Economic

Research

HEALTH IS WEALTH? AN ECONOMETRIC ANALYSIS OF INCOME AND MENTAL HEALTH

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In this econometric investigation, Sarah McDowell uses cross-sectional data to examine the effect of income on mental health in order to determine whether a causal relationship exists. She finds a significant positive relationship between these variables, and identifies other significant factors in determining mental health. An extensive discussion of the empirical challenges associated with determining robust relationships and causation makes this a thorough analysis of a very important topic for policy makers from both an economic and a health perspective.

Introduction

'When I was young I thought that money was the most important thing in life; now that I am old I know that it is.'
-Oscar Wilde

The predominant focus in quantitative studies often involves determining measures of prosperity such as growth and income levels. However, just as important to societal welfare are factors which are more difficult to measure, such as mental well-being. These non-monetary measures of welfare are also hugely important to policy makers. The interplay between income and mental health is also very important in understanding mental health issues in society today.

This paper will investigate the relationship between household income and mental well-being and will examine whether a causal relationship can or cannot be claimed. Aside from the obvious imperative to help those with mental health problems, poor mental health has huge economic disadvantages, costing UK businesses £30 billion per year through lost production, recruitment and absence' (WorldGBC, 2014:7). Understanding the factors affecting mental health is hugely important to improving the standard of life for those with mental health problems and society's overall welfare.

Literary Review

Sareen et al. (2011) outlines two theories behind the positive predicted relationship between income and mental health: social causation and social selection. Social causation proposes that the distress related with low incomes contributes to mental illness, whilst

social selection states that sufferers of mental illness will be more likely to experience declining incomes due to reduced ability to work for example. If the latter holds true, reverse causality is likely to be present in this study.

A plethora of pre-existing studies has been carried out to address this question. Some of these have used longitudinal studies with a panel data approach (Sareen et al., 2011) whilst others have used a cross-sectional approach, such as the Slán Mental Health and Social-Wellbeing report (2007). A common difficulty in the assessment of psychological status is its inherently subjective nature; several methods have been proposed to combat this. In McMillan et al. (2010), a trained clinician asks questions tailored to three categories: physiological distress, mental disorders and suicide ideation/attempts. In others, the subject completes a self-assessment complying with an approved scale (Northern Ireland Health Survey, 2013). Clearly, a varying amount of bias or subjectivity is pertinent to both; in the former the clinician can influence the respondent's result by the manner in which they ask the question, whilst in the latter the answers depend on the individual themselves judging rationally. Unfortunately, focusing bias, whereby we overrate a certain factor, such as relationship status, in our happiness, often clouds judgement (McMillan et al., 2010).

The Slán study (2007) finds that those with higher incomes and higher levels of education reported better mental wellbeing. It also stresses a clear association between physical and mental wellbeing, and cites how males reported better mental health than females. Lorant et al. (2003) conclude that those with low socioeconomic status are more vulnerable to depression. Overall, previous study yields no definitive findings. In fact, many contradictory conclusions have been reached.

Empirical Approach

This paper uses the Northern Ireland Health Survey (2013) of data collected between 2010 and 2011 which is a cross-sectional study of 4,085 participants aged 16 years and older. Created with the aim of developing new health policies, the topics focus on mental wellbeing, physical health, alcohol and drug use. The dependent variable of interest is mental wellbeing, which is assessed by the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) a positive self-assessed scale consisting of fourteen questions with a five-part ordinal response scale (NHS, 2011). To assess the impact of income on mental health the following model is proposed:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{1i} * X_{2i}$$

$Y_i = WEMWBS$ – a self-assessed measure of mental health on a five-part ordinal response scale

X_1 = *INCOME* – the gross household income, ordered in 38 ordinal categories

X_2 = *NUMCHILD* – the number of children in the household

X_3 = *GENDER* – a dummy variable taking the value of 1 if the respondent is male, and 0 if female

X_4 = *MARITALSTATUS* – this is a factor variable of 5 dummy variables, the baseline of which is 'Single, Never Married'. The five categories included in the regression are married, in a civil partnership, separated, divorced, and widowed.

X_5 = *HEALTHCHANGE* – this is a factor variable measuring the respondents health compared to last year. It consists of four dummy variables with a baseline of 'Much better now than 1 year ago'. The four categories included are somewhat better, same, somewhat worse and much worse.

X_6 = *ALCOHOL* – this indicates the average weekly total units of alcohol consumed

X_7 = *ACTIVITY* – the number of days the respondent completed moderate physical activity for at least ten minutes

$X_1 * X_2$ = *GROSSCHILD* – an interaction term for the effect of income and number of children in the household on mental health.

Data and Expectations

Encompassing 874 variables, the Northern Ireland Health Survey was comprehensive in many aspects, yet lacking in others such as the omission of key considerations like age and changes in income. According to Lorant et al. (2007), the latter exercises a large influence on mental health, in particular an increase in financial strain leads to increased likelihood of depression. To attempt to account for these time-variant effects on mental wellbeing, I have included the regressor 'Health compared to last year'.

Marital status is included as an independent variable to attempt to control for focusing bias of individuals in their self-reported answers (McMillan et al, 2010). One would predict those in a 'stable marriage' would report better mental health than divorced or single people, partly due to societal expectations and focussing bias for example. One would also expect a negative relationship between the units of alcohol consumed and mental wellbeing, due to its depressant properties and due to the increased susceptibility of those suffering from depression to addiction.

The Slán study (2007) found strong positive links between physical and mental wellbeing. In this study this will be represented by the number of days in the past week in which the subject completed moderate activity for at least ten minutes, so that it will not be limited to vigorous exercise. It also found males to enjoy better mental wellbeing than females.

For the purposes of this analysis, gross income is divided into categories, the lowest (1) being less than £10 per week and the highest (38) being greater than £1000 weekly. Unfortunately, there is no upper bound, whilst a lower bound (£0) exists. Predictably, income is not evenly distributed, with the first 10 classes (up to and including £100 per week) captures only 7.68% of the sample, whilst the highest class captures 11.45%.

Although the subgroups are less defined than specific income figures, they have the advantage of highlighting more clearly the effects of changing incomes and socioeconomic status on the dependent variable. This uncapped upper category is common in most studies, as drawing a median while including the highest earner in society, an outlier, would be unrepresentative. To eliminate the 12% of the study's respondents with the highest incomes would reduce the statistical power of the study and as such would be unwise.

The unequal widths of the categories could also prove problematic. However, the decreasing marginal utility of income theory, whereby an additional unit of income to a low-income respondent would yield greater utility than to a high earner, means it is less likely to be an issue (Acocella, 1998). Furthermore, the Easterlin paradox highlights how increasing income makes us happier to a certain point but levelling off as we adapt to it (Tachibanaki, 2016). In order to account for these factors, the variable I*NCOME* is generated, which measures the log of gross income, and a further regression with this as the X_1 variable is carried out.

In the data set there are two measures of income: household and personal. Personal income holds dubious power in investigating the relationship between an individual's wealth and mental health, as certain subjects on paper will earn nothing e.g. housewives. Gross household income will therefore be used. However, the personal utility from household income will clearly vary according to the number of individuals sharing said income. To account for this an interaction term *GROSSCHILD* has been generated to investigate whether the number of children in a household influences the effect of income on mental wellbeing.

The *WEMWBS*, due to its self-reported nature, is inherently subjective, although the risk of this conveying unrepresentative results is lessened by its adherence to a professionally constructed scale. The following summary statistics describe the *WEMWBS* results in the data, with a mean of 49.69. The mean result for the Scottish population is 50.7, suggesting our survey sample is reflective (NHS, 2008).

Variable	n	Mean	S.D.	Min	.25	Mdn.	.75	Max
PHIRB_WEMWBS	2517	49.69	8.99	14.00	44.00	50.00	56.00	70.00

Table 1:

Empirical Results

Table 2 outlines the results from the OLS regression:

Variables	OLS Coefficients
WEMWBS, mental well-being scale	0.0677***
Total gross household annual income	-1.650***
Number of children	0.378
Gender	2.419***
Marital Status:	
Married and living with husband in a legally-recognised Civil Partnership	2.001
Married and separated from husband	-0.708
Divorced	0.747
Widowed	2.903***
Health compared to one year ago:	
Somewhat better now (than 1 year ago)	-2.616***
About the same as 1 year ago	-0.715
Somewhat worse now (than 1 year ago)	-5.513***
Much worse now (than 1 year ago)	-11.04***
Average weekly total units of alcohol	-0.0140
Moderate activity	0.329***
Gross_children	0.0377**
Constant	47.55***
Observations	2,254
R^2	0.118
Adjusted R^2	0.112

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2

The intercept term implies that, holding all factors constant, the *WEMWBS* will be 47.55. Interpreting these OLS coefficients indicates that a one category increase in income leads to a 0.0677 point increase in the *WEMWBS*, significant at the 1% level. At the lowest

income levels, from categories 1 to 16, an extra £220 per week increases WEMWBS by 1.016. Therefore, a positive relationship exists between income and mental wellbeing, as predicted. Correlation, albeit not causation, can be established.

Number of children is also significant at the 1% level, with a decrease in *WEMWBS* of 1.65 per additional child, perhaps due to increased stress or the tendency of subjects with a lower socioeconomic status to have larger families. The interaction term, significant at the 5% level, predicts that the positive effect of higher income on mental health is 0.0377 higher per additional child, probably because the additional income is of greater utility when shared between a greater number. Gender, though not statistically significant, predicts the better mental health typically reported by males.

Significant (at 1%) in the Marital Status category is that married respondents living with spouse reported a *WEMWBS* of 2.419 points higher than single counterparts, whilst widowed respondents reported 2.903 points higher, which perhaps simply reflects the omitted variable age.

Predictably, compared with the baseline of much better health compared to 1 year ago, better, somewhat worse and much worse all decrease the *WEMWBS*, with much worse decreasing the *WEMWBS* by 11.04, significant at the 1% level. Mental wellbeing and alcohol consumption predictably have a negative relationship whilst exercise and *WEMWBS* have a strong positive relationship at the 1% level, with a one day increase of ten minutes of moderate activity per week increasing the score by 0.329. The adjusted R^2 is 0.1121; 11.21% of the variation in the scale is captured by the model.

On replacing gross with *INCOME*, the resultant β_1 is 1.36, significant at the 1% level. However, to run this regression the 30 observations in the lowest income bracket (1) must be dropped, as log1=0, thus we lose an important group, especially for policy considerations. This indicates that a one category increase in income increases *WEMWBS* by 1.36%.

Heterogeneity

The OLS assumptions rely on the constant variance –homoscedasticity- of the error term. If this is violated, i.e. the errors have the same variance irrespective of the value of the independent variables, the OLS estimates may be inefficient but will still be unbiased (Wooldridge, 2009). Plotting the fitted values of $\hat{y}$ against the residuals, we see that the dispersion of the error terms is clustered:.

Performing the Cook-Weisberg test for heterogeneity, a high chi-squared value (56.21) and a p-value of 0.000 are found, confirming the presence of heteroscedasticity in the model. This may be due to the presence of unmeasurable genetic factors in the error term, such as the genetic component of many psychiatric illnesses, or the omission of variables such as age. To combat this, heteroscedasticity-consistent (robust) standard errors must be used. Upon augmenting the original OLS regression to include robust

standard errors, all of the aforementioned coefficients remain statistically significant at their previously stated levels.
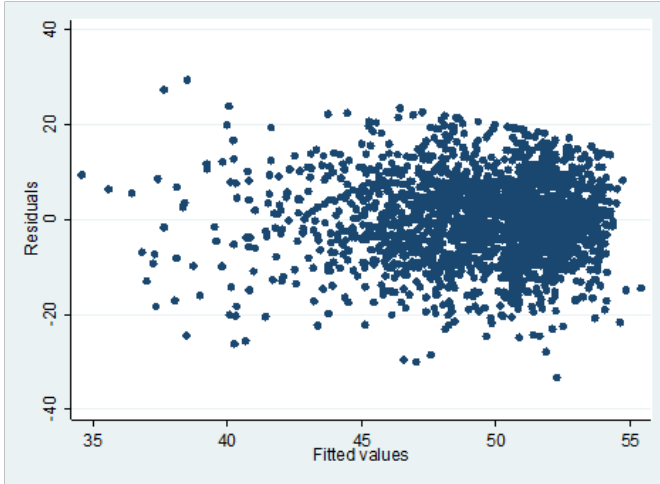
Multicollinearity

When two or more regressors are so correlated such that they are nearly linear combinations of each other, multicollinearity is present, which hinders the isolation of the particular effect of X_i on Y_i (Wooldridge, 2009). To test for multicollinearity, the variance inflation factor can be used. As this command resulted in a mean Variance Inflation Factor of 2.63, we can conclude that multicollinearity is not present in this model (at a tolerance level of <0.03) (UCLA 2016).

Endogeneity

Endogeneity, which occurs when one or more of the regressors is correlated with the error term, can be due to three factors: omitted variables, measurement error or simultaneity. (Wooldridge, 2009: 842). Endogeneity is a problem inherent to the study of health economics, which can lead to biased and inconsistent OLS estimates. Reverse causality whereby mental health affects income is present and also affects other regressors such as exercise levels, alcohol consumption and marital status, as those suffering from poor mental health may generally engage in a more reclusive life. Sareen et al.'s (2011) social selection theory highlights how these persons' ability to work, and thus earn income, will also be reduced. As income and mental wellbeing are determined simultaneously, the presence of simultaneity bias cannot be denied. This could lead to upward bias in our regression coefficients i.e. overstating the effect of income on mental health.

Endogeneity can also be due to omitted variable bias. A weakness in this study is the omission of the age variable; Lorant et al (2003) highlight the U-shaped relationship

between age and depression – the reverse is true of age and income. To test for functional misspecification - omitted variable bias or whether non-linear combinations of present regressors could yield explanatory power - we can use the RAMSEY reset test. The high p-value (0.3969) that the test yields suggests that there is omitted variable bias.

One way to deal with endogeneity would be to use an instrumental variable for gross income that is correlated with income but not with mental health, and thus only affects Y through income. Following this, a 2-stage least squares regression (2SLS) would be performed. After inspecting the dataset, it lacked any suitable instruments – age left full time education, for example, yielded illogical results with a negative coefficient on gross, and its modal age was 14, and so could be affected by the omission of age, as the older generations tended to leave school earlier. Using *NUMCHILD* as an instrument yielded similarly illogical results; both of these could be highly correlated with Y. Suitable instruments for future use could include IQ, which should be correlated with income but not with income. It is also worth noting that the majority of academic studies do not use an instrument for income.

Self-reported data from the respondents could be a source of measurement error. It is possible that the subjects from the lowest incomes, who have never experienced otherwise, in particular are unwilling (or unable to) fully assess the deprivation they experience, pushing the coefficients downwards towards zero. There is also the aforementioned focusing bias, which Homo sapiens, unlike homo-economicus, inevitably suffer from when assessing happiness or fulfilment levels. However, the *WEMWBS* performs favourably compared to other scales on self-deception bias (Stewart-Brown and Janmohamed, 2008).

Extensions

A helpful addition would be a ballpoint figure of last year's gross household income, to enable calculation of medians, adjustment for outliers etc. A larger panel data study would be instructive, focusing on one component of mental disorders, such as the National Epidemiologic Survey on Alcohol and Related Conditions (2002), rather than general wellbeing. An improved approach would be to use a study, which covered various years to facilitate a panel data treatment and allow for the 'examination of temporal relationships between income and mental disorders' (Sareen et al, 2001). A fixed effects model would then be used to control for serial correlation between the control variables and error term. A further advantage of this would be to control for omitted variable bias (Williams, 2015).

Conclusion

The aim of this paper was to show a positive relationship between income and mental wellbeing and prove this using a multi-faceted dataset and examining relevant variables of influence. From the coefficients produced by the model after adjusting the standard errors for heteroscedasticity, taking logs of income and generating an interaction term, it is more than reasonable to conclude that this positive relationship holds. The correlation between mental health and income has important implications for policy in that increasing the material standards of living and incomes of low-earners through redistribution may improve mental health outcomes.

While tentative policy recommendations can be made, further exploration of this topic is needed to ascertain causality. The presence of endogeneity and omitted variables - in particular the omission of age from the dataset – means that a causal relationship cannot be claimed. Indeed, reverse causality is, like many studies in health economics, a complication; Y affects several of the control variables. Ideally, two suitable instrumental variables would have been utilized in order to facilitate a 2SLS regression and thus account somewhat for the endogeneity present in the income regressor at least.

In conclusion, there exists both the scope for further econometric research in this area and, more importantly, the imperative for a greater understanding of factors influencing mental health and their crucial implications for policy makers today.

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