Income Inequality and Mental Health

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Abstract

The causal association between absolute income and health is well established, however the relationship between income inequality and health is not. The conclusions from the received studies vary across the region or country studied and/or the methodology employed. Using the Household, Income and Labour Dynamics in Australia panel survey, this paper investigates the relationship between mental health and inequality in Australia. A variety of income inequality indices are calculated to test both the Income Inequality and Relative Deprivation Hypothesis. We find that mental health is only adversely affected by the presence of relative deprivation to a very small degree. In addition we do not find support for the Income Inequality Hypothesis. Importantly our results are robust to a number of sensitivity analyses.

Keywords: HILDA, Mental Health, Income Inequality, Relative Deprivation.

JEL Classification: I10, I18, C33, D63

The authors are thankful to Paul Frijters, David Johnston, Paula Lorgelly and participants of the Second Australian Health Econometric Workshop for their comments on an earlier version of the paper. A special thanks is due to Elizabeth Savage in her role as discussant of this paper and Glenn Jones who provided detailed feedback. The current version greatly benefited from their comments. We have no conflicts of interest.

Introduction and Background:

The health economics literature has many contributions that aim to quantify the determinants of health (Cutlera and Lleras-Muney, 2010; Berry and Welsh, 2010; Frijters and Ulker, 2008; Ruhm, 2000). The general consensus is that income has a strong impact on health outcomes (Deaton, 2003), hence the absolute income hypothesis (AIH) is supported. This relationship is also found for Australia (Cai, 2009; Heady and Wooden, 2005; Chotikapanich et al., 2003; Clarke and Smith, 2000).

Proponents of the relative income hypotheses (RIH) argue that in developed countries it is the income distribution, rather than absolute income, that matters when it comes to health outcomes (Wilkinson, 1996, Runciman, 1966). However, income inequality as a health determinant has failed to gain robust support, with some studies finding an effect (Subramanyam et al., 2009; Wilkinson and Pickett, 2009) and others finding little or no impact (Jones and Wildman, 2008; Lorgelly and Lindley, 2008). So far, this relationship remains unexplored for Australia and this study fills this gap. In particular, we aim to quantify the relationship between income inequality and mental health for Australia, while testing the sensitivity of our results to the choice of inequality measure. To achieve this we utilize the Household, Income and Labour Dynamics in Australia (HILDA) panel survey. To our knowledge this is the first study that aims to establish a casual relationship between mental health and inequality.

Inconsistent findings between the studies received are partly due to different methods employed to test the relationship between income inequality and health. An important distinction is made between two hypotheses within the RIH: the relative deprivation hypothesis (RDH), which detects an adverse association for some individuals within a group; and the income inequality hypothesis (IIH), which is a stronger association, suggesting that the whole reference group is adversely affected by the inequality within the group.

It is also apparent that the social and economic framework within a country is important in driving conclusions. For example, it is common to find that income inequality either does not affect health outcomes, or affects these outcomes only marginally for the UK and other E.U. countries, which pursue more progressive

health and social policies (Jones and Wildman, 2008; Lorgelly and Lindley, 2008; Gravelle and Sutton, 2009; Hildebrand and Kerm, 2009). This is despite the fact that the UK has significantly higher levels of income inequality in comparison to most other E.U. countries[1] (see Wilkinson and Pickett, 2009 pp 17). Conversely, a stronger effect is commonly found in studies that consider the relationship for the US (Wilkinson, 1996; Wilkinson and Pickett, 2009; Kaplan et al., 1996; Kennedy et al., 1996). Out-of-pocket expenses paid by Australians for health services is greater than that paid in the United Kingdom, reflecting their National Health System (NHS), but lower than the United States, where there is significantly less public funding for health services OECD (2010). Therefore, Australia can be considered as having a health system which lies somewhere in the spectrum between the United Sates and United Kingdom. Additionally, the US, UK and Australia are amongst five developed countries with the highest levels of income inequality[2]. Therefore, it is interesting that the provision of health services by the State may mediate the effects on health of income inequality when we compare US to UK outcomes. Given that income inequality within Australia is roughly comparable to the UK (see Wilkinson and Pickett, 2009 pp 17) our paper allows for further evidence as to whether such a mediating effect exists. That is, considering developed countries with both a socially progressive health system and a low level of income inequality (example Sweden, Finland, Denmark, Belgium, Germany) cannot offer additional evidence on this mediating effect.

An advantage of our study is that we utilize individual level panel data. Even when panel data is utilized, it is often aggregate cross-country data, which cannot measure the effect of inequality of incomes within a reference group and is thus more susceptible to the aggregation problem (Babones, 2008; Beckfield, 2004; Leigh and Jencks, 2007). Using data at an individual level therefore avoids the 'artefact' explanation (Gravelle, 2008). In relation to this, the relationship between income and health may lead to an observable relationship for income inequality at the population level. This apparent effect arises given that the impact of income on health outcomes can be expected to diminish as income rises. Then, if income is transferred from the poor to the rich within a particular society, the decrements on health outcomes of

[1] With the exception of Portugal
[2] The other two countries are Portugal and Singapore (see Wilkinson and Pickett, 2009 pp 17)

poorer individuals will be larger than the benefits to the rich. Overall, health outcomes worsen, even though this effect is caused by the change in individual income rather than a real effect of inequality. Accordingly, it is crucial to control for individual income when commenting on the causation between individual income and health outcomes (Wagstaff and Doorslaer, 2000; Wolfson et al, 1999 and Deaton, 2001).

Additionally, identifying a casual relationship between inequality and health is complicated by endogeneity. To this end, studies that pursue an analysis of cross sectional data, in the absence of an appropriate instrument, can only claim to have found an association between inequality and health (for example, Weich et al., 2001; 2002). Or, as good instruments are difficult to find, the relationship established using instruments may still suffer from some bias (Ettner, 1996; Knight, 2008). While effort has been made to establish causality (Cai, 2009), such applications are exceptions. This study, avoids the endogeneity issues associated with cross sectional studies. That is, the availability of panel data avoids endogeneity bias associated with the explanatory variables being correlated with unobserved heterogeneity. Additionally, we also attempt to address the potentially endogenous relationship between income and health attributable to reverse causality.

Our final contribution to the literature is that we consider a range of alternative measures of inequality. This allows for more robust conclusions, as results may be sensitive to the measure of inequality used. The next section articulates the transmission mechanisms through which income inequality can affect mental health. This is followed by an outline of the methodology adopted to test this framework and by a description of the econometric techniques. A section that describes the dataset follows. Next, empirical results are presented and the paper concludes with a discussion.

Transmission Mechanisms:

This work considers the impact that inequality has on mental health with mental health functioning measured by the Short Form 36 (SF-36) mental health component (see Figure 1). Overall, mental health is a diverse term that, in line with the data set , refers to poor wellbeing reflected in lack of confidence, feelings of being depressed, anxious and unhappy. These psychological characteristics can be triggered by

numerous factors, one of which may be income inequality within the neighbourhood, feelings of deprivation relative to others or low social capital. This section describes these pathways.

There are many pathways through which inequality may affect mental health outcomes. Firstly, Clark and Oswald (1998) have introduced a framework that incorporates economic and sociological ideas to explain the nature of emulative behaviour in society by developing a theory of conformity and deviance. They assume that relative position, or social status, is responsible for explaining at least some part of an individual's utility. Intuitively, the emulative theory suggests humans are in competition with each other and are more likely to have a lower sense of well-being if they consider themselves of lower rank in comparison to their peers (Clark and Oswald, 1998). A lower sense of well-being can then potentially contribute to mental health issues.

Direct adverse consequences to mental health can also arise via stressful social comparisons (Kawachi and Kennedy, 1999). Clark (2007) highlights that the relationship between absolute and relative income on health is analogous to the Easterlin Paradox (Easterlin, 2001)[3]. That is, aspirations are adjusted to the income of the reference group and the achievement of these aspirations leads to greater satisfaction. The resulting 'hedonic treadmill' effect on happiness attainment (Brickman and Cambell, 1971) suggests that mental health can be sensitive to relative income. Perceived deprivation can then motivate excessive consumption beyond the rational leveraging of households in an attempt to signal 'to the Joneses' within the neighbourhood (Alpizar et al., 2005). As a result, individuals are either prone to working longer hours to increase their income, or are subject to the financial stresses of debt. The exposure to relative deprivation increases psychosocial stress and is potentially damaging to mental health.

A direct link between income inequality and mental health also exists without necessitating deprivation. Following from Wilkinson's (1996) IIH, inequality can have a negative impact on the whole neighbourhood, including wealthier members. That is, it is fair to assume that some individuals place value on living in an egalitarian society. Thus, even with a fixed social structure, individual mental health

[3] which describes the relationship between absolute and relative income on reported happiness levels

may be damaged by the psychological exposure to households that are considerably disadvantaged in comparison.

Psychological distress from social comparisons can also provoke maladaptive coping responses, such as self-medication with dangerous substances and other risky behaviour (Subramanyam et al., 2009). Reduced utility is systematically linked to an increased likelihood of discounting the future and dismissing investment opportunities in human capital (Davey-Smith, 1996) and health (Deaton, 2003). Individuals who report having low well-being are less likely to commit to the future and be optimistic. As a consequence, they may be less likely to pursue healthy lifestyle activities such as regular exercise and managing a nutritious diet. They may also choose to engage in risky health-behaviours such as excessive drinking and smoking (Macinko et al., 2003). These behaviours have a direct consequence on the quality of physical and mental health.

Finally, social capital is a multidimensional concept concerned with community participation and social cohesion. Higher rates of violence, crime, teen pregnancy, vandalism and litter are social characteristics attributed to neighbourhoods with low-income households and high inequality. These factors can also contribute to lower levels of mental health (Berry and Welsh (2010)).

Methodology:

The Income Inequality Hypothesis

The IIH postulates that inequality adversely affects the health of all members within a reference group, regardless of income (Bernburg, 2010, Wilkinson, 1996). In order to test the IIH we add a measure of inequality, G, into a standard health production function given by:

$$H_{it} = \alpha + \mathbf{x}\boldsymbol{\beta}_{it} + \gamma G_{it} + \varepsilon_{it} \qquad (1)$$

In equation 1 the health of individual i in period t, H_{it}, is determined by a vector of explanatory variables $\mathbf{x}_{it}$, including income, for each time period (t) and individual (i). The inequality measure G_{it} for each individual is based on the inequality within

his or her own reference group (*i*) for each time period. The IIH is supported if the coefficient on G_{it} is statistically significant and negative ($\gamma>0$).

It is necessary to identify the reference group in order to calculate the inequality measures. These groups refer to the social, demographic or geographic group in which individuals choose to compare their income or status with. The typical reference group used in other studies (Pham-Kanter, 2009; Shields et al., 2009) is a localised region or 'neighbourhood' which also forms the basis for the analysis in the current study. It is characterised by the notion of "keeping up with the Joneses" (Duesenberry, 1949). Given the definition, a reference group may be sensitive to individuals who move regions within the HILDA waves, a sensitivity analysis considers only those individuals who were present in all the 8 waves and resided in the same abode. This robustness check also aids to circumvent any potential biases owed to individuals moving to an area of higher/lower inequality in response to a positive/negative mental health shock.

Using a neighbourhood however, may lead to unreliable conclusions given that the HILDA Survey sample sizes of individuals residing in some neighbourhoods are small (the sample sizes in this study range from 10 individuals to a maximum of 55 in each neighbourhood). Therefore, two additional reference groups are considered in the study. First, a reference group is defined as 'major statistical region' whereby an individuals living in a city compares themselves to those in their own city and non-city residents compare themselves to others in their respective states. Secondly, the analysis is restricted to individuals residing in cities and once again the reference group is individuals residing in their own city[4].

Once the reference group is identified for a given individual the next step is to obtain suitable measures of inequality and relative deprivation which can in turn be used in testing the IIH and RDH. A number of inequality measures are suggested by the literature (see Cowell, 1995 for a review). Three measures of inequality are selected to test the IIH and to check the robustness of the conclusions drawn. These are: (i) Gini coefficient which is a statistical or positive measure; (ii) Theil Index which is an

[4] Here the cities considered are Sydney, Melbourne, Brisbane, Adelaide and Perth. For those not residing in these cities, their major statistical region relates to either New South Wales, Victoria, Queensland, Adelaide, South Australia, Western Australia, Tasmania, Northern Territory or Australian Capital Territory

information theoretic measure based on entropy; and (iii) Atkinson index which is a normative welfare-based measure. In addition the RDH is tested using an individual specific deprivation measure.

The Gini Coefficient

The Gini coefficient is a commonly used measure of inequality, which is defined as twice the area between the Lorenz curve (a popular graphical representation of income distributions) and the egalitarian line of perfect equality. While there are several expressions to compute the Gini coefficient, we make use of the discrete version of the measure and a form proposed by Sen (1973).

For a population with *n* individuals with incomes, which are arranged in an increasing order $y_1 \leq y_2 \leq ... \leq y_n$ the Gini coefficient is given by

$$G = \frac{1}{n}\left[n + 1 - 2\left(\frac{\sum_{i=1}^{n} (n+1-i) y_i)}{\sum_{i=1}^{n} y_i} \right) \right] \tag{2}$$

where y_i represents the income of the i-th individual and n represents the number of individuals in the reference group. The Gini coefficient takes values in the range 0 for perfect equality and 1 for perfect inequality. Though the Gini coefficient is a popular statistical measure, it has two deficiencies. First, the Gini measure is not additively decomposable for population sub-groups and second; the bounds for the measure are independent of the population size. The Theil index overcomes both of these problems.

The Theil Index

The Theil index has its roots in information theory and is based on the concept of entropy. The index compares the logarithmic distance between the incomes of each individual with the mean income for that group. The index, T, is given by:

$$T = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\bar{y}} \ln\left(\frac{y_i}{\bar{y}} \right) \tag{3}$$

where $\bar{y}$ is the mean income of all the individuals belonging to the reference group or the neighbourhood. Values of theil index range from 0 for perfect inequality to ln(*n*)

when there is perfect inequality where one individual gets all the income and the remaining get zero income.

The Atkinson Index

The Atkinson (1970) index is a normative index based on the concept of *equally distributed equivalent* income, y_{EDE}, which is the level of income per head that, if equally distributed, would make total welfare of a society equal to the welfare generated by *n* individuals with incomes $y_1, y_2, ..., y_n$. The Atkinson (1970) index is given by

$$A_{\varepsilon} = 1 - \left[\frac{1}{n} \sum_{i=1}^{n} \left(\frac{y_i}{\overline{y}} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \text{ for } \varepsilon \geq 0 \text{ ; and } A = 1 - \frac{\prod_{i=1}^{n} (y_i)^{\frac{1}{n}}}{\overline{y}} \text{ for } \varepsilon = 1 \qquad (5)$$

where ε is a parameter reflecting the society's aversion towards inequality, with higher values of ε indicating higher levels aversion. The Atkinson index has a simple interpretation. Following Atkinson (1975), a value of the index equal to 0.25 means that the same level of welfare implicit in a given income distribution can be attained by reducing the mean income by 25% when all the individuals get the same income. Further, as ε increases more weight is attached to the lower income deciles.

These three measures are computed for each of the neighbourhoods, major statistical regions and for major cities.

Relative Deprivation Hypothesis (RDH)

In order to test the hypothesis that mental health outcomes are adversely affected by the relative deprivation felt by the individual We use the concept of relative deprivation proposed by Yitzhaki (1979) and adopted by Hey and Lambert (1980). The relative deprivation of an individual with income *y* in a given distribution of income represented by the density function $f(y)$ is given by:

$$D(y) = \int_{0}^{\infty} D(y,z) f(z) dz \text{ where } D(y,z) = (z - y) \text{ if } y \leq z \text{ and } 0 \text{ otherwise.} \qquad (6)$$

In the discrete case with *n* individuals with incomes $y_1 \le y_2 \le ... \le y_n$, the measure of relative deprivation is the average of the income of the difference in incomes of all individuals who have a higher income. Thus the measure, RD_i for individual *i* is given by:

$$RD_i = \frac{1}{n}\sum_{j=1}^{n} D(y_i; y_j) = \frac{1}{n} \sum_{all\ j\ such that\ y_j > y_i} (y_j - y_i) \quad (7)$$

Given that RD_i measures relative deprivation, it is generally a 'local measure' in the sense that it is only the incomes of the individuals within the neighbourhood that will be a source of deprivation. Therefore, we do not consider the "major statistical region' nor "city" as reference groups for this measure.

Once a measure of relative deprivation is obtained, we can test the relative deprivation hypothesis using the following model specification where health outcomes are a function of a set of control variables, $\mathbf{x_{it}}$ and a measure of relative deprivation of the individual with income, y_{it}. The model specified is:

$$H_{it} = \alpha + \mathbf{x_{it}}\boldsymbol{\beta} + \gamma RD_{it} + \varepsilon_{it} \quad (8)$$

where H_{it} is the health status or mental health status of individual *i* in time *t*; $\mathbf{x_{it}}$ is a vector of control variables; and RD_{it} is the measure of relative deprivation given in (7). To find evidence of the RDH hypothesis we need a negative γ coefficient associated with RD_{it}.

Econometric Modelling[5]:

Unobserved latent heterogeneity refers to individual specific factors that are likely to affect the levels of other variables that explain an individual's ability to produce

[5] The censored (tobit) regression is often used in health models when the dependent variable is restricted to a given range. This treatment of the distribution could be employed for the mental health derived variable with a 0 to 100 scale. However, there is evidence in the econometric literature that the Tobit model performs poorly when the distributional assumptions of the model are not satisfied. For example, Tobit estimates are inconsistent in the presence of heteroskedasticity (Maddala, 1983) or if the error term does not satisfy normality (Greene, 2008). In this work, the benefits of Tobit are negligible as there are only a few cases where predictions extend beyond the valid 0 to 100 range. Therefore to avoid making additional parametric assumptions on the model, the linear regression is considered satisfactory to estimate the models for mental health. A similar assumption is made by Heady and Wooden (2005).

mental health. These variables can be difficult to observe, for example psychological factors, which dictate personality traits and discount rates. Alternatively, they are just not available in the panel survey, for example, reliable information on family medical history. If individual specific factors are not accounted for then the estimated coefficients in the health regression will suffer from omitted variable bias. Accounting for these effects has a large impact on estimates in subjective wellbeing models (Ferrer-i-Carbonell and Frijters, 2004, Boyce, 2010). In order to incorporate this latent heterogeneity in our analysis we utilize a fixed effects approach[6] given by:

$$H_{it} = \alpha + \mathbf{x}\boldsymbol{\beta}_{it} + \gamma G_{it} + \varepsilon_{it} \tag{9}$$

where $i = 1,\ldots,N$ and $t = 1,\ldots,8$ and G is a measure of inequality. Here $\mathbf{x}_{it}$ is a vector of control variables included in each regression (which we will subsequently be discussed) and individual level heterogeneity is incorporated in the intercept α. The error term ε_{it} refers to the usual stochastic disturbance, which is assumed to be independently and identically distributed.

Endogeneity:

Even though our aim here does not involve quantifying the AIH, it can be argued that given its link to the RDH and IIH literature, establishing a casual relationship for the AIH is also important. In addition, given that our inequality measures have the potential to be correlated with income, should income be endogenous the inequality coefficients may suffer from bias. That is, it is unlikely that the inequality of a particular area is affected by one individual's mental health status, however, individuals who live in areas of low inequality may be more likely to be rich, with the working and middle classes contending with higher levels of inequality.

The problem of endogeneity between mental health and individual income arises given that having a mental health shock may reduce wages, just as, having an income shock may reduce mental health. Using household income helps to reduce the potential for bias as other individuals within the household can still earn money, but this is not fully satisfactory.

[6] It is worth noting that utilizing the Mundlak estimator or excluding the individual intercepts and adding additional variables that are fixed over time does not effect our final conclusions regarding inequality

Given the lack of suitable instruments in our dataset, an alternative method of sub-sampling is used to circumvent the endogeneity problem. Specifically in a robustness analysis we exclude any individual who may have had reduced incomes due to health complications. By restricting our analysis to those who do not have their incomes reduced by poor health, the bias in the estimates from reverse causality is minimised. Specifically, two subsamples are considered. The first, eliminates individuals who have had unpaid sick leave and the second excludes those who are unemployed. That is, we expect this to circumvent the endogeneity problem assuming that there are no omitted unobservables that determine a person's mental health and their positioning in the distribution that are unrelated to employment status or paid sickness leave. We argue that this assumption is defendable given that we include fixed effects and therefore unobserved personal traits are unlikely to vary over the short period of this sample. If the conclusions relating to the IIH and RDH hypotheses are unaltered we have more confidence in our results.

Data:

The HILDA Survey is a longitudinal household study, which commenced in Australia in 2001 and currently has 8 waves of individual and household level data. The survey is nationally representative with the exception of the under-sampling of individuals living in remote areas. It is conducted annually. While all members of the household are included in the scope of the data, only those aged 15 years and older are included in the interview process and self-completion questionnaire.

The survey collects information on labour and family dynamics as well as data on economic and subjective well-being. The 'household' is defined using the ABS definition of a dwelling, "a group of people that reside and eat together" (ABS, 2000). The included households were selected using a multistage sampling design that began with a random selection of 488 Census Districts.

In order to measure individual mental health we utilize the 'mental health' component of the SF-36. This covers area's regarding being 'nervous, down in the dumps, peaceful, sad and happy'. The SF-36 scales were created by Ware et al. (2000). For mental health, responses to a series of relevant questions are transformed into a score between 0 and 100, where larger numbers represent better mental health. This scale

has received strong support for its validity, reliability and consistency (Ware et al., 2000).

Income measures

Income is calculated using gross income for the previous financial year as reported by the individual. This measure includes all private income (wages and salaries, investment, business, private pension), Australian government transfers and any other income including windfall income. Taxes and social benefits are then calculated based on this information. As an aggregate, this measure compares favourably to the Australian Tax Office records, however, 22% to 29% of households did not provide all financial year income and as a result HILDA imputes these values (Watson, 2010, p47-49).

Household income is an aggregate value of the reported incomes of all the individuals in the dwelling that varies across year and across households. Income in our work is expressed as a per adult equivalent scale based on the standard OECD scale which is also used by the ABS (2006). Under this scale the value for single person households remains unchanged, while any additional adult (15 years and over) has a weight of 0.5, each child then has a weight of 0.3. In order to check if our analysis is sensitive to the use of equivalised income over individual income, a robustness analysis considers re-estimating our models for single households only. Household income is included in the analysis as log income where income is in 000's[7]. This specification recognises that the relationship between income and mental health is likely to be concave. The Atkinson index cannot be calculated for incomes that equal to zero (since the log is taken in the calculation). Therefore, 479 such observations with zero or 'negative' disposable income are set equal to $1[8].

Control variables

[7] We follow the standard specification used in studies similar to ours and include log income. We have also replicated our analysis by including income instead of log income. Our findings based on the use of income are mixed and do not provide any conclusive evidence in support of inequality or the relative deprivation hypothesis. Further it appears that the coefficient associated with income suffers from bias induced by misspecification due to use of linear form in the place of logarithmic form.

[8] This substantially changes the Atkinson index, particularly for higher entropy classes, as the measure is overly sensitive to low values of income. An alternative approach would be to drop the 0 values but a sensitivity analysis shows that this does not affect the overall conclusions of this work.

Along with measures of income and inequality, the analysis also includes additional controls. These are; i) age and age squared; ii) a variable which counts the number of dependents the adult has (0-14 years); iii) an indicator as to whether the individual was born outside of the group of OECD countries; and iv) education measured as 1 if the individual has attained higher education in the form of a bachelor, diploma, honours or doctorate (and zero otherwise)[9].

Sub-samples for sensitivity analyses

As described before, subsamples are considered to minimize the impact of endogeneity. The robustness test utilizes the HILDA question regarding whether or not the respondent has taken unpaid leave during the past 12 months. If the respondent answered 'yes' to having unpaid sick leave they were excluded from the first sub-sample analysis. An alternative robustness test relaxes this criterion and excludes only individuals who experience a relatively large number of unpaid sick leave days (subjectively defined here as greater than 5 days). These questions were only asked from wave 5 to 8 and thus these analyses are restricted to these periods.

The final robustness test utilizes the question on employment status to identify individuals who were unemployed in any of the 8 waves and removes them from the sample. Therefore, only individuals who were employed or not in the labour force at all, are included. This removes the effect of individuals who had low income as a result of not being able to work due to poor health.

Descriptive statistics for all variables used in our analysis can be found in Table 1.

Insert Table 1 around here

Results:

Table 2 presents the full set of results from our preferred specification. This specification utilizes the fixed effects estimator and considers the 'neighbourhood' as our reference group. The coefficients related to the control variables have the expected statistically significant relationship with our mental health outcome; albeit some are not statistically significant once the fixed effects estimator is considered.

[9] HILDA offers a number of education categories, however, alternative groupings failed to be statistically significant in any estimation nor did their inclusion alter our conclusions

However, only the relative deprivation has a small but significant negative effect on mental health status.

******Insert Table 2 around here******

Considering Table 3, the results are shown when inequality and relative deprivation are measured using three different reference groups. The coefficient of per adult equivalent income is also presented.

******Insert Table 3 around here******

From Table 3, it is clear that regardless of which measure of inequality we choose for the IIH there is no statistically significant relationship between inequality and mental health. Therefore, this study does not find evidence to support the IIH for Australia. This result still holds even when we redefine our reference group as a major statistical region or only include those residing in cities in the analysis. In addition, restricting our sample to single households only (see Table 4) or those who had a fixed address throughout the survey (see Table 5) does not alter this general finding. In order to consider whether income being endogenous causes the inequality coefficients to be biased we also consider a number of additional robustness analyses. Specifically, these analyses exclude individuals who may have had their income altered due to ill health and are documented in Table 6. Again, we have further evidence that the IIH is not supported for Australia.

For the RDH, our results from Table 2 suggest that relative deprivation has a statistically significant impact on mental health, albeit it is small (-0.00003). This implies that a $10,000,000 increase in relative deprivation would reduce mental health status by 3%. The significance of the RDH is not found in all of our robustness analyses (see Tables 3 through 5). The fact that the relationship between inequality and health is only found for some groups in developed societies is not unusual (Lobmayer and Wilkinson, 2000 and Lynch et al, 2001); albeit the size is so small here that it does not warrant any significant policy actions.

Adult equivalent household income has a positive and statistically significant coefficient that is consistent in magnitude irrespective of which inequality measure is used in testing the hypothesis. This suggests that the estimate on the relationship between income and health is not sensitive to the type of inequality measure included in the model. The positive statistically significant relationship also holds across the three reference group definitions. This small but positive and statistically significant contribution of income in the regression is consistent with other empirical studies which control for latent heterogeneity to explain individual health (Frijters and Ulker, 2008) and well-being (Ferrer-i-Carbonell and Frijters, 2004). However, the relationship is not robust to our sub sample analysis that aims to consider the endogeneity of income. In fact, from Table 5, while the significance of income holds for the analysis that excludes those who are unemployed, income is no longer statistically significant once we exclude those who had sick leave. The latter therefore suggests that income significance in the main results may be driven by endogeneity, however the robustness of the conclusions surrounding the IIH and RDH are not affected by this potential bias.

******Insert Table 4 around here******

******Insert Table 5 around here******

******Insert Table 6 around here******

Discussion and Conclusion

This study has explored the impact of relative incomes on mental health attainment using data from the HILDA panel survey. The aim was to investigate the validity of the IIH and RDH for the first time using Australian data. The results contribute to the unresolved debate on the significance of relative income on health in the literature, as well as providing new information on the impact of inequality and absolute income for mental health outcomes in Australia.

To date, empirical evidence is predominately based on panel studies from the USA and the EU with varied conclusions. This can be attributed to both the different health and welfare systems operating in the regions, different levels of income inequalities, as well as to the different methodologies employed to explore the RIH. The AIH is

mostly supported across the studies, where income has a positive and statistically significant effect on an individual's health. This is mostly true in our work, however when efforts are made to control for endogeneity using sub sampling the statistical significance of the AIH does not hold in all cases. This highlights, once again, the difficulty in establishing a true relationship between income and health.

While the Gini coefficient is the most common measure to test the IIH, each inequality measure is sensitive to the distribution at different parts of the income spectrum. This study also considers the Theil index, which is common in the literature due to its axiomatic properties, and the Atkinson index, which allows for different levels of aversion to inequality. Relative deprivation is calculated for each individual using the formula proposed by Yitzhaki (1979).

Our study finds no support for the IIH in the case of Australia. This conclusion is robust to alternative measures of inequality, as well as across a number of robustness analyses. Additionally, whilst our main specification finds weak support for the RDH, the size of the effect is small and the conclusion is not robust in all our sensitivity analyses. These results suggest that income inequality does not affect mental health outcomes, however this does not rule out other types of inequality being important. In this vein, future research could investigate the inequality relationship using expenditure data. Consumption has been used in other studies exploring wellbeing as a measure of an individual's position in society and access to resources and services (Luttmer, 2005). However, in light of modern day consumption patterns this may not be very accurate considering individuals may be engaged in excessive consumption and debt accumulation (Debelle, 2004). An alternative approach could use data on the financial status of an individual or a household including equity ratios or the household debt-to-asset ratio. The recent financial crisis and housing price collapse within the developed countries highlights the need to account for the effects of debt in future research relating inequality to health.

As discussed, Australia, the U.S. and the UK have high levels of income inequality in comparison to other developed countries. However, the UK and Australia have relatively progressive health systems whereas the U.S. does not. Therefore, our finding here also suggests that a progressive health system can mediate the effects of

income inequality, even when income inequality is high. However, inequality is a social and economic condition that contributes to a number of other undesirable outcomes such as crime, drug use, teen pregnancy and domestic violence. Therefore, at the aggregate, reducing inequality may have some positive outcomes overall in both Australia and the UK, albeit difficult to quantify the total aggregate gains. Therefore, future research may consider a cross-country analysis that can provide further insight as to whether institutional mechanisms can mediate income inequality across a range of social outcomes.

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Table 1: Descriptive Statistics of Focus Variables

Variable	Mean	Std. Dev.	Min	Max
Mental Health Outcome	74.729	16.8363	0	100
Gini Coefficient	0.245	0.0714	0	0.623
Theil Index	0.119	0.0881	0	0.835
Atkinson Index e = 0.5	0.061	0.0431	0	0.419
Atkinson Index e = 1	0.139	0.1290	0	0.972
Atkinson Index e = 2	0.277	0.2386	0	1.000
Relative Deprivation (in 000's)	8.302	8.3544	0	91.894
Household Income pp. (in 000's)	33.062	22.8079	0.001	500

Source:HILDAdata

Table 2: Mental Health Model- Main Results

Reference Group = Neighbourhood n=67305						
	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
Inequality Measure	1.158	-0.902	-1.281	0.007	-0.059	-0.00003***
Ln (Household income (pp)	0.231***	0.229***	-0.228***	0.239***	0.235***	0.113
Age	-0.500	-0.502	-0.502	-0.499	-0.499	-0.537
Age Squared	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
Child	0.235*	0.235*	0.235*	0.237*	0.237*	0.230*
Highest Education	0.616	0.615	0.614	0.618	0.617	0.628

Table 3: Mental Health Model- Main Results

Reference Group = Neighbourhood n=67305						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	1.158	-0.902	-1.281	0.007	-0.059	-0.00003***
Ln (Household income (pp)	0.231***	0.229***	-0.228***	0.239***	0.235***	0.113

Reference Group =Major Statistical Region n=67305						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	0.437	-0.321	-1.204	-0.205	-0.058	N/A
Ln Household income (pp)	0.239***	0.239***	0.238***	0.238***	0.238***	N/A

Reference Group = City n=40753						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	-1.754	-1.996	-2.340	0.952	-0.442	N/A
Ln (Household income (pp))	0.181***	0.181***	0.181***	0.182***	0.178***	N/A

All regressions relate to individuals >=15 years. Along with measures of income and inequality, the analysis also includes additional controls. These are; i) age and age squared; ii) a variable which counts the number of dependents the adult has (0-14 years); iii) an indicator as to whether the individual was born outside of the group of OECD countries; and iv) education measured as 1 if the individual has attained higher education in the form of a bachelor, diploma, honours or doctorate (and zero otherwise). * p<0.10, ** p<0.05, *** p<0.01

Table 4: Mental Health Model, Single Households Only

Reference Group = Neighbourhood {Household Included if the person was single for *all* periods} n= 6,098						
	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
Inequality Measure	0.292	1.187	2.257	0.254	-0.226	0.000
Ln (Household income (pp)	0.314**	0.309**	0.315**	0.307**	0.284**	0.381***

Reference Group =Neighbourhood {Household Included if the person was single in *a particular* period} n=10,967						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	-1.000	-1.528	-2.720	-1.014	-0.596	-0.000
Ln Household income (pp)	0.173	0.166	0.161	0.147	0.136	0.129

All regressions relate to individuals >=15 years. Along with measures of income and inequality, the analysis also includes additional controls. These are; i) age and age squared; ii) a variable which counts the number of dependents the adult has (0-14 years); iii) an indicator as to whether the individual was born outside of the group of OECD countries; and iv) education measured as 1 if the individual has attained higher education in the form of a bachelor, diploma, honours or doctorate (and zero otherwise)**.** * p<0.10, ** p<0.05, *** p<0.01

Table 5: Individuals in fixed abode

Reference Group = Neighbourhood {Household Included if they lived in the same house for 8 waves} n=35,336						
	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
Inequality Measure	-1.882	-1.210	-1.602	0.024	-0.006	-0.00003**
Ln (Household income (pp)	0.213***	0.213***	0.211***	0.227***	0.226***	0.103***

Reference Group =Neighbourhood {Household Included if they lived in the same house for 8 waves or until the move} n=37,450						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	-1.326	-0.733	-0.817	0.205	0.020	-0.00003
Ln Household income (pp)	0.225***	0.226***	0.227***	0.243***	0.236***	0.130

All regressions relate to individuals >=15 years. Along with measures of income and inequality, the analysis also includes additional controls. These are; i) age and age squared; ii) a variable which counts the number of dependents the adult has (0-14 years); iii) an indicator as to whether the individual was born outside of the group of OECD countries; and iv) education measured as 1 if the individual has attained higher education in the form of a bachelor, diploma, honours or doctorate (and zero otherwise) * p<0.10, ** p<0.05, *** p<0.01

Table 6: Sub group analysis to address income endogeneity

Reference Group = Neighbourhood. Individual is excluded if they have had any sick leave in the past 12months n=24,001						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	-1.788	-1.145	-2.557	-0.522	-0.271	-0.00002
Ln (Household income (pp)	-0.004	-0.003	-0.013	-0.010	-0.007	-0.097

Reference Group = Neighbourhood. Individual excluded more than 5 days sick leave in the past 12months N=31,954						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	-0.502	-0.0374	0.320	0.454	0.114	-0.00002*
Ln Household income (pp)	0.092	0.096	0.099	0.114	0.103	-0.019

Reference Group = Neighbourhood. Neighbourhood. Individual is excluded if they are unemployed in all 8 waves						
Inequality Measure	Gini	Theil	Atkinson ($\epsilon = 0.5$)	Atkinson ($\epsilon = 1$)	Atkinson ($\epsilon = 2$)	Relative Deprivation
	-1.571	-1.467	-1.412	0.368	0.210	-0.00005**
Ln (Household income (pp))	0.264***	0.259***	0.261***	0.285***	0.283***	-0.083

All regressions relate to individuals >=15 years. Along with measures of income and inequality, the analysis also includes additional controls. These are; i) age and age squared; ii) a variable which counts the number of dependents the adult has (0-14 years); iii) an indicator as to whether the individual was born outside of the group of OECD countries; and iv) education measured as 1 if the individual has attained higher education in the form of a bachelor, diploma, honours or doctorate (and zero otherwise). * p<0.10, ** p<0.05, *** p<0.1

Figure 1: SF-36 Division between physical and mental health:

