally the estimates for compensating or equivalent surplus. Our income coefficients, both for the general population and for the Kāinga Ora tenant population, are within the plausible range of results from previous studies that consider the New Zealand context and are not out of line with international estimates. The estimates of coefficients for non-market outcomes are plausible for the general NZGSS population but the small sample size for the Kāinga Ora proximity group combined with relatively little variation in outcomes within this sub-sample means that the coefficients for this group are less reliable.

Income Coefficient

Table 5 compares the income coefficients from four potential specifications of the income model. The full regressions include a full range of demographic control variables and can be found in appendix three.

Table 5. NZGSS income coefficient estimates

Dependent Variable: Life satisfaction	**General Population Income Model**			**Kāinga Ora Proximity Income Model**
	Ordinary Least Squares	Unfiltered Household Income	Robust Standard Errors	Robust Standard Errors
	Adj. R^2 = 0.054	Adj. R^2 = 0.061	Adj. R^2 = 0.061	Adj. R^2 = 0.094
Logged Normalised Household Income	0.5674*** (0.02453)	0.4106*** (0.023)	0.4593*** (0.02518)	0.5006*** (0.1688)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*				

There are two alternative models outlined here which are included only for comparison purposes: a model with normal standard errors (Ordinary Least Squares), and a model that does not filter incomes below the statistically significant turning point of $9,999 annual household income (Unfiltered Household Income).

The Ordinary Least Squares income model has a lower adjusted R^2 score than alternative income models and also tested positive for heteroskedasticity. All subsequent models therefore employ robust standard errors with a Generalised Methods of Movements (GMM) regression approach. The unfiltered household income model includes responses with an equivalised household income of $9,999 or less but all other models do not. This model has the lowest coefficient of all those tested, consistent with the view that the inclusion of these households will bias the income coefficient downwards.

A brief comparison of our income coefficients against the income coefficients of other studies identified in the literature review (refer to table 3) shows that our income coefficient is relatively high compared to the coefficients from other cross-sectional analyses (e.g. Brown, Woolf, and Smith, Jia and Smith, Davies, and Pawdthavee) and is broadly similar to the coefficient from Carver and Grimes, and Murtin et al. However, the coefficient is significantly lower than those co-efficients with a strong causal identification including Fujiwara, Winkelmann et al, and Frijters et al.

We use two income coefficients in our subsequent estimates of the compensating surplus for wellbeing outcomes. These are Fujiwara (2013) which has a strong identification strategy and also provides an upper limit for credible estimates of the income coefficient. We supplement this with our own estimate for the Kāinga Ora proximity population cited above in table 5 as this draws on New Zealand data and provide a meaningful lower credible limit on the size of the income

coefficient. It is also relatively close to the estimate from Carver and Grimes (2016).

The decision to use two coefficients is a deliberate one as it presents estimates of the compensating or equivalent surplus as a range of plausible values rather than a misleadingly precise point estimate. Given the inevitable uncertainty associated with estimating values for non-market outcomes, providing a range within which the true value is likely to lie is more transparent and robust than identifying a single estimate of value.

Non-market Outcome Coefficients

The following section presents coefficients for non-market outcomes from four successive models:

1. an objective model, which only considers housing and other objective variables where personality or other shared effects are unlikely to strongly influence responses;
2. a physical health model, which introduces a physical health variable to model 1;
3. a mental health model similar to model 2 but which replaces physical health with a measure of mental health; and
4. a subjective model, which includes both health measures along with a small range of subjectively measured variables relating to other non-market outcomes of interest.

These four models are repeated for the total NZGSS sample (NZGSS General Population) and for the Kāinga Ora Proximity Group. The key results of each of these models is outlined in tables 6 and 7 below. The complete regressions include demographic controls alongside logged household income and can be found in appendix three.

NZGSS General Population

Table 6 outlines the four non-market outcome regressions for the NZGSS general population. The subjective model, as the most complete model with the largest variety of variables, has an adjusted R^2 value of 0.367, which is relatively high compared to other similar models (e.g. Brown, Woolf, and Smith, 2012).

Table 6. NZGSS general population regression results

Dependent Variable: Life satisfaction		**NZGSS General Population (n = 16,800)**			
		Objective Model	**Physical Health Model**	**Mental Health Model**	**Subjective Model**
		Adj. R^2 = 0.144	Adj. R^2 = 0.152	Adj. R^2 = 0.343	Adj. R^2 = 0.367
Unemployed		-0.4926*** (0.0906)	-0.509*** (0.0904)	-0.3196*** (0.0772)	-0.3019*** (0.07665)
Good Condition	House Condition: Minor Problems	-0.1498*** (0.02928)	-0.146*** (0.0292)	-0.0678** (0.0265)	-0.06151** (0.02604)
	House Condition: Some Problems	-0.29*** (0.03557)	-0.2762*** (0.0355)	-0.1577*** (0.0319)	-0.1356*** (0.03137)
	House Condition: Very Bad/Extreme Problems	-0.5054*** (0.0646)	-0.4792*** (0.0641)	-0.2989*** (0.0557)	-0.2584*** (0.054668)
No Mould	House Mould: Some	-0.1494*** (0.03217)	-0.138*** (0.0321)	-0.0712** (0.0288)	-0.04739* (0.02845)
	House Mould: Very Bad	-0.2369*** (0.07557)	-0.225*** (0.0756)	-0.0898 (0.06624)	-0.05621 (0.06496)
No Cold	House Cold: Sometimes	-0.255*** (0.02954)	-0.243*** (0.02946)	-0.167*** (0.0264)	-0.1493*** (0.02601)
	House Cold: Often/Always	-0.4017*** (0.04036)	-0.385*** (0.0402)	-0.253*** (0.0363)	-0.2078*** (0.03561)
Household is Crowded		-0.04937 (0.04036)	-0.0603 (0.103)	0.029 (0.087)	0.03318 (0.08685)
Household is Crowded: Maori and Pacific Interaction		0.3361** (0.1489)	0.343** (0.149)	0.165 (0.129)	0.1322 (0.1277)
Victim of Discrimination		-0.409*** (0.038)	-0.387*** (0.0379)	-0.143*** (0.0335)	-0.04866 (0.03316)
Victim of a Crime		-0.2002*** (0.03944)	-0.193*** (0.0393)	-0.0959*** (0.0344)	-0.07508** (0.03367)
Member of a Religious Group		0.226*** (0.0331)	0.2271*** (0.0331)	0.212*** (0.0298)	0.2205*** (0.02944)
Member of a Volunteering Group		0.1474*** (0.03007)	0.1299*** (0.0299)	0.102*** (0.0269)	0.07844*** (0.02645)
Physical Health (0-100 Scale)			0.01613*** (0.00155)		0.01285*** (0.001376)
Mental Health (0-100 Scale)				0.0777*** (0.0015)	0.06878*** (0.001565)
Drugs or Alcohol Problem in Neighbourhood					-0.0994*** (0.02988)
Cultural Expression (0-5 Scale)					0.2075*** (0.01711)
Lonely (0-5 Scale)					-0.1626*** (0.0144)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*					

The coefficients in this table largely show the expected signs, including the consistent negative impact of poor housing outcomes (poor condition of the house, mouldiness of the house, cold) as well as unemployment, the experience of discrimination and crime, loneliness, and neighbourhood drug or alcohol problems. Volunteering, membership in a religious group, better physical and mental health, and the ability to express one's culture all have the expected positive relationship with life satisfaction.

Out of the housing outcomes, crowding alone is not significant in any of the models. However, an interaction term between household crowding and Maori or Pacific ethnicity is significant in the objective and physical health models. This coefficient drops in size and loses significance when mental health is added to the model, suggesting that the presence of whānau or family members in the household may have an important impact on the wellbeing of Maori or Pacifica respondents.

The addition of physical health to the objective model does not result in statistically different coefficients for housing outcomes (i.e. the coefficients of the physical health model are well within the standard deviations of the coefficients of the objective model). However, the addition of mental health to the objective model *does* result in a statistically significant shift in many coefficients for housing outcomes. This means that it is necessary to make a decision about whether to use the coefficient from the subjective model or a more restricted model.

In the value calculations we use the coefficient from the first model in which the variable is introduced (i.e. for unemployment or housing outcomes we use the coefficient from the objective model, but for mental health we use the coefficient from the mental health model). This approach aims to account for (although it cannot eliminate) the impact of shared method variance on relative coefficient sizes. We do not use a reduced form model for the more subjective variables (mental health and those added in the subjective model) as this will exacerbate the impact of shared method variance.

NZGSS Kāinga Ora Proximity Group

Table 7 outlines the four successive non-market outcome regressions for the NZGSS Kāinga Ora proximity group**.** The subjective model, is the most complete model with the largest variety of variables and has an adjusted R^2 value of 0.364, which is similar to that for the general population model in table 6.

Table 7. NZGSS Kāinga Ora proximity group regressions

Dependent Variable: Life satisfaction		**NZGSS Kāinga Ora Proximity Group (n = 657)**			
		Objective Model	**Physical Health Model**	**Mental Health Model**	**Subjective Model**
		Adj. R^2 = 0.149	Adj. R^2 = 0.146	Adj. R^2 = 0.346	Adj. R^2 = 0.364
Unemployed		-0.353 (0.377)	-0.3654 (0.379)	-0.207 (0.3433)	-0.2522 (0.335)
Good Condition	House Condition: Minor Problems	-0.323 (0.2337)	-0.3225 (0.2335)	-0.153 (0.207)	-0.1145 (0.2056)
	House Condition: Some Problems	-0.3006 (0.229)	-0.2998 (0.2293)	-0.1311 (0.207)	-0.093 (0.2024)
	House Condition: Very Bad/Extreme Problems	-0.589 (0.3745)	-0.5702 (0.377)	-0.4824 (0.3177)	-0.44088 (0.3049)
None	House Mould: Some	-0.0203 (0.1993)	-0.019 (0.1987)	-0.001 (0.172)	-0.0216 (0.1724)
	House Mould: Very Bad	0.4811* (0.289)	0.4742 (0.2899)	0.5826** (0.2577)	0.5893** (0.2618)
No Cold	House Cold: Sometimes	-0.5946*** (0.2248)	-0.5859*** (0.2252)	-0.4315** (0.2029)	-0.4147** (0.2007)
	House Cold: Often/Always	-0.6266*** (0.2262)	-0.62176*** (0.2257)	-0.408** (0.2002)	-0.3413* (0.2048)
Household is Crowded		-0.5163 (0.3984)	-0.5242 (0.4023)	-0.3907 (0.318)	-0.4497 (0.339)
Household is Crowded: Maori and Pacific Interaction		0.8177* (0.4883)	0.8304* (0.4925)	0.5302 (0.3957)	0.5331 (0.417)
Victim of Discrimination		-0.5163** (0.2388)	-0.5084** (0.2398)	-0.1952 (0.1948)	-0.12 (0.193)
Victim of a Crime		-0.4915* (0.2635)	-0.4943* (0.2632)	-0.2051 (0.2218)	-0.149 (0.231)
Member of a Religious Group		0.3868* (0.2139)	0.3809* (0.2143)	0.2244 (0.1924)	0.2153 (0.192)
Member of a Volunteering Group		0.4338 (0.264)	0.4105 (0.2638)	0.342 (0.2287)	0.3588 (0.229)
Physical Health (0-100 Scale)			0.0045 (0.0084)		0.0016 (0.0067)
Mental Health (0-100 Scale)				0.0751*** (0.0065)	0.0671*** (0.007)
Drugs or Alcohol Problem in Neighbourhood					-0.1709 (0.1708)
Cultural Expression (0-5 Scale)					0.2926*** (0.100)
Lonely (0-5 Scale)					-0.1138 (0.0876)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*					

While the signs and magnitudes of the coefficients in table 8 are largely plausible, only a small proportion of them are significant. This reflects the fact that the Kāinga Ora group is both much smaller than the NZGSS general population and that there is much less variation in outcomes within the group. In particular, the drop off in significance for the mental health and subjective models suggests that these may be over-specified (i.e. the model includes too many explanatory variables relative to the amount of variation in circumstances among people in the sample group).

There is one obvious exception to this general pattern, which is the large positive coefficient on very bad household mould. This coefficient is also one of the few that are statistically significant ($p<0.05$) but is clearly counter-intuitive and conflicts with both the wider literature and the results from the general population (table 6). Given the number of coefficients tested in the subjective model (19), the small sample size of the Kāinga Ora proximity group, and the likelihood of significant multicollinearity[7] between household cold and mould, we choose to treat this coefficient as a false positive.

Taking these limitations into account, there are still a number of observations that can be made about the coefficients in table 7. First, the absolute magnitude of the coefficients associated with poor housing outcomes is larger for people in the Kāinga Ora proximity group than is the case for the general population. This implies that the value of improvements in housing outcomes for this group will tend to be larger than for the general population. Also, although not significant, the impact of crowding is consistently negative in all specifications of the model for the Kāinga Ora proximity group. Crime and discrimination are also both (marginally) significant for this group and with much larger coefficients than for the general population.

Wellbeing Valuation

To complete our wellbeing valuation analysis, we incorporate the income coefficients from table 5 and the outcome coefficients from tables 6 and 7 into the valuation calculation discussed in the methodology section of this report. We calculate values both for the general population and for the Kāinga Ora proximity group. However, for both sets of values, we use the median income of the Kāinga Ora proximity group ($26,200) as our reference income. Because of the diminishing marginal utility of income, a given change in income will generate a greater impact on wellbeing at the lower end of the income distribution. This means that a higher reference income will inflate values for non-market outcomes because at a higher reference income than at a lower one, more income is required to generate an equivalent change in wellbeing to that caused by the non-market outcome in question.

For an individual making an investment decision for themselves the correct reference income is their own income as this represents the opportunity cost of investing money as opposed to using it for another purpose. However, for government, the opportunity cost of providing a housing service to someone in the general population is not necessarily providing that person with income but could rather be providing income to the group in the population with the highest need. For this reason we use the median income of the Kāinga Ora proximity group as the reference income for all compensating or equivalent surplus calculations.

The following valuations should be interpreted as the compensating surplus for each welfare improving non-market outcome, which is the portion of household income that an individual would be willing to forego in exchange for the outcome in question, and the equivalent surplus for each welfare reducing non-market outcome, which is the portion of household income that an individual would need to receive to be rendered willing to adopt the outcome in question. This measure of compensating or equivalent surplus is directly comparable to values calculated through willingness to pay or similar approaches, including the “value of statistical life” currently used in the New Zealand Treasury CBAx cost-benefit tool.

Note that these valuations are measures of *compensating and equivalent surplus*, and not of the net fiscal cost of each activity. These valuations do not calculate the money flows associated with each outcome. Rather, the valuations reflect the value of one year of wellbeing impact to each respondent, as measured in Q1:2019 equivalent New Zealand dollars.

For robustness, we present our results using Fujiwara’s (2013) income coefficient of 1.73 for a “low” estimate of compensating or equivalent surplus, as well our own Kāinga Ora income

[7] Multicollinearity is when two explanatory variables in a regression are correlated with each other in a linear fashion. This has the effect that one or both of the estimated coefficients on the explanatory variables will be inaccurate.

coefficient of 0.5006 for a "high" estimate of compensating or equivalent surplus. Using this coefficient allows us to suggest a range of plausible estimates of compensating or equivalent surplus. We select each wellbeing outcome coefficient from the left-most column in tables 6 and 7 where each outcome appears.

Table 8 below presents estimates of the compensating or equivalent surplus associated with different housing outcomes. Estimates based on coefficients from the Kāinga Ora proximity group have been reported even where these are not significant for comparison purposes. Although the standard error for these coefficients is high and these values should be treated with caution, it is of interest that the values for the Kāinga Ora proximity group across all housing condition and cold outcomes are higher than those for the general population. Values have been rounded to the nearest dollar in all cases.

Table 8. NZGSS Wellbeing Valuation for Housing Outcomes

Wellbeing outcomes		**Wellbeing Valuation: Housing Outcomes for Kāinga Ora Tenants**			
		NZGSS General Population Coefficients (M^0 = $26,200)		**NZGSS Kāinga Ora Tenant Proximity Group Coefficients (M^0 = $26,200)**	
		Fujiwara Estimate	Smith and Davies Estimate	Fujiwara Estimate	Smith and Davies Estimate
Good Condition	House Condition: Minor Problems	-$2,173	-$6,776	(-$4,462)	(-$12,458)
	House Condition: Some Problems	-$4,044	-$11,521	(-$4,180)	(-$11,830)
	House Condition: Very Bad/Extreme Problems	-$6,638	-$16,654	(-$7,561)	(-$18,123)
None	House Mould: Some	-$2,164	-$6,749	(-$306)	(-$1,041)
	House Mould: Very Bad	-$3,353	-$9,878	-	-
No Cold	House Cold: Sometimes	-$3,591	-$10,458	-$7,621	-$18,213
	House Cold: Often/Always	-$5,429	-$14,457	-$7,961	-$18,707

Valuations in parentheses are not statistically significant.

M_0 is the reference income at which values are calculated.

Positive values are compensating surplus, negative values are equivalent surplus.

A key result in our estimates of compensating or equivalent surplus for housing outcomes is that the impact of housing condition, mouldiness, and coldness outcomes is non-linear. This was not addressed in the earlier wellbeing valuation work of Davies (2018) which estimates the compensating or equivalent surplus of a house in poor condition as -$4,700 for each one-point decline in housing condition over a 0-4 scale. Here, however, we find that for a person from the general population (evaluated using the median income and income coefficient of a Kāinga Ora tenant), the compensating or equivalent surplus of a house in poor condition is a maximum of $6,776 in the case of minor problems, an additional -$4,745 in the case of some problems (-$11,521 total), and an additional -$5,133 on top of this (-$16,654 total) in the case of very bad or extreme problems (which combines the two worst levels of housing condition due to the small

number of respondents who reported an "extremely bad" condition).

We similarly find that the compensating or equivalent surplus of cold housing is non-linear, with a maximum estimated compensating or equivalent surplus of -$10,458 for a house that is sometimes cold and an additional impact of -$3,999 if the house is often or always cold, as compared to the original linear estimate of -$5,220 for each one-point decline over a 0-3 scale as in Davies (2018).

No wellbeing values are provided in table 8 for the impact of very bad mould. This is because the estimate for this group shows a large positive compensating or equivalent surplus associated with "very bad" mould. This conflicts with common sense and with the results for the general population and is likely due to an omitted variable bias or multicollinearity with other housing outcomes. The potential impact of an omitted or correlated variable is more pronounced for the Kāinga Ora population than for the general population on account of the smaller sample size.

Table 9 reports values for non-market outcomes not directly related to housing. The values reported in this table are subject to greater measurement error than those in table 8 as some outcomes – such as mental health and loneliness – are subjective themselves and therefore the coefficients for these variables will be inflated due to the impact of shared method variance (i.e. the error terms for both life satisfaction and mental health loneliness are correlated with each other due to the impact of personality on response styles).

Table 9. NZGSS Wellbeing Valuation for Non-Housing Outcomes

Wellbeing outcomes	**Wellbeing Valuation: Other Outcomes for Kāinga Ora Tenants**			
	NZGSS General Population Coefficients (M^0 = $26,200)		**NZGSS Kāinga Ora Tenant Proximity Group Coefficients (M^0 = $26,200)**	
	Fujiwara Estimate	Smith and Davies Estimate	Fujiwara Estimate	Smith and Davies Estimate
Unemployment	-$6,493	-$16,407	-$4,837	-$13,258
Victim of Discrimination	-$5,517	-$14,627	-$6,761	-$16,860
Victim of a Crime	-$2,863	-$8,637	-$6,480	-$16,386
Member of a Volunteering Group	$2,140	$6,683	($5,250)	($15,186)
Physical Health (0-100 Scale)	$243	$831	($68)	($235)
Mental Health (0-100 Scale)	$1,151	$3,767	$1,113	$3,650
Drugs or Alcohol Problem in Neighbourhood	-$1,463	-$4,719	(-$2,465)	(-$7,579)
Cultural Expression (0-5 Scale)	$2,962	$8,891	$4,077	$11,596
Lonely (0-5 Scale)	-$2,350	-$7,267	(-$1,668)	(-$5,328)

Valuations in parentheses are not statistically significant.

M_0 is the reference income at which values are calculated.

Positive values are compensating surplus, negative values are equivalent surplus.

6. DISCUSSION

The focus of this paper is to produce estimates the compensating or equivalent surplus of a selection of housing and non-housing outcomes for New Zealand with a focus on vulnerable households such as those tenanted by the social housing provider Kāinga Ora. This section of the paper highlights key results and compares these with the findings from other studies. The second half of this section then discusses how the estimates of compensating or equivalent surplus for non-market outcomes derived in this paper can be applied in a policy context.

Results on the Income Coefficient

Our results identify a higher income coefficient than in some earlier New Zealand work (e.g. Jia and Smith, 2016; Brown, Woolf, and Smith, 2012, Davies, 2018), but is generally in line with more recent estimates of the income coefficient such as Carver and Grimes (2016). This reflects the greater focus in this paper and in Carver and Grimes on producing a robust estimate of the relationship between income and wellbeing. As discussed in the methodology section, the income coefficient in this paper is derived from a reduced form regression including only income and demographic controls. This results in a higher coefficient than the approach adopted by Davies (2018) where the income coefficient is taken from a regression containing many non-market outcomes that covary with income.

Despite the focus on obtaining a more robust income coefficient, the NZGSS coefficient remains noticeably lower than international estimates based on longitudinal data which are able to support better causal inference (such as Fujiwara, 2013, or Frijters, 2004). As a result of this lower income coefficient, our estimates for the compensating or equivalent surplus of non-market outcomes based on the NZGSS income coefficient are skewed upwards. To account for this, we have provided estimates of compensating or equivalent surplus using both the NZGSS income coefficient from this paper and the income coefficient of Fujiwara (2013), which allows us to provide a plausible range of estimates for compensating or equivalent surplus.

Estimates of non-market value

In comparing our estimates for the Kāinga Ora Proximity group to our estimates for the General Population group (tables 8 and 9), we find that the General Population group has a lower absolute valuation for almost all non-market outcomes. This is broadly consistent with the intuition that any given improvement in a wellbeing outcome is likely to have a greater impact on overall wellbeing for those with poorer outcomes generally.

Selected Comparisons to the Literature

Most of the estimates of compensating or equivalent surplus in this paper have a larger magnitude than earlier papers using willingness-to-pay surveys. This is likely because our approach captures the full economic value of each outcome (e.g. housing coldness) rather than a specific aspect of this outcome (e.g. in-house heating).

Cold House

This paper estimates the compensating or equivalent surplus of a house that is sometimes cold between -$3,590 and -$10,460 for the general population, and between -$7,620 and -$18,210 for an equivalent Kāinga Ora tenanted household. We also estimate the compensating or equivalent surplus of a house that is *often* or *always* cold as between -$5,430 and -$14,470 for the general population, and between -$7,960 and -$18,710 for an equivalent Kāinga Ora tenanted household.

It is useful to compare these results to previous studies in New Zealand that use willingness to pay surveys to estimate the compensating or equivalent surplus of in-house heating – although a direct comparison is not entirely possible. Chapman (2006) estimates the compensating or

equivalent surplus of in-house heating at $396 for low income households, and between $1,321 and $2,639 for high income households. This compares well with Vujcich (2008), who finds that Kāinga Ora tenants are willing to pay between $373 and $429 per year for in-house heating, compared to approximately $1,649 for high income households, while Phillips and Scarpa (2010) provide the highest New Zealand estimate for the compensating or equivalent surplus of in-house heating, at a maximum of $4,287 per year for owner-occupiers.

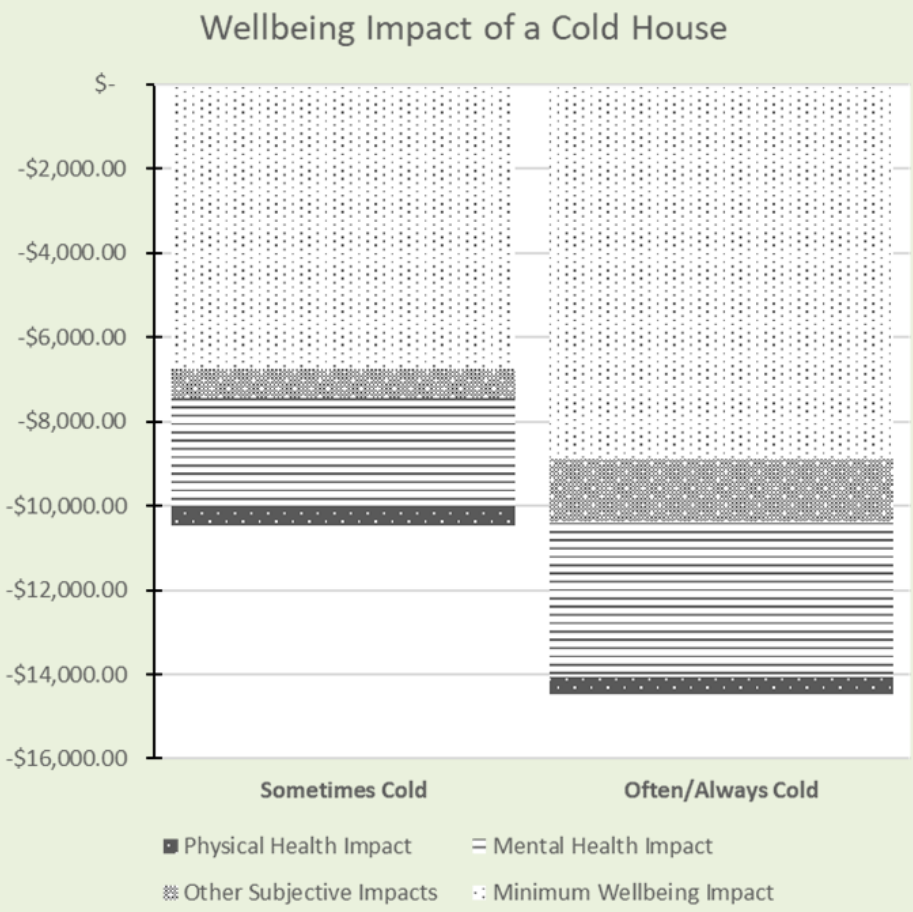
Even the lowest estimate for the compensating or equivalent surplus of a cold house from this paper for vulnerable and low-income households exceeds the equivalent estimates by Chapman (2006) and Vujcich (2008), which likely reflects the fact that our study captures the full range of factors that contribute to the warmth of a house, while the willingness to pay surveys only capture a single aspect of this outcome. In particular, note that a heating system still imposes a cost on the user in terms of power usage before it results in a warmer home.

Although a full decomposition of the compensating or equivalent surplus of a non-market outcome such as housing coldness is beyond the scope of our study, we are able to observe some associations between outcomes by looking at how coefficients change as additional variables are added to the regression model. Box 1 (below) illustrates how the compensating or equivalent surplus of living in a cold house, changes as the impact of physical and mental health outcomes are added to the model.

Box 1. Decomposition of Non-market value Derived from A Cold House

By looking at the impact of adding variables to our regression model it is possible to decompose the degree to which the impact of a wellbeing outcome – such as housing coldness – is mediated by sequentially added variables such as physical health, mental health, and other subjective variables. For example, the objective model estimates the "full" wellbeing impact of a cold house, while the physical health model estimates the wellbeing impact of a cold house less the degree to which this impact is mediated by the impact of living in a cold house on physical health. By comparing the difference between these two valuations, we can infer the portion of the compensating or equivalent surplus of a cold house that is correlated with physical health outcomes. This can be repeated for the correlation with mental health outcomes, and other subjective outcomes.

Figure 1. Decomposition of the non-market value associated with cold housing



As figure 1 suggests, a decomposition of the compensating or equivalent surplus derived from a house that is sometimes cold reveals that of the -$10,460 total impact for the NZGSS general population, $385 of this value is correlated with physical health outcomes, $2,640 of this value is correlated with mental health outcomes, and $675 of this value is correlated with other subjective outcomes such as the quality of the neighbourhood and perceived loneliness.

A similar overall picture is visible for the impact of a house that is often or always cold, with physical health, mental health, and other subjective impacts accounting for about a third of the compensating or equivalent surplus associated with living in an often/always cold house. Of this, the single largest impact is associated with mental health. The high portion of compensating or equivalent surplus that is associated with mental health is likely a reflection of personality effects, as the dependent wellbeing indicator of life satisfaction is often highly correlated with mental health indicators such as the SF-12.

Unemployment

The interpretation of compensating or equivalent surplus is particularly important when considering unemployment. Becoming unemployed will impact on a person's wellbeing via its impact on their incomes and via the non-pecuniary costs of unemployment such as stress, self-esteem, and social contact. Following the literature, the compensating or equivalent surplus for unemployment we estimate here captures only the non-pecuniary costs of unemployment.

Our wellbeing valuation approach suggests that the equivalent surplus (or the equivalent wellbeing impact) of unemployment is between -$6,490 and -$16,507 for the General Population group, and between -$4,840 and -$13,260 for Kāinga Ora tenants. This compares to Fujiwara (2013), who estimates that the compensating or equivalent surplus of unemployment is equivalent to -$23,042 NZD (Q1:2019) at a time when the gross median income in the UK was an equivalent NZD$55,033. Our estimate of -$13,260 is a little less than half the equivalised median income of Kāinga Ora tenants in this study ($26,200).

Applying non-market values

Estimates of compensating or equivalent surplus provide a useful tool for considering the social or wellbeing impact of investment decisions. These results capture the total impact on an individual's wellbeing if they were to experience the outcome in question. This means that, while the compensating or equivalent surplus may reflect some measure of the monetary cost of the outcome to the individual, this value also reflects other health and emotional impacts that would not be captured simply by looking at the net fiscal impact of a proposal. It is important to note, though, that these results only measure value that accrues to the affected individual, and does not capture wider systemic or economic benefits such as those that may accrue to the New Zealand government or spill-overs to other members of society.

These compensating or equivalent surplus can be used to estimate the "social return on investment" (SROI) for an intervention or program *if* it is possible to establish strong causal evidence between the intervention and the non-market outcome in question. For example, the calculation of the SROI for an intervention to improve the insulation of a home would require information on the perceived coldness of the home before and after the intervention took place (see Box 2). Ideally, this question should have the same phrasing as the NZGSS with the same possible responses.

These estimates for compensating or equivalent surplus can also provide a useful tool for estimating the minimum required change in non-market outcomes to create a positive SROI for an intervention or program. For example, each one-point change in physical health corresponds to an estimated compensating or equivalent surplus of between $240 and $830. If an intervention were suggested to improve the physical health of vulnerable households, and the intervention cost $1,000 per individual, the intervention should improve the physical health of these individuals by between 4.2 and 1.2 points in order to have a positive SROI. This can be a useful tool to consider whether a particular intervention has been efficient in achieving its intended impact.

Box 2. Calculating the impact of a change in housing quality using wellbeing values

To understand how the values presented in this paper can be used to support decision-making it is useful to present a worked example. The following example considers an intervention that has improved the coldness of the house from "often cold" to "sometimes cold". To calculate the change in compensating or equivalent surplus to the household of the intervention we look at the difference between the values for these two states and multiply this by the number of people affected. Specifically, the improvement in wellbeing is the value of the situation after the improvement in outcomes minus the value before the improvement.

The values for housing outcomes can be taken from table 8 of this paper. For the impact of a cold house the lower values (based on the income coefficient from Fujiwara, 2013) are:

- Not cold: $0
- House cold sometimes: -$3,591
- House cold often/always: -$5,429

For an improvement in housing quality from often/always cold to sometimes cold we subtract the value before the improvement from the value after the improvement:

- -$3,591 (after) minus -$5,429 (before) equals $1,838

This gives us a minimum compensating or equivalent surplus for the change in wellbeing associated with moving one person from an often/always cold house to one that is sometimes cold of $1838. We could also use the higher values from table 8 based on the New Zealand income coefficient from this paper. These values are:

- Not cold: $0
- House cold sometimes: -$10,458
- House cold often/always: -$14,457

The impact of the improvement is the calculated as:

- -$10,458 (after) minus -$14,457 (before) equals $3,999

This provides an upper bound for the compensating or equivalent surplus for the change in wellbeing for one person.

If the intervention had instead improved the coldness of the house from “often cold” to “never cold”, then the “after” value per person in both examples becomes $0 and the compensating or equivalent surplus would therefore range from $5,429 to $14,457.

Similarly, if the intervention improved other outcomes alongside whether the house was cold or not, the compensating or equivalent surplus of these would be added to the value associated with the change in household warmth. Thus if the housing intervention in the example also improved physical health by one point this would increase the value of the intervention by between $243 per person (Fujiwara) and $831 per person (NZGSS) in addition to the original values of $1,838 and $3,999.

Limitations

This study builds on and improves the analysis in Davies (2018), which used only the 2014 wave of the NZGSS to provide estimates of compensating or equivalent surplus for a range of non-market outcomes in New Zealand. In particular, this paper increases the overall sample size, examines how values for Kāinga Ora tenants differ from the New Zealand average, and provides a more systematic treatment of shared method varianceproviding greater confidence around the relative magnitudes of values from subjectively and objectively measured outcomes. This paper also presents a range of estimates for the income coefficient. As a result of these changes the estimates of compensating or equivalent surplus contained in this paper are significantly more robust than those in Davies (2018).

However, this study is not without its own limitations. In particular, sample size places important constraints on the ability to estimate robust regression coefficients – particularly for the Kāinga Ora proximity sample. This issue is exacerbated by the fact that the nature of the group in question – largely clients of Kāinga Ora – tends to limit within-group variation in housing conditions. This lower level of variation in housing conditions and a limited sample size explains why the housing regression coefficients for the Kāinga Ora proximity group had limited scope for statistical significance, as well as the observed counter-intuitive estimate of the impact of severe mould.

Another limitation relates to the strength of causal inference possible for the estimates. This is weaker than would be desirable. While we control for obvious confounding factors through

regression, the cross-sectional nature of the NZGSS places inherent limits on the identification strategies possible. One potential avenue for improvement is to use the longitudinal nature of the administrative data in the IDI combined with cross-sectional NZGSS data to produce a dataset containing "synthetic transitions". This approach has been adopted to value social housing provision (Anastasiadis et al, 2018) and movement from the benefit system into employment (Rea et al, 2019) and could be used to estimate a more robust income coefficient for New Zealand.

Finally, the lack of strong causal inference impacts on the size of the income coefficient estimated in the models presented in this paper and forces a choice between using a relatively low income coefficient (and consequently relatively high values for non-market outcomes) and using an income coefficient from the international literature (with weaker New Zealand relevance). We choose to address this issue by reporting a range of values with an upper and lower bound based on our estimated coefficient and that of Fujiwara (2013) respectively.

The use of a range of values sacrifices simplicity, but also has two important advantages. First, it provides a direct signal to users of the value estimates that there is a degree of uncertainty around the listed values and provides some idea of the magnitude of this uncertainty. This is preferable to false and potentially misleading precision when applied to real-world decisions. Second, it is possible to use the lower and upper estimates in different ways. If the cost of providing the relevant non-market outcome is less than the lower estimate of compensating or equivalent surplus then the case that the proposal raises overall wellbeing can be considered strong. Alternatively, if the cost of provision is above the upper estimate of compensating or equivalent surplus then this provides good evidence that the costs of the project exceed the benefits even under relatively generous assumptions.

7. CONCLUSION

The valuations for non-market outcomes provided in this paper build on and refine those presented in Davies (2018). In particular, they provide a more systematic treatment of the income coefficient and a more robust approach to managing the tension between the desire to include both objective and subjective outcomes relevant to wellbeing in the analysis and potential measurement bias in the coefficients between the two types of outcome due to the impact of personality. The approach used here builds on the substantial existing literature on cost-wellbeing analysis and adapts Fujiwara's (2013) three-stage wellbeing valuation to the New Zealand context as far as is possible with a strictly cross-sectional survey such as the NZGSS.

The approach to cost-wellbeing valuation adopted here varies in a number of minor points from that adopted elsewhere in the literature. First, we consistently use the reference income of an at need group (the Kāinga Ora proximity group) for all valuations. This reflects the fact that the relevant group to consider when evaluating the impact of income transfers on wellbeing for public policy decision-making is the impact of providing income to those most at need, rather than simply providing income to the public at large. Put simply, it ***might*** be possible to justify the government provision of a public good to a middle-income group if this produced a higher wellbeing return than providing an equivalent income transfer to a low-income group. It would generally ***not*** be possible to justify a pure income transfer on these grounds to a middle-income group.

A second minor change in our approach as compared to Fujiwara (2013) is that, while we follow Fujiwara in using a reduced form equation to estimate the full income coefficient, we use a partial coefficient (i.e. controlling for other wellbeing outcomes) to estimate values for the non-market outcomes. This reflects the intended use of the values, which in a policy context means that multiple values are likely to be claimed for a single proposal. Using the partial coefficient to calculate values – as we have done here – avoids the risk of counting the impact of a non-market outcome both in its own right and through the consequences of another non-market outcome (i.e. it avoids the risk counting the value of an improvement in physical health both directly and by including it as part of the estimated value of an improvement in the warmth of the house).

A comparison of the values calculated in this paper with estimates from willingness to pay studies and overseas examples of cost-wellbeing analysis shows that estimates of an individual's compensating or equivalent surplus derived from the NZGSS are not out of line with other estimates from the literature. However, there remains significant uncertainty in the range of plausible values for each outcome estimated from the NZGSS. This is primarily due to uncertainty around the income coefficient which serves as the denominator for estimates of non-market value. Without a better causal estimate of the size of the income coefficient for New Zealand there is no alternative but to use either a New Zealand value for the income coefficient that is likely too low, or a coefficient from the international literature that may not fully reflect New Zealand circumstances.

The values presented here provide a starting point for building a more comprehensive suite of non-market values for New Zealand suitable for use in cost-benefit analyses. These values can also be used to triangulate against similar studies from the international literature to establish the degree to which values from these studies can be meaningfully applied in New Zealand.

Ongoing investment in improving the quality of these non-market values has the potential to contribute to better public policy decision-making. In particular, intelligent use of the wider IDI alongside the NZGSS and similar surveys has the ability to produce better non-market valuations. A research agenda along these lines would focus both on using joint tax and NZGSS data in the IDI to obtain a better income coefficient estimate for New Zealand as well as leveraging the longitudinal nature of the IDI to obtain better causal estimates of the non-market value associated with social sector interventions. This viability of this approach has already been demonstrated (e.g. Anastasiadis et al, 2018; Rea et al, 2019) and it has the potential to

significantly improve the precision and robustness of estimates of the compensating or equivalent surplus of non-market outcomes in New Zealand.

Although this paper does not directly consider the policy implications of the analysis, two final points are worth making. First, even the minimum estimates of the compensating or equivalent surplus of most of the non-market outcomes considered here are sizable. This highlights the inherent risk in evaluating policy options based purely in terms of net fiscal impact. A purely fiscal approach to cost-benefit analysis is likely to risk significant misallocation of resources. Second, it is relatively easy to do better. The analysis in this paper represents only the lowest hanging of fruit. Significant improvements in estimates of compensating or equivalent surplus are possible using combined IDI and survey data and are unlikely to require a large investment in resources to realise.

BIBLIOGRAPHY

Anastasiadis, S., Anwar, N., Benny, V., Lee, W., MacCormick, C., Smith, C., and Vandenbroucke, B. (2018). Measuring the wellbeing impacts of public policy: social housing. Using linked administrative and survey data to evaluate the wellbeing impacts of receiving social housing. *Social Investment Agency Working Paper SIA-2018-0105*

Benjamin, D. J., Heffetz, O., Kimball, M. S., & Szembrot, N. (2014). Beyond happiness and satisfaction: Toward well-being indices based on stated preference. *American Economic Review, 104(9),* 2698-2735.

Blanchflower, D., & Oswald, A. J. (2007). Is well-being U-shaped over the life cycle? *NBER Working Paper No. 12935*

Bond, T. N., & Lang, K. (2019). The sad truth about happiness scales. *Journal of Political Economy*, 127(4), 1629-1640.

Brown, D., Woolf, J., & Smith, C. (2012). An empirical investigation into the determinants of life satisfaction in New Zealand. *New Zealand Economic Papers,* 46(3), 239-251.

Carver, T. & Grimes, A. (2016). Income or consumption: Which better predicts subjective wellbeing? *Motu Economic and Public Policy Research, Working Paper 16-12,* August (2016).

Clark, A. A., & Oswald, A. J. (2006). The curved relationship between subjective well-being and age. *HALSHS, 0050404 (?)*

Clark, A. E., & Oswald, A. J. (2002). A simple statistical method for measuring how life events affect happiness. *International Journal of Epidemiology*, 31(6), 1139-1144.

Dalton, H. (1920). The measurement of the inequality of incomes. *Economic Journal,* 30(119), 348-361

Davies, C., (2018), *Wellbeing Valuation of Social Housing Provision,* Housing New Zealand

Deaton, A. (2008). Income, health, and well-being around the world: Evidence from the Gallup World Poll. Journal of Economic perspectives, 22(2), 53-72.

Dolan, P. & Fujiwara, D. (2012). Valuing Adult Learning: Comparing Wellbeing Valuation to Contingent Valuation. *Department for Business, Innovation and Skills Research Paper 85*, November (2012).

Dolan, P. & Kahnneman, D. (2008). Interpretations of utility and their implications for the valuation of health.

Ferrer-i-Carbonell, A., & Frijters, P. (2004). How important is methodology for the estimates of the determinants of happiness? *The Economic Journal,* 114(497), 641-659.

Frijters, P., Haisken-DeNew, J., & Shields, M. (2004). Money Does Matter! Evidence from Increasing Real Income and Life Satisfaction in East Germany Following Reunification. *The American Economic Review,* 94(3), 730-740.

Fujiwara, D. (2013). A general method for valuing non-market goods using wellbeing data: three-stage wellbeing valuation.

Fujiwara, D., Houston, R., Keohane, K., Iulian, G. & Maxwell, C. (2018). Valuation of the impact of roadworks and flooding using the Wellbeing Valuation method. *Simetrica,* February (2018).

Fujiwara, D., Kudrna, L. & Dolan, P. (2014). Quantifying and Valuing the Wellbeing Impacts of Culture and Sport. *Australian Department for Culture, Media & Sport*, April (2014).

Gardner, J. & Oswald, A. J. (2007). Money and Mental Wellbeing: A Longitudinal Study of Medium-Sized Lottery Wins. *Journal of Health Economics,* 26(1), 49-60.

Jia, K. & Smith, C. (2016). Subjective wellbeing in New Zealand: Some recent evidence. *New*

Zealand Productivity Commission, Research Note 2016/03, May (2016).

Kaiser, C. F., & Vendrik, M. C. (2019). Different versions of the Easterlin Paradox: New evidence for European countries. In *The Economics of Happiness* (pp. 27-55). Springer, Cham.

Moore, J., Stinson, L., & Welniak, E. (2000). Income Measurement Error in Surveys: A Review. *Journal of Official Statistics,* 16(4), 331-361.

Murtin, F., Boarini, R., Cordoba, J. C., & Ripoll, M. (2017). Beyond GDP: Is there a law of one shadow price? *European Economic Review,* 100, 390-411.

OECD, (2013), *OECD Guidelines on measuring subjective wellbeing*, OECD Publishing, Paris

OECD, (2013). *Guidelines on Measuring Subjective Well-being*. OECD Publishing, Paris.

Perry, B (2019), *The material wellbeing of NZ households: Overview and Key Findings*, Ministry of Social Development

Phillips, Y. & Scarpa, R. (2010). Waikato Warm Home Study. *New Zealand Agricultural and Resource Economics Society (Inc.).* Paper presented at the 2010 NZARES Conference, August (2010).

Powdthavee, N. (2010). How much does money really matter? Estimating the causal effects of income on happiness. *Empirical Economics,* 33, 77-92

Rea, D., Anastasiadis, S., Benny, V., Chokkanathapuram, A., Lee, W., Smith, C., and Vandenbroucke, B. (2019). Exploring new ways to measure wellbeing: benefit to work transitions *Social Investment Agency Working Paper*. Wellington, New Zealand.

Sandvik, E., Diener, A & Seidlitz, L. (1997). Subjective Well-being: The Convergence and Stability of Self-Report and Non-Self Report Measures.

Schimmack, U., Schupp, J., and Wagner, G., (2008), The influence of environment and personality on the affective and cognitive component of subjective wellbeing. *Social Indicators Research, 89(1)*, pp41-60.

Stevenson, B., & Wolfers, J. (2008). *Economic growth and subjective well-being: Reassessing the Easterlin paradox* (No. w14282). National Bureau of Economic Research.

Stevenson, B., & Wolfers, J. (2013). Subjective well-being and income: Is there any evidence of satiation?. *American Economic Review*, *103*(3), 598-604.

Vujcich, H. (2008). Valuing Warm Homes – Exploring New Zealand's Home Heating Choices. *Thesis for partial fulfilment for the Master of Environmental Studies 593, Victoria University of Wellington,* March (2008).

Winkelmann, R., Oswald, A. & Powdthavee, N. (2011) What Happens to People after Winning the Lottery? In *European Economic Association & Econometric Society Parallel Meetings*.

Yao, R. & Kaval, P. (2007). Non Market Valuation in New Zealand: 1974 through 2005. *University of Waikato, Department of Economics Working Paper 07/17*, September (2007).

APPENDIX ONE: TURNING POINT MODEL

General population (17,178), including Kāinga Ora respondents. Filtered at lower quartile of household income, $24,000. Adjusted R-squared value of 0.08912. Normal standard errors.

Dependent Variable: Life satisfaction		**Turning Point Model**
		Coefficients (Standard Errors)
Intercept		8.847*** (0.3146)
Logged Normalised Household Income		-5.099e-05* (3.084e-05)
Logged Normalised Household Income^2		2.550e-09*** (9.684e-10)
2016 Survey Group		0.05601 (0.06594)
Age in Years		-0.09841*** (-0.008454)
Age^2		0.001095*** (7.980e-05)
Male		-0.02412*** (0.06826)
Has Partner		0.6128*** (0.07689)
NZ European	Maori	0.01838** (0.0899)
	Pacific	0.2716** (0.1297)
	Asian	0.2122 (0.1337)
	MELAA	0.6489* (0.3321)
	Other Ethnicity	-0.1006 (0.26)
Auckland	Wellington	-0.08037 (0.1251)
	Canterbury	-0.1407 (0.1161)
	Northland	0.2157* (0.1123)
	Rest of North Island	0.06456 (0.1101)
	Rest of South Island	0.006331 (0.1159)
Standard errors in parentheses. *P-values: * = 10%; ** = 5%; *** = 1%*		

APPENDIX TWO: DESCRIPTIVE STATISTICS

		Kāinga Ora Proximity Population	NZGSS General Population
Life Satisfaction (0-10 Scale)		7.09 (6.92-7.27)	7.73 (7.71-7.76)
Drugs or Alcohol Problem in Neighbourhood		0.37 (0.33-0.41)	0.19 (0.18-0.20)
Cultural Expression		3.06 (2.99-3.13)	3.34 (3.33-3.36)
Lonely		0.845 (0.763-0.927)	0.66 (0.64-0.67)
Physical Health		43.93 (42.93-44.94)	48.44 (48.28-48.6)
Mental Health		44.58 (43.53-45.62)	49.33 (49.17-49.49)
Unemployed		0.07 (0.05-0.09)	0.02 (0.02-0.03)
Good condition	House Condition: Minor Problems	0.31 (0.29-0.35)	0.34 (0.33-0.35)
	House Condition: Some Problems	0.29 (0.25-0.32)	0.24 (0.23-0.25)
	House Condition: Very Bad/Extreme Problems	0.10 (0.07-0.14)	0.08 (0.07-0.08)
No Mould	House Mould: Some	0.36 (0.31-0.39)	0.25 (0.25-0.26)
	House Mould: Very Bad	0.16 (0.13-0.19)	0.06 (0.06-0.06)
Not Cold	House Cold: Sometimes	0.25 (0.22-0.29)	0.27 (0.26-0.27)
	House Cold: Often/Always	0.44 (0.33-0.50)	0.22 (0.21-0.26)
Household is Crowded		0.17 (0.12-0.2)	0.04 (0.04-0.05)
Household is Crowded: Maori and Pacific Interaction		0.12 (0.09-0.16)	0.02 (0.02-0.03)
Victim of Discrimination		0.24 (0.21-0.27)	0.17 (0.16-0.17)
Victim of a Crime		0.17 (0.14-0.2)	0.14 (0.13-0.14)
Member of a Religious Group		0.30 (0.26-0.34)	0.19 (0.17-0.19)
Member of a Volunteering Group		0.13 (0.1-0.16)	0.2 (0.19-0.21)
Hig h	Highest Education - Certificate	0.17 (0.14-0.20)	0.25 (0.24-0.26)

	Highest Education – Bachelor's Degree	s	0.12 (0.11-0.13)
	Highest Education - Post-Graduate Degree	s	0.1 (0.09-0.1)
Had Couple Parents	Had Single Parent	0.15 (0.12-0.18)	0.07 (0.07-0.08)
	Had Many Parents	0.13 (0.1-0.15)	0.08 (0.08-0.09)
	Had Institute Parents	s	0.01 (0.01-0.01)
Means are rounded to 2 d.p. with 95% confidence intervals in parentheses; values that relate to a group of less than 20 individuals have been suppressed for confidentiality.			

APPENDIX THREE: REGRESSION TABLES

Dependent Variable: Life satisfaction		General Population Income Model			Kāinga Ora Proximity Income Model
		Normal Standard Errors	Unfiltered Household Income	Robust Standard Errors	Robust Standard Errors
		Adj. R^2 =	*Adj. R^2 = 0.061*	*Adj. R^2 = 0.061*	*Adj. R^2 = 0.094*
Intercept		2.647*** (0.2694)	4.271*** (0.2513)	3.74*** (0.2706)	4.038** (1.762)
Logged Normalised Household Income		0.5674*** (0.02453)	0.4106*** (0.0233)	0.4593*** (0.02518)	0.5006*** (0.1689)
2016 Survey Group		0.006551 (0.02763)	-0.01428 (0.0253)	-0.01758 (0.02543)	-0.1528 (0.1737)
Age in Years		-0.06367*** (0.003883)	-0.05465*** (0.003541)	-0.05517*** (0.003587)	-0.126*** (0.0214)
Age^2		7.676e-02*** (3.816e-05)	6.693e-04*** (3.493e-05)	7.063e-04*** (3.543e-05)	0.0014*** (0.0002)
Male		-0.1306*** (0.02771)	-0.121*** (0.02559)	-0.1267*** (0.0257)	-0.4203** (0.1896)
NZ European	Maori	0.07256* (0.0425)	0.05798 (0.04291)	0.0841* (0.04337)	0.4689** (0.2344)
	Pacific	0.2301*** (0.06291)	0.2518*** (0.06599)	0.2573*** (0.0672)	1.102*** (0.2819)
	Asian	0.2225*** (0.05089)	0..2346*** (0.04734)	0.2439*** (0.04794)	0.1344 (0.437)
	MELAA	0.3383** (0.1568)	0.2054 (0.1471)	0.2107 (0.1549)	0.412 (0.592)
	Other Ethnicity	-0.1946* (0.1045)	-0.205* (0.107)	-0.1815* (0.107)	0.956 (0.8107)
Auckland	Wellington	-0.01566 (0.04833)	0.005114 (0.04343)	0.004458 (0.04375)	0.35 (0.272)
	Canterbury	-0.05992 (0.04619)	-0.01504 (0.04237)	-0.00926 (0.0425)	0.081 (0.30)
	Northland	0.159*** (0.04876)	0.1631*** (0.04555)	0.1749*** (0.04564)	0.774** (0.327)
	Rest of North Island	0.1065** (0.04174)	0.1079*** (0.0378)	0.111*** (0.03795)	0.292 (0.271)
	Rest of South Island	0.1036** (0.04832)	0.1366*** (0.043)	0.1362*** (0.04323)	0.236 (0.321)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*					

Dependent Variable: Life satisfaction		**Objective Model** with Robust Standard Errors	
		General Population	Kāinga Ora Proximity Group
Intercept		6.283*** (0.2982)	3.9206* (2.0386)
Unemployed		0.2688*** (0.02695)	-0.353 (0.377)
Good condition	House Condition: Minor Problems	-0.1498*** (0.02928)	-0.323 (0.2337)
	House Condition: Some Problems	-0.29*** (0.03557)	-0.3006 (0.229)
	House Condition: Very Bad/Extreme Problems	-0.5054*** (0.0646)	-0.589 (0.3745)
No Mould	House Mould: Some	-0.1494*** (003217)	-0.0203 (0.1993)
	House Mould: Very Bad	-0.2369*** (0.07557)	0.4811* (0.289)
Not Cold	House Cold: Sometimes	-0.255*** (0.02954)	-0.5946*** (0.2248)
	House Cold: Often/Always	-0.4017*** (0.04036)	-0.6266*** (0.2262)
Household is Crowded		-0.04937 (0.04036)	-0.5163 (0.3984)
Household is Crowded: Maori and Pacific Interaction		0.3361** (0.1489)	0.8177* (0.4883)
Victim of Discrimination		-0.409*** (0.038)	-0.5163** (0.2388)
Victim of a Crime		-0.2002*** (0.03944)	-0.4915* (0.2635)
Member of a Religious Group		0.226*** (0.0331)	0.3868* (0.2139)
Member of a Volunteering Group		0.1474*** (0.03007)	0.4338 (0.264)
High School	Highest Education - Certificate	-0.00695 (0.03073)	0.0581 (0.2276)
	Highest Education – Bachelor's Degree	-0.009131 (0.03739)	-0.9274* (0.4914)
	Highest Education - Post-Graduate Degree	-0.00594 (0.04088)	-0.5593 (0.5875)
Had Couple Parents	Had Single Parent	-0.234*** (0.05257)	-0.1717 (0.2657)
	Had Many Parents	-0.1324*** (0.04714)	-0.175 (0.261)
	Had Institute Parents	-0.005942 (0.1378)	-0.666 (0.5402)
Logged Normalised Household Income		0.2668*** (0.02695)	0.5546*** (0.1943)

2016 Survey Group		-0.04283* (0.02505)	-0.2152 (0.1798)
Age in Years		-0.06297*** (0.003757)	-0.10918*** (0.0222)
Age^2		7.242e-04*** (3.7539e-05)	0.001235*** (0.00022)
Male		-0.1495*** (0.025)	-0.3823** (0.1876)
Individual	Has Partner	0.4449*** (0.03086)	0.0875 (0.2707)
	Couple – Young Kids	0.1225*** (0.03366)	0.34733 (0.3396)
	Couple – Other Kids	-0.03753 (0.0481)	-0.2101 (0.3523)
	Single – Young Kids	0.05924 (0.06426)	0.3322 (0.2506)
	Single – Other Kids	-0.1342* (0.07929)	0.1323 (0.334)
NZ European	Maori	0.23*** (0.04303)	0.3949 (0.2438)
	Pacific	0.2516*** (0.07154)	0.8121** (0.3225)
	Asian	0.1788*** (0.04781)	0.3292 (0.4612)
	MELAA	0.179 (0.149)	0.3552 (0.6177)
	Other Ethnicity	-0.1345 (0.1001)	1.023 (0.681)
Auckland	Wellington	0.04592 (0.04217)	0.4325 (0.281)
	Canterbury	-0.02429 (0.04104)	0.059 (0.296)
	Northland	0.1723*** (0.04459)	0.7664** (0.3146)
	Rest of North Island	0.1066*** (0.03658)	0.3902 (0.285)
	Rest of South Island	0.1093*** (0.04187)	0.2086 (0.316)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*			

Dependent Variable: Life satisfaction		**General Population Health Model** with Robust Standard Errors	
Independent Variables		Physical Health	Mental Health
Intercept		5.834*** (0.3013)	3.365*** (0.2776)
Physical Health		0.0163*** (0.00155)	
Mental Health			0.0777*** (0.001499)
Unemployed		-0.509*** (0.0904)	-0.3196*** (0.0772)
Good condition	House Condition: Minor Problems	-0.1461*** (0.02919)	-0.0678** (0.0265)
	House Condition: Some Problems	-0.2762*** (0.03547)	-0.1577*** (0.0319)
	House Condition: Very Bad/Extreme Problems	-0.4792*** (0.06413)	-0.2989*** (0.0557)
No Mould	House Mould: Some	-0.1382*** (0.0321)	-0.0712** (0.0288)
	House Mould: Very Bad	-0.2248*** (0.07559)	-0.0898 (0.06624)
Not Cold	House Cold: Sometimes	-0.2429*** (0.02946)	-0.167*** (0.0264)
	House Cold: Often/Always	-0.3848*** (0.04021)	-0.253*** (0.0363)
Household is Crowded		-0.06025 (0.1032)	0.029 (0.087)
Household is Crowded: Maori and Pacific Interaction		0.3432** (0.1493)	0.165 (0.129)
Victim of Discrimination		-0.3867*** (0.03787)	-0.143*** (0.0335)
Victim of a Crime		-0.1927*** (0.03934)	-0.0959*** (0.0344)
Member of a Religious Group		0.2271*** (0.03305)	0.212*** (0.0298)
Member of a Volunteering Group		0.1299*** (0.02994)	0.102*** (0.0269)
None or High School	Highest Education - Certificate	-0.0109 (0.0306)	-0.0379 (0.02738)
	Highest Education – Bachelor's Degree	-0.02749 (0.0373)	-0.0201 (0.0339)
	Highest Education - Post-Graduate Degree	-0.02177 (0.04077)	0.00756 (0.0364)
Had Couple Parents	Had Single Parent	-0.2285*** (0.05248)	-0.1352*** (0.04616)
	Had Many Parents	-0.117** (0.0471)	-0.05989 (0.04213)
	Had Institute Parents	0.03593 (0.1377)	0.1011 (0.1108)
Logged Normalised Household Income		0.2286*** (0.02688)	0.1468*** (0.02419)
2016 Survey Group		-0.03216	-0.03995*

		(0.025)	(0.02236)
Age in Years		-0.0643***	-0.05176***
		(0.00375)	(0.003348)
Age^2		7.672e-04***	5.894e-04***
		(3.765e-05)	(3.366e-05)
Male		-0.1632***	-0.2257***
		(0.02497)	(0.02252)
Individual	Has Partner	0.4439***	0.3772***
		(0.03078)	(0.02766)
	Couple – Young Kids	0.1145***	0.124***
		(0.03364)	(0.03113)
	Couple – Other Kids	-0.03457	-0.04483
		(0.04818)	(0.04192)
	Single – Young Kids	0.0339	0.09331*
		(0.06395)	(0.0551)
	Single – Other Kids	-0.1331	-0.0284
		(0.07971)	(0.06546)
NZ European	Maori	0.2378***	0.2273***
		(0.04283)	(0.03842)
	Pacific	0.2471***	0.1351**
		(0.07168)	(0.06392)
	Asian	0.1688***	0.07445*
		(0.0477)	(0.04469)
	MELAA	0.177	0.1013
		(0.15)	(0.1335)
	Other Ethnicity	-0.1262	-0.1107
		(0.1005)	(0.08647)
Auckland	Wellington	0.05217	0.07*
		(0.04211)	(0.03744)
	Canterbury	-0.0195	-0.04985
		(0.0409)	(0.03684)
	Northland	0.1815***	0.101**
		(0.0445)	(0.03966)
	Rest of North Island	0.1215***	0.105***
		(0.03653)	(0.03311)
	Rest of South Island	0.1152***	0.04336
		(0.04168)	(0.03803)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*			

Dependent Variable: Life satisfaction		**Kāinga Ora Proximity Group Health Model** with Robust Standard Errors	
Independent Variables		Physical Health	Mental Health
Intercept		3.8033* (2.05)	1.3822 (1.77)
Physical Health		0.0045 (0.0084)	
Mental Health			0.0751*** (0.0065)
Unemployed		-0.3654 (0.379)	-0.207 (0.3433)
Good condition	House Condition: Minor Problems	-0.3225 (0.2335)	-0.153 (0.207)
	House Condition: Some Problems	-0.2998 (0.2293)	-0.1311 (0.207)
	House Condition: Very Bad/Extreme Problems	-0.5702 (0.377)	-0.4824 (0.3177)
No Mould	House Mould: Some	-0.019 (0.1987)	-0.001 (0.172)
	House Mould: Very Bad	0.4742 (0.2899)	0.5826** (0.2577)
Not Cold	House Cold: Sometimes	-0.5859*** (0.2252)	-0.4315** (0.2029)
	House Cold: Often/Always	-0.62176*** (0.2257)	-0.408** (0.2002)
Household is Crowded		-0.5242 (0.4023)	-0.3907 (0.318)
Household is Crowded: Maori and Pacific Interaction		0.8304* (0.4925)	0.5302 (0.3957)
Victim of Discrimination		-0.5084** (0.2398)	-0.1952 (0.1948)
Victim of a Crime		-0.4943* (0.2632)	-0.2051 (0.2218)
Member of a Religious Group		0.3809* (0.2143)	0.2244 (0.1924)
Member of a Volunteering Group		0.4105 (0.2638)	0.342 (0.2287)
Highest Education: None or High School	Highest Education - Certificate	0.0527 (0.227)	-0.588 (0.188)
	Highest Education – Bachelor's Degree	-0.9161* (0.491)	-0.785* (0.423)
	Highest Education - Post-Graduate Degree	-0.566 (0.5967)	-0.5061 (0.42)
Had Couple	Had Single Parent	-0.166 (0.2667)	-0.2316 (0.2368)
	Had Many Parents	-0.1666 (0.2621)	-0.302 (0.227)

	Had Institute Parents	-0.6556 (0.5422)	-0.873* (0.475)
Logged Normalised Household Income		0.5375*** (0.199)	0.3495** (0.165)
2016 Survey Group		-0.1987 (0.1838)	-0.1312 (0.159)
Age in Years		-0.1065*** (0.0232)	-0.067*** (0.021)
Age^2		0.00122*** (0.0002)	0.00081*** (0.0002)
Male		-0.3894** (0.1878)	-0.4036** (0.1645)
Individual	Has Partner	0.0805 (0.2725)	0.2593 (0.2575)
	Couple – Young Kids	0.3454 (0.3404)	0.1249 (0.3299)
	Couple – Other Kids	-0.1895 (0.357)	-0.2906 (0.3173)
	Single – Young Kids	0.315 (0.252)	0.34 (0.2299)
	Single – Other Kids	0.1488 (0.3377)	0.198 (0.285)
NZ European	Maori	0.397 (0.2434)	0.318 (0.2097)
	Pacific	0.7988** (0.324)	0.719** (0.283)
	Asian	0.3178 (0.4633)	0.25 (0.398)
	MELAA	0.368 (0.6244)	0.418 (0.49)
	Other Ethnicity	1.03 (0.6765)	1.1 (0.894)
Auckland	Wellington	0.431 (0.282)	0.344 (0.244)
	Canterbury	0.0715 (0.299)	0.264 (0.261)
	Northland	0.7638** (0.3148)	0.697** (0.286)
	Rest of North Island	0.3864 (0.2851)	0.4367* (0.238)
	Rest of South Island	0.213 (0.3167)	0.39 (0.288)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*			

Dependent Variable: Life satisfaction		**Subjective Model** with Robust Standard Errors	
Independent Variables		General Population	Kāinga Ora Proximity Group
Intercept		3.187*** (2.801)	1.288 (1.842)
Drugs or Alcohol Problem in Neighbourhood		-0.0994*** (0.02988)	-0.1709 (0.1708)
Cultural Expression		0.2075*** (0.01711)	0.2926*** (0.100)
Lonely		-0.1626*** (0.0144)	-0.1138 (0.0876)
Physical Health		0.01285*** (0.001376)	0.0016 (0.0067)
Mental Health		0.06878*** (0.001565)	0.0671*** (0.007)
Unemployed		-0.3019*** (0.07665)	-0.2522 (0.335)
House Condition: Good	House Condition: Minor Problems	-0.06151** (0.02604)	-0.1145 (0.2056)
	House Condition: Some Problems	-0.1356*** (0.03137)	-0.093 (0.2024)
	House Condition: Very Bad/Extreme Problems	-0.2584*** (0.054668)	-0.44088 (0.3049)
None	House Mould: Some	-0.04739* (0.02845)	-0.0216 (0.1724)
	House Mould: Very Bad	-0.05621 (0.06496)	0.5893** (0.2618)
Not Cold	House Cold: Sometimes	-0.1493*** (0.02601)	-0.4147** (0.2007)
	House Cold: Often/Always	-0.2078*** (0.03561)	-0.3413* (0.2048)
Household is Crowded		0.03318 (0.08685)	-0.4497 (0.339)
Household is Crowded: Maori and Pacific Interaction		0.1322 (0.1277)	0.5331 (0.417)
Victim of Discrimination		-0.04866 (0.03316)	-0.12 (0.193)
Victim of a Crime		-0.07508** (0.03367)	-0.149 (0.231)
Member of a Religious Group		0.2205*** (0.02944)	0.2153 (0.192)
Member of a Volunteering Group		0.07844*** (0.02645)	0.3588 (0.229)
Highest Education: M	Highest Education - Certificate	-0.04879* (0.02696)	-0.059 (0.1843)
	Highest Education – Bachelor's Degree	-0.03567 (0.03304)	-0.8139* (0.4304)

	Highest Education - Post-Graduate Degree	-0.01445 (0.0357)	-0.4718 (0.4206)
Had Couple Parents	Had Single Parent	-0.1167*** (0.0449)	-0.2497 (0.2334)
	Had Many Parents	-0.03546 (0.04151)	-0.2905 (0.2248)
	Had Institute Parents	0.1962* (0.1116)	-0.7944 (0.5309)
Logged Normalised Household Income		0.08259*** (0.02392)	0.2924* (0.1726)
2016 Survey Group		-0.01283 (0.02205)	-0.14 (0.2309)
Age in Years		-0.0522*** (0.003281)	-0.0624*** (0.022)
Age^2		6.148e-04*** (3.317e-05)	0.00076*** (0.00022)
Male		-0.2328*** (0.0216)	-0.3879** (0.1618)
Individual	Has Partner	0.3431*** (0.02723)	0.2512 (0.2567)
	Couple – Young Kids	0.1046*** (0.03065)	0.084 (0.334)
	Couple – Other Kids	-0.06077 (0.04118)	-0.3434 (0.329)
	Single – Young Kids	0.05574 (0.0543)	0.2767 (0.2308)
	Single – Other Kids	-0.04111 (0.06429)	0.2154 (0.2903)
NZ European	Maori	0.2322*** (0.03779)	0.3075 (0.212)
	Pacific	0.1576** (0.06362)	0.788*** (0.2796)
	Asian	0.1789*** (0.04514)	0.3936 (0.3859)
	MELAA	0.2308* (0.1319)	0.6213 (0.5271)
	Other Ethnicity	-0.0812 (0.08449)	1.3468 (0.9798)
Auckland	Wellington	0.06838* (0.03684)	0.3713 (0.2443)
	Canterbury	-0.01204 (0.03621)	0.3732 (0.2579)
	Northland	0.1137*** (0.03897)	0.7318** (0.2887)
	Rest of North Island	0.129*** (0.03253)	0.4971** (0.2303)
	Rest of South Island	0.06389* (0.03744)	0.4633 (0.2906)
*Standard errors in parentheses. P-values: * = 10%; ** = 5%; *** = 1%*			