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Geographic Reference Income and the Subjective Wellbeing of Australians

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Abstract

In this paper panel data is used to estimate the relationship between geographic reference income and subjective wellbeing in Australia. Recent cross-sectional US-based studies suggest that the income of other people in a neighbourhood – geographic reference income – impacts on individual wellbeing but is mediated by geographic scale. On controlling for a household's own income, subjective wellbeing is raised by neighbourhood income and lowered by region-wide income. However, these findings could be driven by the self-selection of innately happy or unhappy individuals into higher-income areas. This study's methodology takes advantage of panel-data modelling to show that unobserved individual heterogeneity is in fact correlated with reference income, but on curbing its impacts through the inclusion of fixed-effects we find that there is still a positive relationship between reference income and subjective wellbeing at the neighbourhood level. However, we detect no relationship at the region-wide level. Additionally, the subjective wellbeing relationship is the same no matter an individual's rank in the distribution of incomes within an area. The neighbourhood wellbeing relationship has implications for policies addressing residential segregation and social mixing.

Key words: Reference income, subjective wellbeing, panel data, residential segregation, social mixing.

Declarations

Compliance with Ethical Standards:

Conflict of Interest - The authors declare no competing interests.

Research involving Human Participants and/or Animals - Not applicable.

Informed consent - Not applicable.

Data availability statement: This empirical paper uses general-purpose survey data from the restricted version of the Household, Income and Labour Dynamics in Australia (HILDA) survey. To access this data, eligible researchers are required to submit an application to the surveys managers, The Melbourne Institute at the University of Melbourne. We also use Australian equivalised household income data for small areas that is not freely available and must be licensed from the Australian Bureau of Statistics.

Disclaimer Notices: This paper uses unit record data from HILDA. HILDA was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the authors and should not be attributed to the Australian Government, DSS or the Melbourne Institute. http://dx.doi.org/10.26193/0LPD4U

Introduction

The Australian Federal Government recently released a National Wellbeing Framework[1]. The indicators defining this framework are organised according to five wellbeing themes (Healthy, Secure, Sustainable, Cohesive, Prosperous). However, the 50 metrics listed under these 5 themes are all defined at a national level, which assumes that the neighbourhoods in which people reside are irrelevant to individual subjective wellbeing (SWB). This ignores an important literature which suggests that people are far from indifferent to the neighbourhoods in which they live. On the one hand there is the idea that people benefit from rising levels of prosperity in their neighbourhoods because of its correlation with higher amenity (Broxterman et al., 2019; Glaeser et al., 2001). On the other hand, there is the relative income hypothesis which posits a negative relationship between individual SWB and the incomes of neighbours (Luttmer, 2005). High levels of inter- and intra- neighbourhood income segregation will have a bearing on the importance of relationships between individual SWB and the incomes of fellow residents living in the same neighbourhood, however such analysis has been neglected by Australian researchers exploring determinants of SWB. This is perhaps one reason why neighbourhoods have been ignored in the Australian National Wellbeing Framework and is an important motivation for this paper's focus on individual SWB and its relationship with neighbourhood income.

Our paper has a second motivation as this relationship between SWB and neighbourhood income is of relevance to policies addressing income redistribution and social mixing. Studies motivated by the relative income hypothesis posit that the wellbeing impact of income depends on both an individual's own income and comparisons to the income of others (Duesenberry, 1949). In a widely cited paper, Luttmer (2005) provided evidence that on controlling for one's own income, SWB decreases as the incomes of neighbours increases. This finding is attributed to negative comparisons between an individual's own income and that of their neighbours, which is referred to in the literature as geographic reference income.

A negative relationship between SWB and geographic reference income is contrary to contemporary studies in the urban literature on cities as centres of consumption. This literature theorises that individuals benefit from the rising incomes and consumption of those around them; in high-income countries, technological advancement has enabled an increasingly

[1] See https://ministers.treasury.gov.au/ministers/jim-chalmers-2022/media-releases/release-national-wellbeing-framework. The report itself is available at: https://treasury.gov.au/publication/p2023-mwm

affluent population to shift away from production agglomeration towards agglomeration in "consumer cities", endowed with higher amenity and oriented towards consumer wellbeing (Broxterman et al., 2019; Glaeser et al., 2001). This apparent refutation of the consumer cities thesis is qualified by recent international studies showing that the link between reference income and SWB is mediated by geographic scale (Brodeur & Flèche, 2019; Ifcher et al., 2018). They find that positive impacts of reference income dominate at the neighbourhood level, while negative impacts dominate at the region-wide level. However, these studies use cross-sectional data that have limitations when it comes to addressing endogeneity and selection concerns due to unobserved individual heterogeneity (Luttmer, 2005); and hence the true direction of the reference income and SWB relationship may be obfuscated.

These wellbeing relationships have important implications for urban policy responses to residential segregation. Residential segregation is the spatial manifestation of the inequality of household incomes and wealth, interacting with heterogenous household preferences in the neighbourhood sorting process, resulting in clusters of advantage and disadvantage across urban areas (Cheshire et al., 2014). In Australia, it is often assumed that the negative consequences from clusters of social disadvantage will be reduced through social mixing policies (Parkinson et al., 2014). These policies seek to encourage diversity of income, tenure and class within neighbourhoods and are most often implemented in Australia through the dispersion of social housing tenants away from clusters of disadvantage (Parkinson et al., 2014). In the consumer city paradigm, these individuals could potentially benefit from the higher levels of endogenous amenity found in more affluent neighbourhoods. However, as argued by Cheshire et al. (2014), if the negative externalities impacting the poor as a result of living among the rich outweigh the positive externalities, then polices to encourage social mixing would be a cost-ineffective. Instead, it would be better to redistribute resources and opportunities from the richer to the poorer, since income inequality is the source of residential segregation in the first place.

The objective of this study is to establish whether there is a positive or negative relationship between geographic reference income and individual SWB in Australia. To achieve this objective, we analyse panel data on the subjective and economic wellbeing of individuals from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. Using a *within-between* random effects (hybrid) ordered probit panel-data estimation method, we model the SWB of HILDA Survey participants as a function of their own household equivalised income and the equivalised incomes of neighbours.

This paper makes three specific contributions to the Australian and international literature. First, as far as we are aware, it is the first comprehensive study of this relationship in the Australian literature, and so the findings will help inform Australian urban policy on the importance of neighbourhoods to wellbeing. Second, recent international literature indicates that the impact of geographic reference income on SWB differs depending on the spatial unit used to define the geographic reference group (Brodeur & Flèche, 2019; Ifcher et al., 2018). However, these studies are US-based. We are among the first (Kingdon & Knight, 2007) to ask whether the link between SWB and reference income effects defined at different levels of spatial aggregation take on a different character outside of the US context. Evidence from Senik (2008) suggests that relative income comparisons are shaped by a country's institutions and culture. US findings could then be country specific. Finally, our key contribution stems from our estimation strategy – the panel-data techniques used in this paper help identify and alleviate endogeneity issues that arise due to unmeasured heterogeneity and self-selection. Most recent studies are based on cross-sectional data, that can yield biased results if, for example, innately (un)happy individuals self-select into higher-income areas (Luttmer, 2005). If correlation exists between unobserved heterogeneity and geographic reference income, doubt may then be cast on the recent cross-sectional literature. Moreover, those few studies using panel-data sets employ estimation techniques that fail to address unmeasured heterogeneity in an ordinal dependent variable setting – a hurdle addressed by our approach.

We begin by setting out some key ideas on neighbourhood income and SWB and then reviewing those empirical studies of the relationship between neighbourhood income and SWB. The paper then describes the HILDA Survey data and explains the specification of our panel-data model and its variants. The empirical findings are then presented before a discussion of their implications for Australian residential segregation policy.

Background

The key relationships motivating our study are summarised in equation (1):

$$SWB_i = SWB(AI_i, GRI_i, X_i) \quad (1)$$

Where SWB_i is the subjective wellbeing of individual i, AI_i is their absolute income, GRI_i is geographic reference income, and X_i is a vector of i's personal characteristics, thought to be important determinants of SWB. If Individuals' aspirations are shaped by neighbours' consumption patterns, comparisons with better off neighbours could adversely impact SWB.

For example, if envy, aspirations or shame motivate feelings of relative deprivation, the effect of GRI_i will be negative (Kingdon & Knight, 2007). Alternatively, such feelings could be offset by a positive amenity effect, in which case the GRI_i impact will be positive. The empirical studies in the review that follows suggest that the impact of GRI_i varies depending on the scale of the spatial units that define it.

Luttmer's (2005) influential paper used US panel data from the National Survey of Families and Households to investigate the relationship between SWB and geographic reference income. It finds that higher earnings of neighbours depress levels of self-reported happiness. At the regional level, Blanchflower & Oswald (2004) also report a negative reference income effect. However, Clark et al. (2009) find a positive reference income effect using Danish administrative date for small neighbourhoods. The spatial units used to define geographic reference incomes varies across these papers. In Luttmer (2005), income and wellbeing data was matched to 'neighbourhoods' as defined by Public Use Microdata Areas (PUMAs), which, on average, contain 150,000 people. PUMAs are large areas that could be capturing wellbeing effects from sources other than income comparisons. This is likely if income comparison effects occur at smaller spatial scales, while other channels of transmission such as costs of living operate at larger spatial scales.

In their cross-section model estimated using South African data, and using much smaller geographic reference groups of about 3000 people, Kingdon Knight (2007) identify a positive relationship between reference income and individual wellbeing. However, on increasing the reference group's geographic scale of measurement, this positive effect disappears. The authors suggest that feelings of community altruism become dominant in smaller spatial units where people have stronger social connections, and therefore want to see those around them benefit, regardless of their own position.

Recent modelling exercises reported in US-based studies from Brodeur & Flèche (2019) and Ifcher et al. (2018) confirm that the size of the geographic reference group matters. Both studies employ multiple geographic reference income variables in their model specifications, defined using spatial units measured at alternative geographic scales. They find that SWB is increasing with small, postcode-level reference income measures, but decreasing with Metropolitan Statistical Area (MSA) reference income, a much larger spatial unit. Ifcher et al. (2018) believe that these findings are the net effect of multiple distinct channels linking reference income and SWB. In addition to the direct effects from relative deprivation or community altruism, there are indirect effects from public goods and amenities, the cost of living, as well as expectations of future income that can be correlated with reference income. They also suggest that these separate channels of transmission can vary across alternative spatial units used to define geographic reference income.

The concepts of neighbourhood consumption externalities and endogenous amenities can be linked to the public goods and amenities channel. In the consumer cities literature, neighbourhood consumption externalities occur when households gain utility from having higher-income households nearby, as it allows them to consume amenities that are endogenously determined by the incomes, wealth and talents of residents in higher-income neighbourhoods.[2] Several examples of desirable amenities that are endogenous to high-income neighbourhoods include lower crime rates, higher quality public goods such as schools, and ampler neighbourhood amenities, such as cafés or personal fitness services (Guerrieri et al., 2013). Both Brodeur & Flèche (2019) and Ifcher et al. (2018) find that public goods and amenities explain a sizable portion of the positive relationship between reference income and SWB at the neighbourhood level.

Ifcher et al. (2018) proxies for cost of living effects using both neighbourhood (postcode) and region wide (MSA) median rents. They find that controlling for MSA rent removes the negative effect of MSA reference income on SWB, but the positive impact of postcode reference income remains when controlling for postcode rents. This suggests that it is cost of living, not negative income comparisons, that drive the MSA effect. Why would cost of living reduce SWB at the region-wide level, but not at the neighbourhood level? A possible explanation is neighbourhood and region-wide rents proxy for different components of cost of living (Ifcher et al., 2018). Region-wide rents are correlated with the cost of non-discretionary expenses, such as food and utilities. Meanwhile, neighbourhood rents could price in the level of local amenity that helps to offset negative cost of living effects operating at a region-wide spatial level.

Hirschman & Rothschild (1973) suggest the existence of a positive *tunnel effect*. In the current context, geographic reference income is a positive signal of an individual's future income when the tunnel effect is present; a higher geographic reference income will then lift reported levels of wellbeing. Senik (2008) presents evidence supporting this notion when using professional

[2] See Broxterman et al. (2019) for a series of papers discussing endogenous amenities and the consumer city.

peers as the reference group in an aspatial study, but no evidence for the tunnel effect has been found when using geographic reference groups (Ifcher et al., 2018).

The majority of empirical studies reviewed utilise cross section data sets, including those employing geographic reference income variables based on alternative spatial unit definitions[3]. So, for example, the Brodeur & Flèche (2019), Ifcher et al. (2018), and Kingdon and Knight (2007) studies used cross-sectional data sets. They have limitations when it comes to addressing endogeneity and selection concerns due to unobserved individual heterogeneity; results could therefore be driven by omitted individual characteristics that influence self-reported happiness as well as residential location (Luttmer, 2005). Take, for instance, the positive effect of neighbourhood reference income on SWB, which may be unrelated to any of the previously proposed channels, but is instead the consequence of inherently happy individuals selecting into higher-income neighbourhoods (Luttmer, 2005). In this paper we take advantage of a panel-data modelling approach that controls for time-invariant aspects of unobserved individual heterogeneity and are also appropriate for use with ordinal based measures of wellbeing. This empirical approach is novel in the present context and may offer more reliable estimates.

Empirical Approach

Key data sources

In this paper we utilise panel data on the subjective and economic wellbeing of individual Australians. SWB data was sourced from the HILDA Survey (Department of Social Services & Melbourne Institute of Applied Economic and Social Research, 2021).[4] The first wave of data collected in 2001 interviewed 13,969 persons in 7,682 responding households, and the survey has grown each year to now include 17,070 persons interviewed in 9,555 responding households in wave 20.[5] Participating members of responding households aged 15 years and over complete annual interviews and self-completion questionnaires on a rich variety of

[3] Of the 6 key empirical studies reviewed above, three (Kingdon & Knight, 2007; Brodeur & Flèche 2019; Ifcher et al., 2018) are based on cross sectional data sets, one (Blanchflower & Oswald, 2004) uses pooled cross sections and only two (Clark et al., 2009; Luttmer, 2005) employ panel-data sets.

[4] For information on the design of the HILDA Survey see Watson & Wooden (2012).

[5] New members of a household that were part of the original sample frame participate in surveys from the year that they join the household. A top-up sample of individuals and households was also added to the survey in wave 11 (2011).

subjects. The HILDA Survey has become one of the primary data sources for explorations of SWB dynamics in the wellbeing literature due to its consistency, longevity and breadth (Johnston & Stavrunova, 2021). For our paper, the key data point is the answer to the question on overall life satisfaction, which provides us with a measure of an individual's self-reported SWB. Each wave of the survey the respondent was asked "All things considered, how satisfied are you with your life?" as rated on an ordinal scale of one-unit increments between 0 (totally dissatisfied) and 10 (totally satisfied). Australians are generally skewed towards a high level of satisfaction, with a modal response of 8.[6]

The HILDA Survey also provides a measure of income for each household that can then be compared to measures of geographic reference income. Household financial year total income is documented for each wave of the survey. As is standard in the geographic reference income literature (Brodeur & Flèche, 2019; Ifcher et al., 2018; Luttmer, 2005), we use reported total *household* income; individuals are assumed to compare their combined household resources to those of neighbours, not their own personal income. To account for differences in a household's size and composition, we equivalise household income following the OECD modified equivalence scale methodology.[7] The equivalised household income data, and all other monetary data used in this study, was inflation adjusted to 2020 values using the Consumer Price Index (CPI) of the individual's relevant State.[8]

The HILDA Survey's information on the residential location of each household allows us to match respondents to data on their neighbourhoods.[9] Our measure of neighbourhood reference income – median total equivalised household income – was sourced from the Australian census (ABS, 2016). As the Australian census is conducted every five years, the analysis is executed in the four HILDA Survey waves contemporaneous with Census years 2001, 2006, 2011, and 2016. Across these years there are 61,447 person-year observations in which HILDA

[6] Authors own calculation using the HILDA Survey waves 1, 6, 11, and 16.

[7] We use this method of equivalence as it is the same method used for the equivalised income data reported in the Australian Census, which is our source of reference group income. This method was performed by first calculating a household's equivalence factor that allocates points to each person in a household (1 point to the first adult, 0.5 points to each additional person who is 15 years and over, and 0.3 to each child under the age of 15). Household income was then divided by the sum of the points allocated to each person (the equivalence factor).

[8] CPI data was obtained from Australian Bureau of Statistics catalogue 6401.0 – Consumer Price Index, Australia.

[9] Access to the *Restricted Release* of the HILDA Survey was required for this research, as it contains the location of responding households at the neighbourhood level. The confidentialised release of the HILDA Survey, referred to as the *general release*, does not contain detailed geography – location is limited to city-wide or regional measures, such as the household's greater capital city, section of state, and remoteness area.

respondents (15 years or older) provided the necessary life satisfaction and income responses and could be matched to data on their neighbourhoods. These person-year observations consist of 26,814 unique persons and form our modelling sample.

As recent studies have established that the impact of reference income on SWB differs depending on geographic scale (Brodeur & Flèche, 2019; Ifcher et al., 2018), we experiment with multiple geographic reference groups. Our spatial unit of analysis representing the local neighbourhood is the Statistical Area Level 2 (SA2). SA2s are spatial units specifically designed by the Australian Bureau of Statistics (ABS) as part of the Australian Statistical Geography Standard (ASGS) (ABS, 2020).[10] They represent a community that is socially and economically connected, and usually comprises a limited number of suburbs or rural localities.[11] It is the finest level of spatial aggregation at which aggregate equivalised household income data is available in the Australian Census, and has been used to represent neighbourhood-level data in another recent Australian study (Clark et al., 2022). SA2s are also similar in scale to the postcode-level measures used to represent neighbourhoods in recent US-based studies, which facilitates comparison of results.

For urban residents, Greater Capital City Statistical Areas (GCCSAs) are chosen to measure region-wide incomes, our second geographic reference group. GCCSAs are also part of the ASGS and represent the functional extent of Australia's eight state and territory capital cities. They encompass populations that live in built-up areas of capital cities, as well as populations in the smaller towns and areas surrounding those cities, that regularly work, socialise and consume within those cities (ABS, 2020). 38.5% of observations in our sample reside outside Australia's capital cities. In the GCCSA classifications these populations are classified as Rest of State. The Rest of State classification is too broad a geographic reference group to represent region-wide incomes, and so Statistical Area Level 4s (SA4s), the first sub-classification of GCCSAs, are used instead. SA4s represent regional labour markets, and aggregate to form whole GCCSAs (ABS, 2020).

[10] The borders of a small number of SA2s changed over the study period. We ensure concordance of the SA2 data by employing consistent 2011 ASGS border definitions across all census years.

[11] The population of SA2s generally ranges between 3,000 and 25,000 persons, with an average population of 10,000 (ABS, 2020).

13.1% of observations in our sample reside in rural areas.[12] It is arguable whether SA4s in rural areas are valid for measurement because they cover large, remote parts of Australia that have weak social and economic connections as compared to urban populations and can exhibit greater heterogeneity. So, while reference income effects could be important in urban Australia, they may be obscured by the inclusion of rural areas. We experiment with models employing samples that alternately include and omit rural Australia.

Estimation strategy

The paper aims to identify relationships between geographic reference income (measured at finer as well as coarser spatial units) and the SWB of individual Australians, while controlling, as far as possible, for both observed and unobserved heterogeneity. To do this, we employ panel-data models that exploit the longitudinal nature of the HILDA survey by capturing variations in SWB both *between* individuals and *within* the same individual over time. A random-effects panel-data model uses variation within and between individuals to control for unobserved heterogeneity, but random-effects will only produce consistent estimates if the unobserved heterogeneity is uncorrelated with the measured independent variables (Cameron & Trivedi, 2010). As shown later in the analysis, this assumption does not hold, meaning a conventional random-effects specification is unsuitable.

Fixed-effects panel-data models utilise within-individual variations only, and can produce consistent estimates even when unobserved *time invariant* heterogeneity (e.g. personality traits) is correlated with measured explanatory variables (Cameron & Trivedi, 2010). Fixed-effects estimates will have the important attribute of ensuring that estimates of reference income SWB relationships are not driven by the self-selection of innately happy (unhappy) individuals into higher-income (lower-income) areas, a concern that is commonly expressed (Cheshire, et al., 2014; Luttmer, 2005).

However, the ordinal nature of the chosen life satisfaction dependent variable measure complicates the use of fixed-effects. In the social sciences, measures of SWB are commonly collected on ordinal scales. Ordered logit or ordered probit models allow researchers to account for the ordinal nature of SWB measures and estimate how the different variables affect the

[12] As based on the individual's Section of State classification in the Australian Statistical Geography Standard (ASGS).

likelihood of moving from one satisfaction rating to another.[13] However, when analysing ordinal panel data, there is no standard method for estimating a *fixed-effects* ordered logit/probit panel-data model.[14] This is because, in general, and unlike in the linear case, there is no simple transformation of the data that will eliminate the individual effects. Thus, estimation of a genuine *fixed-effects* ordered logit/probit model would require estimation of potentially thousands of individual-specific effects, but also be subject to the well-known *incidental parameters* problem (Neyman & Scott, 1948).

Researchers must then turn to competing estimation approaches that have been developed in the applied literature. These include, first, utilizing a conditional estimator for a fixed-effects ordered logit model; second, employing an approximation of fixed-effects within ordered random-effects models; or third, relaxing the assumption of ordinality entirely and utilizing a fixed-effects ordinary least squares (OLS) model.

In the context of the first option, conditional estimators for a fixed-effect ordered logit (FEOL) can be derived from the fixed-effects estimator originally designed for the binary logit model. An example of such a FEOL model was formulated by Ferrer-i-Carbonell & Frijters (2004) and applied in research investigating the relationship between wellbeing and various variables, including income (Frijters et al., 2004, 2005). Additionally, a FEOL panel-data model has been recently introduced as a community-contributed command for *Stata* by Baetschmann et al. (2020).

Though less robust, the third option is often preferred for ease of implementation and interpretation – coefficients can be interpreted as linear changes in the units of the satisfaction scale. In the geographic reference income literature, Luttmer (2005) elected to disregard the ordinal nature of their data by estimating linear pooled panel-data models.[15] Other recent papers also disregard the ordinal nature of the data (Ifcher et al., 2018), and/or are limited to purely cross-sectional data sets (Brodeur & Flèche, 2019; Ifcher et al., 2018). However, papers by Ferrer-i-Carbonell (2005) and Senik (2004), which include both spatial and aspatial measures

[13] Examples in the applied literature of the application of ordered models to our specific SWB measure from the HILDA Survey include Brown et al. (2014), Shields et al. (2009), and Zumbro (2014).

[14] For example, popular econometrics and statistical software package *Stata* provides only a random-effects specification for its ordered logit or ordered probit panel-data models (StataCorp, 2021).

[15] The author estimated an ordered probit model as a robustness check, but only on the cross-sectional data.

of reference income, buck this trend and estimate a correlated random-effects (CRE) ordered probit model (Mundlak, 1978).

CRE is an example of the second option, the approximation of fixed-effects within ordered random-effects models. A closely related substitute for CRE is the application of a *within-between* random-effects (REWB) specification to an ordered logit or probit panel-data model. REWB is commonly referred to as a hybrid random-effects model, and as explained by Schunck & Perales (2017), allows for the approximation of within-group effects (fixed-effects) using any generalized linear mixed model (GLMM) for which a fixed-effects estimator is not readily available. In the context of panel data on individuals, REWB decomposes the relevant time-variant independent variable X_{it} into a between-individual component, which is its mean ($\bar{X}_i$), and a within-individual component, which is the usual *within* transformation ($X_{it} - \bar{X}_i$). This type of model differentiates within- and between-cluster effects, to allow unobserved heterogeneity to be linearly correlated to the models' independent variables.

Of the three estimation strategies presented in this section, we elect to use the REWB approach due to an easily interpretable property; if the within- and between-effects of a variable are not equivalent, then this suggests unobserved heterogeneity is linearly correlated with the models' independent variables (Bell et al., 2019). By not equivalent, we mean that there is a statistically significant difference in the estimated values of the within- and between-effect coefficients for a given variable. The presence of correlation between unobserved heterogeneity and our geographic reference income variables has two implications. First, a traditional random-effects model would not have produced consistent estimates, and we are then justified in applying the REWB specification. Second, and more importantly, it suggests aspects of unobserved time-invariant heterogeneity, such as inherent happiness, impacts upon the SWB and reference income relationship. This would then cast doubt on the recent cross-sectional literature, forming a key contribution of this paper.

However, as exemplified in a comparison of estimation methods by Brown et al. (2015), reference income relationships can be highly sensitive to the choice of estimation method. We therefore re-estimate our primary specification using the FEOL and fixed-effects OLS methods to test the stability and consistency of the observed associations.

Primary specification

The REWB ordered probit panel-data model used in our analysis is:

$$SWB_{it}^{*} = \beta_{1W} ln(AI_{it} - \overline{AI}_i) + \beta_{2W} \ln\left(RI_{it}^{SA2} - \overline{RI}_i^{SA2}\right) + \beta_{3W} ln\left(RI_{it}^{GCCSA/SA4} - \overline{RI}_i^{GCCSA/SA4}\right)$$

$$+ \beta_{1B} ln(\overline{AI}_i) + \beta_{2B} ln\left(\overline{RI}_i^{SA2}\right) + \beta_{3B} ln\left(\overline{RI}_i^{GCCSA/SA4}\right) + V_{Wit} + V_{Bit} + \mu_i + \varepsilon_{it} \quad (2)$$

In which the dependent variable SWB_{it}^{*} is individual i's probability of being in a particular subjective wellbeing category at time t. AI_{it} is i's absolute income, RI_{it}^{SA2} and $RI_{it}^{GCCSA/SA4}$ are the reference incomes of an individual's SA2 and GCCSA/SA4 reference groups, V_{Wit} is the within-effects of a vector of time variant control variables, V_{Bit} is the between-effects of a vector of time-variant and time-invariant control variables, μ_i are the model's random-effects for individual i, and ε_{it} is an idiosyncratic error term.[16]

The within-effect coefficients of the reference income variables, β_{2W} and β_{3W}, are the estimates key to establishing the geographic reference income and SWB relationship within Australia. For a given geographic reference group, a positive and significant coefficient implies positive SWB externalities from high reference income areas, such as better public goods and amenities, that outweigh negative externalities, such as feelings of relative deprivation (envy or jealousy). The opposite is true if the within-effect coefficient is negative and significant. The between-effects of the reference income variables, β_{2B} and β_{3B}, are in our context necessary controls for applying the REWB specification and are not directly relevant to our analysis. However, as discussed earlier, they will be used to test for equivalence of the within- and between-effects of the models' covariates.

Model extensions

In an extension of the baseline model, we test if the within-effect coefficients of the reference income variables are dependent on i's rank in the distribution of household incomes within their geographic reference group. Reference income might have an asymmetric effect on SWB when lower-income households are more prone to feelings of relative deprivation than higher-income neighbours (Distante, 2013). Alternatively, lower-income households may experience greater benefit from amenities in high reference income neighbourhoods, such as access to better schools. To test for asymmetry, we interact each reference income measure with a dummy variable indicating whether i's income places them in the bottom half of their reference group's income distribution. If the estimated coefficients of these interaction terms are

[16] All prior studies of reference income and wellbeing log transform their income variables, and so we also follow this convention.

insignificant, there is no asymmetry. When these interaction terms are found to be positive (negative) and significant, they suggest that an absolute income below the median in their reference group lifts the positive (negative) impact of reference income on SWB.

We also assess the possibility that occurrence of financial deprivation or financial abundance alter reference income relationships. For example, an individual with a high household income, living in a *very*-high refence income neighbourhood, may not concern themselves with unfavourable comparisons to neighbours if their financial needs and wants are already met. Hence, we repeat the above exercise, but using i's rank in the *national* distribution of household incomes, with a specific focus on the extremities. We produce indicators for those below the national poverty line – incomes less than half of the national median (OECD, 2023) – and those we refer to as the upper-income class – incomes double the national median. We then interact each of these indicators with our reference income variables.

In a second extension, we test the extent to which the within-effect coefficients of the reference income variables are related to cost of living effects in that geographic reference group. Ifcher et al. (2018) suggests that it is a higher cost of living, as proxied by median rent, that drives a negative region-wide income effect in Brodeur & Flèche (2019) and Ifcher et al. (2018). Following Ifcher et al. (2018), we include median SA2 and GCCSA/SA4 rents to represent the cost of living channel. If the within-effects of these rent variables are found to be negative and significant, while estimated SA2 or GCCSA/SA4 reference income coefficients fall, then the cost of living channel could be a key driver of the SWB and reference income relationship.

In a final model extension, we examine whether reference incomes signal expectations of future income, and if SWB is impacted through this transmission channel. Ifcher et al. (2018) tested for this *tunnel effect* by adding the individual's expected wellbeing in five years as an additional predictor to their wellbeing models, on the assumption that reference income and wellbeing are fully mediated by changes in expectations of future income. Unfortunately, expectations of future income and wellbeing are not available in the HILDA Survey, so we turn to alternative measures. Senik (2008) points out that if higher reference incomes (defined for professional peer groups) are a marker of i's stronger expectations of future income, then impacts on wellbeing should be greater for younger people because their income gains endure over a longer period of labour force participation (LFP). To investigate this, Senik (2008) interacted reference income with a binary indicator for those that are young (aged < 41).[17] We follow this empirical approach but adapted for a geographic reference income context. Positive impacts for people under the age of 41 suggest that expectations of future income help mediate the relationship between reference income and SWB.

Summary statistics and other control variables

We draw on the SWB literature to specify a rich set of control variables that capture well known demographic, socioeconomic, housing, and health factors shaping wellbeing outcomes.[18] State of residence and year controls are also included in all model specifications. Summary statistics for these control variables, as well as the key absolute and reference income measures, are provided in Table 1. The average real household equivalised income across all person-year observations in the sample is \$66,661, but there is considerable variation around this mean, with a standard deviation of \$70,775.[19] 39.4% of household income observations are below their respective SA2 real median household equivalised incomes, and 40.6% are below their respective GCCSA/SA4 real median household equivalised incomes.

Demographic control variables include the participant's age, sex, country of birth and role in the household. We do not use population weights in this analysis, and so cannot claim that the demographic profile of our modelling sample is nationally representative. However, the HILDA Survey was conceived as a nationally representative panel-data survey, and boasts an excellent retention rate – wave-by-wave re-interview rates have been maintained at over 96% from wave 9 onwards (Watson & Wooden, 2021). The survey also employs robust panel maintenance strategies, such as booster samples, to address attrition and maintain representativeness (Watson & Wooden, 2021). Hence, our modelling sample is respectably representative of the profile of the Australian adult population. Table 1 shows the average age of person-year observations in our sample to be 44 years. The impact of age on SWB tends to

[17] Senik (2008) does not offer a rationale for the 41 years of age threshold, but it likely represents the *early career* stage of LFP, characterised by the strongest opportunities for positive earnings growth. This is evidenced in the 2016 Australian census, which documents a peak in the median earnings of full-time workers at 41 years (ABS, 2016).

[18] We considered the inclusion of measures of social capital, including participation in *i*'s local community. However, these measures are contained in the voluntary self-completion questionnaire of the HILDA Survey, which have lower levels of response compared to our other predictors, significantly reducing model sample size.

[19] The maximum household income observed is \$4,594,092. Removing the bottom and top five percent of observations, as ranked by household income, reduces the average to \$60,134 and the standard deviation to a less extreme \$31,512.

be 'U-shaped', meaning SWB declines with age, until a point later in life after which it starts increasing (Wilkins et al., 2020). We therefore specify age as a quadratic. Over 60% of responses are in couple relationships (both with and without children), while just 5.6% are lone parents. SWB studies generally find lower life satisfaction among lone parents, reflecting greater difficulties juggling family and income-earning responsibilities (Shields & Wooden, 2003).

Socioeconomic and housing variables include highest educational attainment, employment status, dwelling type, dwelling tenure, and residence in a major city as defined by their remoteness area in the ASGS (ABS, 2020). Roughly two thirds of our sample reside in a major city, with the remainder in other areas of Australia. The employment status categories identify full-time employed, part-time employed, the self-employed, the unemployed, as well as full-time students, retirees, and others absent from the labour force. Respondents were largely outright owners or mortgagors of their homes (68.6%), and the vast majority lived in a detached house (88.5%), as opposed to units or other dwelling types.

To cover for the impact of an individual's health on SWB, we include a control for whether the individual has a long-term disability. The HILDA survey does contain an individual's self-assessed health, which is likely to be a better measure of an individual's overall health, however, there are likely to be endogeneity concerns when using both self-assessed health and self-assessed SWB in the same model (e.g. very happy people are likely to be more positive about their state of health) (Clark et al., 2009; Shields & Wooden, 2003). Hence, we use the presence of long-term disability, an exogenous measure of health, and augment this with severity – slight, moderate, and severe – based on how much their condition impacts their ability to participate in employment.

We also control for the presence of other adults during the interview in which the respondent provided their life satisfaction rating. Interviewers in HILDA are unable to ensure that interviews are conducted in private. In the presence of others, one might feel pressured to report a higher life satisfaction to avoid upsetting another person or creating conflict. 37.3% of the sample's person-year observations were potentially impacted by this upward bias.

Results

The results of our analysis are presented in Table 2. Column C1 reports estimates from the REWB ordered probit model specified in equation (2), and the remaining columns, C2-C7, list estimates obtained from model extensions.

First, consider the results from the main model in C1. The within-effect coefficients attached to neighbourhood (SA2) and region-wide (GCCSA/SA4) reference income variables are the key estimates. We find that increasing reference income is *positively* associated with SWB at the neighbourhood level ($\beta_{2W} = 0.178$), but *insignificant* at the region-wide level. These associations suggest that at the neighbourhood level in Australia, the positive externalities from living alongside those with higher incomes, such as better public goods and amenity, outweigh the negative externalities, such as feelings of relative deprivation and cost of living effects. At the region-wide level, the net of externalities effect on SWB is insignificantly different from zero. These SWB relationships only partially match the conclusions established in recent US-based literature (Brodeur & Flèche, 2019; Ifcher et al., 2018), which do estimate a positive coefficient at the neighbourhood level but uncover a negative coefficient at the region-wide level.

A potential explanation for this divergence are Australian-US cultural differences concerning altruism and materialism, but our use of panel data and the REWB specification allow for another explanation. A Wald test rejects a hypothesis of no difference between the within-effect and between-effect of both reference income variables at the 1% level.[20] This suggests that we are justified in including within-effects using REWB, instead of a conventional random-effects specification. It also signals correlation between unobserved individual heterogeneity and the reference income variables. Therefore, by failing to control for this, the negative coefficient at the region-wide level in the prior literature could be inadvertently capturing the self-selection of innately unhappy individuals into higher-income regions, or any other example of endogenous self-selection. Region-wide spatial units are characterised by extensive heterogeneity in the composition and status of its residents. It appears that on controlling for this heterogeneity through panel-data methods, amenities effects or income comparisons are only captured by neighbourhood reference income measures. In other words, the channels between reference income and SWB identified in the *background* section of the paper may only be active at the neighbourhood level.

[20] The application of Wald tests to REWB models is demonstrated in Schunck (2013).

Second, after controlling for geographic refence income, we find that own financial year household equivalised income still has a marginally positive impact on SWB ($\beta_{1W} = 0.071$), an estimate significant at the 0.1% level. In comparison, neighbourhood reference income has a greater impact on life satisfaction. Neighbourhood income effects are larger at 2.5 times that of own household income. This finding could indicate that place-based policies designed to raise community-wide incomes are a viable compliment to traditional welfare policy. However, as noted by Luttmer (2005, p976), the coefficient on own household equivalised income might be small because the regression includes other proxies for income such as educational attainment.

Third, the coefficients of the models' covariates are consistent with expected relationships. Our main specification (C1) includes a diverse set of controls that capture well known demographic, socioeconomic, housing, and health factors shaping wellbeing outcomes. The coefficients for these covariates are presented in the online supplementary materials. As commonly observed in prior literature (Wilkins et al., 2020), SWB declines with age, until a point later in life after which it starts increasing. Those in childless couples experience greater SWB as compared to couples with children, lone parents, and lone persons. The binary indicator for survey respondents interviewed in the presence of another adult shows an upward bias in SWB, which suggests those interviewed in an unconcealed setting may have felt pressured to provide a higher life satisfaction rating.

Outright homeowners are the happiest tenure type, but whether the home is a detached house or unit has no effect. As compared to the full-time employed, the part-time employed and those not in the labour force experience a SWB premium, while unsurprisingly, the unemployed suffer a SWB penalty. Those with a severe long-term disability experience the largest reduction in SWB – as compared to those unburdened by disability. Lastly, the third of our sample residing outside Australia's major cities exhibit higher SWB compared to those living within major cities.

Fourth, the exclusion of residents in rural Australia (13.1% of all person-observations), where public good and amenity channels are thought to be weaker, does not radically alter estimates. In column C2 the within-effects of our income variables remain largely unchanged.

Fifth, the reference income relationships established in C1 are the same regardless of whether individuals' own incomes are above or below neighbourhood or region median incomes. In C3, we add binary indicators signalling individuals in the bottom half of their neighbourhood or region-wide household income distribution. We then interact each indicator with the corresponding neighbourhood income and region-wide income variables. The within-effects estimates of these interaction terms are statistically insignificant, while reference income variable coefficient estimates are unchanged. It appears that individuals receive a positive SWB uplift as neighbourhood income rises and are indifferent when region-wide income rises, regardless of their rank in the neighbourhood income distribution.

However, for individuals experiencing financial deprivation, indifference towards region-wide income is replaced with a negative SWB penalty. In C4 and C5, we shift focus to those in the extremities of the *national* distribution of household incomes. Reference income is interacted with an indicator for those below the national poverty line – incomes less than half of the national median – and an indicator for the upper-income class – incomes double the national median. The within-effects estimates of these interaction terms are statistically insignificant for those in the upper-income class, but significant and negative for those below the poverty line. Thus, the SWB of those experiencing financial deprivation is reduced when region-wide incomes rise, highlighting the ongoing need for traditional welfare policy to redistribute income to those that are deprived.

Sixth, the negative region-wide reference income relationship remains insignificant and is not explained by a higher cost of living as it is in the Ifcher et al. (2018) US-based study. The specification estimated in C6 adds median SA2 and GCCSA/SA4 rents to capture cost-of-living effects. However, the within-effect rent coefficients are statistically insignificant.

Lastly, the reference income relationships established in C1 do not differ between the young – those in the early career stage of labour force participation – and old. In C7, we define a dummy variable indicating age under 41 years and interact it with neighbourhood income and region-wide income measures. When these two interaction terms are added, their within-effect coefficients are found to be statistically insignificant. These results imply that geographic reference income effects on SWB are unlikely to be due to expectations of future income (the *tunnel effect*), as they would be stronger among the young. Ifcher et al. (2018) also reports no evidence of a tunnel effect.

Additional model selection, endogeneity, and self-selection checks

In columns C8-C11 of Table 3, we present four additional robustness checks. The REWB specification used in this analysis allows for an approximation of fixed-effects estimates for ordinal panel data. However, Brown et al. (2015) suggests that reference income relationships can be sensitive to the choice of estimation method. In C8, we test the sensitivity of our results when applying a competing estimator of fixed-effects for ordered panel-data – the FEOL model (Baetschmann et al., 2020). In C9, we then loosen the restricting assumption that our SWB measure is ordinal and apply a fixed-effects *OLS* estimator. On re-estimation, we find that the relationships from our main specification (C1) are maintained when using these different estimation methods, providing further support for the stability and consistency of the observed relationships.

Our current main specification uses fixed-effects to counter the possibility that estimates are driven by the self-selection of innately happy or unhappy individuals into higher-income neighbourhoods or regions. However, this specification does not rule out selection based on unobserved time-variant characteristics (Luttmer, 2005). One particular concern is movers. Their relocations could generally be triggered by unmeasured positive events (e.g., job promotion) that both lift SWB and prompt moves into higher income neighbourhoods. Alternatively, unmeasured negative events (e.g., relationship break down, job loss) could both lower SWB and prompt moves into lower income neighbourhoods. We address this concern in column C10, by adding a binary indicator for respondents who moved across neighbourhood (SA2) boundaries in the last 5 years (time *t-5* to *t*). The inclusion of this indicator reduces the number of person-year observations to 38,184, as each observation now requires location data at both *t-5* and *t*. We find that moves across neighbourhoods are associated with an increase in SWB, a plausible result given residential mobility is known to be associated with variations in subjective wellbeing and mental health (Wood et al., 2023). Despite this, the reference income relationships identified in our original sample frame are unchanged.

An alternative strategy motivated by endogenous self-selection concerns is to restrict the estimation sample by selecting those for whom choice of neighbourhood is likely exogenous. We hypothesise that dependent children living in the parental home are less susceptible to endogeneity concerns, as location is most likely decided by their parents. Our sample contains 4,131 person-year observations in which a dependent child aged fifteen or over is living in the parental home, a sample size that is too small for the ordered probit REWB estimation. However, given the case for exogeneity in this sub-sample, we can implement a pooled ordered probit specification. In C11, the neighbourhood reference income effect is still positive, but is statistically insignificant. The perception of the relative benefits of household income amongst dependent children may differ from their parents and warrants further exploration.

Conclusion

This study aimed to establish the relationships between alternative versions of geographic reference income and individual SWB in Australia. Our empirical investigation finds that after controlling for individuals' own household incomes and time-invariant unobserved heterogeneity, there is a positive relationship between reference income and SWB at the neighbourhood level, but no relationship at the region-wide level. At the neighbourhood level, the positive externalities from living amongst higher-income households, such as better public goods and amenity, seem to outweigh negative externalities, such as feelings of relative deprivation. At the region-wide level, these channels between reference income and SWB appear to be inactive or have no net effect.

These SWB relationships only partially match the conclusions established in recent US-based literature (Brodeur & Flèche, 2019; Ifcher et al., 2018). The use of panel data and the REWB specification in our study allow for a potential explanation; we show that unobserved individual heterogeneity is correlated with reference income variables. By failing to control for this, the negative coefficient at the region-wide level in the prior literature could be inadvertently capturing endogenous self-selection effects.

In extensions to our main model specification, we find that the positive neighbourhood reference income to SWB relationship is unaffected by an individual's ranking in their neighbourhood distribution of incomes. This finding highlights the potential importance of place-based policies towards improving wellbeing, in addition to traditional welfare programmes. In Australia, it is often argued that policies encouraging diversity of income, tenure and class within neighbourhoods will break up clusters of social disadvantage and improve outcomes (Parkinson et al., 2014). However, critics argue these social mixing policies will be an ineffective use of societal resources. It may be better to implement policies targeted on disadvantaged households as spatial income segregation is caused by a neighbourhood sorting process that reflects household income inequality (Cheshire et al., 2014). The positive neighbourhood reference income SWB relationship we identify for Australia suggests there could be merit in policies that encourage social mixing.[21] This supports the locating of new social housing within mixed-tenure neighbourhoods, an initiative that is gaining currency

[21] A less positive interpretation could be applied to social mixing. An influx of lower-income residents into higher-income neighbourhoods would raise the wellbeing of *new* residents, as reference incomes are higher relative to their previous neighbourhood. However, if this influx of lower-income residents lowers reference income, the wellbeing of *existing* residents will be reduced.

among some Australian state governments. The research also suggests that policies promoting the construction of middle to higher income housing in disadvantaged communities could have positive impacts on the wellbeing levels of lower-income residents in those communities.

While our results offer some support for these policies there are important caveats as our findings are nuanced. A potentially important research direction is the employment of Quasi-experimental methods that exploit the introduction of social mixing interventions into neighbourhoods, to measure SWB impacts (for both new and existing residents) in comparison to neighbourhoods where no interventions have been made.

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Tables

Table 1 Descriptive statistics describing person-year observations of the modelling sample.

	Mean	*Std Dev*
Life satisfaction (SWB)	7.92	1.51
0 (totally dissatisfied)	0.2%	
1	0.2%	
2	0.4%	
3	0.7%	
4	1.2%	
5	4.3%	
6	5.8%	
7	18.8%	
8	32.8%	
9	21.8%	
10 (totally satisfied)	13.8%	
Real household equivalised income	$66,661	$70,775
SA2 real median household equivalised income	$ 46,839	$13,815
GCCSA/SA4 real median household equivalised income	$ 46,421	$8,368
Bottom half of SA2 income	39.4%	
Bottom half of GCCSA/SA4 income	40.6%	
Below poverty line (<50% of national income)	13.9%	
Upper-income class (>200% of national income)	18.2%	
SA2 real median rent	$310	$109
GCCSA/SA4 real median rent	$300	$81
Age	44.1	18
Is early career (< 41 years old)	46.1%	
Gender		
Male	46.73%	
Female	53.27%	
Role in household		
Couple w/o children	29.6%	
Couple w/ children	32.3%	
Lone parent	5.6%	
Lone person	15.4%	
Child aged 15+ years (dependant or non-dependant)	12.8%	
Other	4.4%	
Country of birth		

Australia – non-Indigenous	75.0%
Australia – indigenous	2.5%
Main English-speaking	9.9%
Other	12.6%
Dwelling type	
House	88.5%
Unit or other	11.5%
Dwelling tenure	
Outright Owner	31.8%
Owns with any Mortgage	36.8%
Renter	28.8%
Rent free/Life Tenure	2.6%
Highest education attainment	
Bachelor's degree or higher	21.9%
Other post-school qualification	29.1%
Completed high school	15.2%
Less than high school completion	33.7%
Employment status	
Employee full-time (FT)	35.6%
Employee part-time (PT)	17.6%
Employer or self-employed	10.0%
Not in labour force – FT student	3.8%
Not in labour force – retired	17.6%
Not in labour force – other	11.5%
Unemployed	3.9%
Long-term health condition	
No	73.57%
Slight	7.7%
Moderate	17.7%
Severe	1.0%
Other adult present during interview	
No	62.7%
Yes	37.3%
Resides in major city (ABS remoteness area)	
Major city	65.4%
Other area	34.6%
State of residence	
New South Wales	30.3%
Victoria	25.1%
Queensland	20.4%
South Australia	9.2%

Western Australia	9.3%	
Tasmania	3.1%	
Northern Territory	0.7%	
Australian Capital Territory	1.9%	
Year of observation		
2001	22.5%	
2006	20.9%	
2011	28.3%	
2016	28.4%	
Person-year observations (N)		61,447
Individuals (n)		26,814
Average N per n		2.3
Minimum N per n		1
Maximum N per n		4

Source: Authors own calculations using Australian Census data and responses to wave 1, 6, 11, and 16 of the HILDA survey.

Notes: SA2s, GCCSAs/SA4s and remoteness area are defined by the 2011 ABS ASGS. For individuals outside Australia's capital cities, SA4s are used as the spatial unit instead of GCCSAs. All monetary figures are in Australian dollars and were inflated to real 2020 values using the relevant CPI from ABS catalogue 6401.0 – Consumer Price Index, Australia. 'Main English speaking' countries are the United Kingdom, New Zealand, Canada, USA, Ireland, and South Africa.

Table 2 REWB ordered probit panel-data models of subjective wellbeing.

Dependent variable: One's Life satisfaction	*(C1) REWB Ordered Probit*	*(C2) w/o Rural Australians*	*(C3) Income Rank Interactions*	*(C4) Poverty Interactions*	*(C5) Upper-class interactions*	*(C6) With Rent Variables*	*(C7) Age Interactions*
	Coeff. (SE)	***Coeff. (SE)***	***Coeff. (SE)***	***Coeff. (SE)***	***Coeff. (SE)***	***Coeff. (SE)***	***Coeff. (SE)***
Within-Effects of key variables:							
Ln real household equivalised income (β_{1W})	0.071*** (.012)	0. 071*** (.013)	0.069*** (.015)	0.078*** (.014)	0.076*** (.013)	0.071*** (.012)	0.071*** (.012)
Ln SA2 real median household equivalised income (β_{2W})	0.178*** (.049)	0.185*** (.052)	0.192*** (.054)	0.157** (.050)	0.184*** (.051)	0.137** (.056)	0.206** (.066)
Ln GCCSA/SA4 real median household equivalised income (β_{3W})	0.044 (.109)	0.038 (.127)	0.059 (.114)	0.097 (.110)	0.020 (.110)	0.109 (.141)	0.162 (.128)
Bottom half of SA2 income	-	-	0.073 (.636)	-	-	-	-
Bottom half of GCCSA/SA4 income	-	-	0.735 (.976)	-	-	-	-
Bottom half of SA2 income: Ln SA2 real median household equivalised Income	-	-	-0.008 (.059)	-	-	-	-
Bottom half of GCCSA/SA4 income: Ln GCCSA/SA4 real median household equivalised Income	-	-	-0.066 (.090)	-	-	-	-
Below poverty line (<50% of national income)	-	-	-	2.367* (1.116)	-	-	-
Below poverty line: Ln SA2 real median household equivalised Income	-	-	-	0.153 (.094)	-	-	-
Below poverty line: Ln GCCSA/SA4 real median household equivalised Income	-	-	-	-0.371** (.131)	-	-	-
Upper-income class (>200% of national income)	-	-	-	-	-1.356 (1.047)	-	-

Upper-income class: Ln SA2 real median household equivalised Income	-	-	-	-	-0.032 (.079)	-	-
Upper-income class: Ln GCCSA/SA4 real median household equivalised Income	-	-	-	-	0.157 (.127)	-	-
Ln SA2 real median rent	-	-	-	-	-	0.071 (.048)	-
Ln GCCSA/SA4 real median Rent	-	-	-	-	-	-0.081 (.096)	-
Early career (age < 41)	-	-	-	-	-	-	2.82*** (.941)
Early career: Ln SA2 real median household equivalised Income	-	-	-	-	-	-	-0.048 (.076)
Early career: Ln GCCSA/SA4 real median household equivalised Income	-	-	-	-	-	-	-0.216 (.121)
Between-effects of key variables	✓	✓	✓	✓	✓	✓	✓
Within- and between-effects of control variables:							
Age and age squared	✓	✓	✓	✓	✓	✓	✗
Gender^	✓	✓	✓	✓	✓	✓	✓
Role in household	✓	✓	✓	✓	✓	✓	✓
Country of birth^	✓	✓	✓	✓	✓	✓	✓
Dwelling type and housing tenure	✓	✓	✓	✓	✓	✓	✓
Educational attainment	✓	✓	✓	✓	✓	✓	✓
Employment status	✓	✓	✓	✓	✓	✓	✓
Long-term health condition and severity	✓	✓	✓	✓	✓	✓	✓
Other adult present during interview	✓	✓	✓	✓	✓	✓	✓

Resides in a major city (ABS remoteness area)	✓	✓	✓	✓	✓	✓	✓
State of residence	✓	✓	✓	✓	✓	✓	✓
Year of observation controls	✓	✓	✓	✓	✓	✓	✓
Person-year observations (N)	61,447	53,416	61,447	61,447	61,447	61,445	61,447
Number of individuals (n)	26,814	24,330	26,814	26,814	26,814	26,814	26,814

* P < 0.05, ** p < 0.01, *** p < 0.001.

Source: Authors own calculations using Australian Census data and responses to wave 1, 6, 11, and 16 of the HILDA survey.

Notes: SA2s and GCCSAs/SA4s are defined by the ABS ASGS. For individuals outside Australia's capital cities, SA4s are used as a spatial unit instead of GCCSAs. Full results for all models are available upon request.

^ These variables are time-invariant, and therefore are not split into within- and between-effects.

Table 3 Additional model selection, endogeneity, and self-selection checks

Dependent variable: One's Life satisfaction	*(C8) C1 but Fixed-Effects Ordered Logit (FEOL)*	*(C9) C1 but Fixed-Effects OLS*	*(C10) C1 with neighbourhood move indicator*	*(11) Those living in the parental home (Pooled Ordered Probit)*
	Coeff. (S.E)	***Coeff. (S.E)***	***Coeff. (S.E)***	***Coeff. (S.E)***
Ln real household equivalised income (β_{1W})	0.133*** (0.025)	0.073*** (0.014)	0.059*** (0.016)	0.077* (0.032)
Ln SA2 real median household equivalised income (β_{2W})	0.294** (0.098)	0.182*** (0.054)	0.204** (0.068)	.010 (0.087)
Ln GCCSA/SA4 real median household equivalised income (β_{3W})	0.227 (0.221)	0.119 (0.122)	-0.069 (0.166)	-.277 (0.181)
Moved neighbourhood (SA2) [time t-5 to t]	-	-	0.129*** (0.020)	-
Person-year observations (N)	42,861	61,447	38,184	4,131
Number of individuals (n)	13,654	26,814	18,948	-

* P < 0.05, ** p < 0.01, *** p < 0.001.

Source: Authors own calculations using Australian Census data and responses to wave 1, 6, 11, and 16 of the HILDA Survey.

Notes: The errors in the pooled ordered probit model are robust to individual clusters. Control variables omitted from Table 3. The estimated coefficients for the control variables are available upon request.

Geographic Reference Income and the Subjective Wellbeing of Australians:

Online supplementary material

Table S1 Baseline REWB ordered probit panel-data model of subjective wellbeing (C1 from Table 2 of main text, but with all coefficients shown).

Dependent variable: **One's Life satisfaction**	**Coefficient**	**Std. err.**	**P>z**	**[95% conf.**	**interval]**
R_ Is female	0.064	0.016	0	0.032	0.095
R_ Born an Indigenous Australian [RG: Born in Australia]	0.294	0.046	0	0.204	0.385
R_ Born overseas in a main English-Speaking country	0.070	0.025	0.006	0.020	0.120
R_ Born elsewhere overseas	-0.157	0.023	0	-0.203	-0.111
W_ Ln real household equivalised income	0.071	0.012	0	0.047	0.095
W_ Ln SA2 real median household equivalised income	0.179	0.049	0	0.083	0.274
W_ Ln GCCSA/SA4 real median household equivalised income	0.044	0.109	0.686	-0.170	0.258
W_ Age	-0.035	0.004	0	-0.044	-0.027
W_ Age Squared	0.000	0.000	0	0.000	0.000
W_ Couple with children [RG: Couple without children]	-0.102	0.021	0	-0.143	-0.061
W_ Lone parent	-0.473	0.037	0	-0.545	-0.401
W_ Lone person	-0.319	0.027	0	-0.372	-0.265
W_ Child aged 15+ years	-0.268	0.036	0	-0.338	-0.198
W_ Another household member	-0.396	0.042	0	-0.479	-0.314
W_ Completed highschool [RG: Did not complete highschool]	-0.257	0.039	0	-0.334	-0.180
W_ Other post-school qualification	-0.162	0.039	0	-0.238	-0.087
W_ Bachelor's degree or higher	-0.148	0.053	0.005	-0.252	-0.044
W_ Lives in a separate or semi-detached house	-0.008	0.024	0.729	-0.055	0.038
W_ Owns with any Mortgage (RG: Owns outright)	-0.053	0.020	0.01	-0.093	-0.013
W_ Renter	-0.170	0.027	0	-0.222	-0.118
W_ Rent free	-0.048	0.045	0.293	-0.136	0.041
W_ Employee part-time (PT) [RG: Employee full-time (FT)]	0.121	0.021	0	0.080	0.162
W_ Employer or Self-employed FT	-0.027	0.033	0.421	-0.092	0.039
W_ Employer or Self-employed PT	0.223	0.040	0	0.146	0.301
W_ Not in labour force – FT student	-0.100	0.036	0.006	-0.172	-0.029
W_ Not in labour force – retired	0.185	0.044	0	0.099	0.272
W_ Not in labour force – other	0.232	0.032	0	0.170	0.294
W_ Unemployed	0.137	0.027	0	0.085	0.189
W_ Slight health condition [RG: No health condition]	-0.115	0.024	0	-0.161	-0.068
W_ Moderate health condition	-0.411	0.022	0	-0.453	-0.369
W_ Severe health condition	-0.704	0.061	0	-0.824	-0.584
W_ Another adult was present during interview	0.037	0.014	0.009	0.009	0.064
W_ Resides in major city (ABS remoteness area)	-0.081	0.035	0.019	-0.149	-0.013
W_ Victoria [RG: State is New South Wales]	-0.014	0.061	0.814	-0.134	0.105
W_ Queensland	0.073	0.053	0.169	-0.031	0.177
W_ South Australia	0.186	0.094	0.047	0.002	0.371
W_ Western Australia	-0.035	0.088	0.688	-0.207	0.137
W_ Tasmania	0.302	0.117	0.01	0.073	0.531
W_ Northern Territory	-0.159	0.122	0.193	-0.399	0.081
W_ Australian Capital Territory	-0.046	0.101	0.645	-0.244	0.151
W_ Year of observation belonged to second decade	0.070	0.021	0.001	0.029	0.112
B_ Ln real household equivalised income	0.136	0.015	0	0.106	0.166
B_ Ln SA2 real median household equivalised income	0.020	0.039	0.607	-0.057	0.098
B_ Ln GCCSA/SA4 real median household equivalised income	-0.352	0.081	0	-0.512	-0.193

B_ Age	-0.056	0.003	0	-0.061	-0.050
B_ Age Squared	0.001	0.000	0	0.001	0.001
B_ Couple with children [RG: Couple without children]	-0.046	0.025	0.06	-0.095	0.002
B_ Lone parent	-0.629	0.042	0	-0.712	-0.546
B_ Lone person	-0.422	0.030	0	-0.482	-0.363
B_ Child aged 15+ years	-0.231	0.037	0	-0.303	-0.158
B_ Another household member	-0.351	0.041	0	-0.431	-0.271
B_ Completed highschool [RG: Did not complete highschool]	-0.119	0.025	0	-0.167	-0.070
B_ Other post-school qualification	-0.114	0.021	0	-0.155	-0.074
B_ Bachelor's degree or higher	-0.178	0.024	0	-0.225	-0.130
B_ Lives in a separate or semi-detached house	0.015	0.030	0.619	-0.044	0.074
B_ Owns with any Mortgage (RG: Owns outright)	-0.125	0.025	0	-0.173	-0.077
B_ Renter	-0.228	0.027	0	-0.280	-0.176
B_ Rent free	-0.061	0.059	0.306	-0.177	0.055
B_ Employee part-time (PT) [RG: Employee full-time (FT)]	0.093	0.028	0.001	0.037	0.149
B_ Employer or Self-employed FT	-0.032	0.037	0.383	-0.105	0.040
B_ Employer or Self-employed PT	0.198	0.056	0	0.088	0.308
B_ Not in labour force – FT student	-0.238	0.047	0	-0.330	-0.147
B_ Not in labour force – retired	0.159	0.048	0.001	0.065	0.254
B_ Not in labour force – other	0.327	0.044	0	0.240	0.414
B_ Unemployed	0.173	0.034	0	0.106	0.240
B_ Slight health condition [RG: No health condition]	-0.241	0.037	0	-0.314	-0.168
B_ Moderate health condition	-0.919	0.026	0	-0.971	-0.867
B_ Severe health condition	-1.433	0.098	0	-1.625	-1.241
B_ Another adult was present during interview	0.102	0.021	0	0.062	0.142
B_ Resides in major city (ABS remoteness area)	-0.124	0.025	0	-0.173	-0.076
B_ Victoria [RG: State is New South Wales]	0.019	0.020	0.348	-0.020	0.058
B_ Queensland	-0.019	0.022	0.374	-0.062	0.023
B_ South Australia	-0.016	0.030	0.588	-0.074	0.042
B_ Western Australia	-0.048	0.028	0.088	-0.102	0.007
B_ Tasmania	0.026	0.046	0.567	-0.064	0.117
B_ Northern Territory	0.071	0.106	0.499	-0.136	0.278
B_ Australian Capital Territory	0.113	0.062	0.068	-0.008	0.233
B_ Year of observation belonged to second decade	0.127	0.025	0	0.078	0.176
Person-year observations (N)	61,447				
Number of individuals (n)	26,814				

Source: Authors own calculations using Australian Census data and responses to wave 1, 6, 11, and 16 of the HILDA survey.

R_ These variables are time-invariant, and therefore are not split into within- and between-effects.

W_ Within effect of variable.

B_ Between effect of variable.