Implicitly estimating the cost of mental illness in Australia: A standard of living approach

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Abstract

Background

Estimating the costs of mental illness provides useful policy and managerial information to improve the quality of life of people living with a mental illness and their families.

Objective

This paper estimates the costs of mental health in Australia using the standard-of-living approach.

Methods

The cost of mental illness was estimated implicitly using a standard of living approach. We analyse data from 16 waves of the Household, Income and Labour Dynamics in Australia Survey (HILDA) using 209,871 observations. Unobserved heterogeneity was mitigated using an extended random-effects estimator.

Results

The equivalised disposable income of people with mental illness, measured by a self-reported mental health condition, needs to be 50% higher to achieve a similar living standard as those without a mental illness. The cost estimates vary considerably with measures of mental illness and standard of living. An alternative measure of mental illness using the first quintile of the SF-36 mental health score distribution resulted in an increase of estimated costs to 80% equivalised disposable income.

Conclusion

People with mental illness need to increase equivalised disposable income, which includes existing financial supports, by 50%-80% to achieve a similar level of financial satisfaction as those without a mental illness. The cost estimate can be substantially higher if the overall life satisfaction is used to proxy for standard of living.

Keywords: Cost of mental illness; a standard of living approach; panel data; extended random-effects estimator; Australia

JEL Classification: I10, I18

Key points for decision makers

- Existing financial support is not sufficient to meet the needs of people with a mental illness.
- The current prevalence of mental illness may be under-reported due to the stigma associated with this health issue.
- Non-financial support could be more effective to reduce the prevalence and costs of mental illness.

1. Introduction

Mental illness includes a wide range of behavioural and psychological conditions from eating disorders to personality disorders (1). Mental illness is a serious public health issue in many countries. In Australia, 3.2 million people have a mental illness that requires access to mental health services or medications (2). Apart from requiring large public health expenditure, people with mental illness and their families also face difficulties in various aspects of life such as finding and maintaining jobs (3, 4). The costs of mental illness are high. In Australia, the direct costs of mental illness were estimated to be $A6.9 billion in 2010-2011, accounting for 7.7% of the total government health budget (5). Previously in the United Kingdom (UK), it was revealed that the cost of living with conduct disorders from childhood to the age of 28 was up to 10 times higher than for those living without a conduct problem (6). However, limited research has been conducted to estimate the costs of mental illness in Australia from individual and household perspectives. This type of research will provide useful inputs for policy applications such as evaluating whether the current financial support for people with mental illness is enough. Further, Australia is on the verge of introducing a National Disability Insurance Scheme (NDIS), which supports all Australians with a disability, including mental illness, to improve their lives (7). Thus, an estimate of mental illness costs in Australia at present will also provide a useful reference for future evaluations of the NDIS.

This study makes three contributions to the literature by estimating the costs of mental illness in Australia using data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. First, it provides an updated estimate of the costs of mental illness in Australia using the HILDA data. Second, it exploits the longitudinal structure of the HILDA data to estimate both short-run and long-run costs of mental illness. Third, it controls for individual-specific unobserved effects by using an extended random-effects estimator.

2. A brief review of the literature

A recent, comprehensive review of the cost of mental illness by Doran and Kinchin (5) found 45 studies from Australia, the UK, Canada and New Zealand that applied diverse methods to estimate the cost of mental illness. Australia contributed almost half of the total studies reviewed with 22 studies, followed by Canada (12) and the UK (10). Among the types of mental illness, most studies focused on overall mental disorders (19), followed by

specific conditions such as depression (11) and schizophrenia (7). Most studies concentrated on estimating direct costs of mental illness, while only six estimated the indirect costs of mental illness. This trend may result in an under-estimation of mental health costs because indirect costs such as productivity loss could be much larger than direct costs (8-12).

Most studies estimated short-run costs of mental illness and its impacts. Only nine studies examined long-run costs, which were found significantly higher than the short-run costs. The long-term impacts of mental illness studied include low education attainment, low labour force engagement, low productivity (via presentism, absenteeism and early retirement), and welfare dependency. Perhaps most alarmingly, the majority of studies revealed that the costs of mental illness are substantial and increasing. For example, the estimated excess costs of major depression in South Australia was $A13,000 per case per year, of which costs to patients was $A10,000 (10). The relative cost of mental illness in Australia was also high: individuals with depression and other mental disorders had 97% less saving and retirement income by the age of 65 than those without mental illness (13).

We updated the review of Doran and Kinchin (5) by searching for studies in other developed countries that have a similar level of economic development to Australia. In the United States of America (USA), Marcotte and Wilcox-Gök (14) found that mental illness resulted in a lower income by up to $US6,000 per year, accounting for 24% of the median income of $US25,000 (15).

The costs of mental illness studies in the literature can be classified into several dichotomies: prevalence- versus (vs) incidence-based; prospective vs retrospective; bottom-up vs top-down; (16). The prevalence-based approach estimates all costs associated in a given period while the incidence approach estimates the life-time costs of new cases. The retrospective approach applies when all costs have already occurred while prospective approaches apply when not all costs are already collected. The top-down approach estimates costs at national or regional levels, which can then project individual-level costs by dividing aggregated costs by the number of cases. The bottom-up approach estimates costs at the individual level then aggregate these costs by the number of cases to obtain the national estimates.

A prevalence-based, prospective and bottom-up approach is more relevant to studies using survey data like this study. In particular, we select the Standard of Living (SoL)

approach, which estimates the cost of mental illness as the amount of additional income needed to make the standard of living of people with an illness similar to that of people without mental illness (17-19). The SoL is based on the assumption that for the same income level, people with a mental illness will experience a lower standard of living due to part of the income is spent to cover additional costs (e.g., medication, health services). This approach has been widely used in the literature to measure income inequality and poverty (18). The SoL approach was applied in the literature to implicitly estimate both direct and indirect costs of disability (19-21). One advantage of the SoL approach is that it does not require the collection of data on specific costs associated with a mental illness. However, this approach does not include intangible costs, which are often estimated by willingness-to-pay (16). Also, with a relevant panel data specification, this approach allows the estimation of both short-run and long-run costs. This study will be the first application of the SoL approach to estimate the costs of mental illness in Australia.

3. Methods

3.1 Specification

Econometrically, the costs of mental illness using the SoL approach are specified as:

$$S_{it}^{*} = \beta_0 + \beta_1 lnY_{it} + \beta_2 MI_{it} + \delta X_{it} + (\alpha_i + \varepsilon_{it}) \quad (1)$$

where S_{it}^{*} is a latent (unobserved) variable representing the standard of living of individual i at period t; lnY_{it} is the natural logarithm of inflation-adjusted equivalised disposable income; MI is a dummy variable representing mental illness; X is a vector of individual, household and neighbourhood characteristics; and the composite error term consists of time-invariant individual-specific unobserved characteristics (α_i) and random noise (ε_{it}).

The observed value S_{it} (e.g., financial satisfaction) is linked to the latent variable S_{it}^{*} as:

$$S_{it} = k \text{ if } \mu_{ik} \leq S_{it}^{*} \leq \mu_{i,k+1} k=1,..,K \quad (2)$$

where individual-specific thresholds μ_i are increasing with $\mu_{i1} = -\infty$ and $\mu_{iK} = +\infty$.

The cost of mental illness under the SoL approach is defined as the additional amount of income (ΔY) needed to keep the living standard of people with a mental illness ($S_{lnY+\Delta Y|MI=1}$) equal to that of people without a mental illness ($S_{lnY|MI=0}$). Replacing the value of income and mental health status for those with and without a mental illness into Equation

(1), other variables remain unchanged and hence are dropped for brevity, results in the SoL estimation of additional income (cost of mental illness) as:

$$(\Delta Y + lnY)\beta_1 + \beta_2 = \beta_1 lnY \quad (3)$$

Particularly, the cost of mental illness using the SoL approach is the ratio of the mental illness and log of income parameters ($-\beta_2/\beta_1$). This ratio is interpreted as the percentage of disposable income needed for individuals with a mental illness to reach the same level of standard of living of those without a mental illness.

Due to the presence of individual-specific unobserved characteristics α_i, the composite error term may be correlated with other observable covariates. Thus, applying a standard regression to Equation (1) may produce biased estimates. Mundlak (22) proposed an extended random-effects estimator where the time-invariant individual unobserved characteristics (α_i) correlates with the individual-average of endogenous covariates:

$$\alpha_i = \gamma \bar{Z}_\iota + u_i \quad (4)$$

where Z_i is a set of potentially endogenous time-varying observable covariates, which is a subset of X_{it}; and u_i is normally distributed with zero mean and standard deviation δ_u and uncorrelated with Z_{it} or $\bar{Z}_i$. In this study, the potential endogenous time-varying observable variable is equivalised disposable income.

Replacing α_i from Equation 4 into Equation 1 and applying a standard random-effect estimator can mitigate the effects of individual unobserved characteristics.

$$S_{it}^* = \beta_0 + \beta_1 lnY_{it} + \beta_2 MI_{it} + \delta X_{it} + \gamma \bar{Z}_\iota + (u_i + \varepsilon_{it}) \quad (5)$$

A static specification like Equation 5, however, does not reflect the fact that costs of mental illness during the current periods could be affected by those in the previous periods. Thus, the lagged values of mental illness status and income have been included to specify this dynamic relationship:

$$S_{it}^* = \beta_0 + \beta_1 lnY_{it} + \beta_2 MI_{it} + \beta_3 lnY_{i,t-1} + \beta_4 MI_{i,t-1} + \delta X_{it} + \gamma \bar{Z}_\iota + (u_i + \varepsilon_{it}) \quad (6)$$

The advantage of this specification is that it can separate the contemporaneous costs of mental illness (estimated using the current period parameters) with the long-run costs of mental illness (estimated using the previous period parameters).

The estimation of Equation 6 will be conducted using a random-effects ordered logit estimator. The logit distribution link function is selected instead of the normal distribution

link function (i.e., a probit estimator) due to its ability to perform a fixed-effects if statistical tests suggest that a random-effects estimator is not suitable.

3.2 Data

3.2.1 Data source

The data used in this study was from the first 16 waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey, which was a popular nationally representative longitudinal study in Australia. The annual survey began in 2001 and collected a wide range of information on relationships, childcare, employment, income and health from all household members aged 15 years and older (23). In this study, we use data from Wave 1 to Wave 16, conducted in 2016.

The survey attained a reasonably high response rate of 66% at the household level and 61% at the individual level (24). The average retention rate of Wave 1 sample was relatively high, from 85.9% in Wave 2 to 55.6% in Wave 16 (25). The number of survey participants ranges from 13,969 in Wave 1 to 17,694 in Wave 16, and a large top-up of households occurred in Wave 11.

3.2.2 Variable selection

<u>Standard of living</u>

We measured the costs of mental illness using a standard of living approach. There were two main measures of the standard of living in the literature: overall wellbeing (26), and financial situation (27). We prefer the financial satisfaction measure for several reasons. First, the financial situation is easier to adjust by changes in income. In contrast, overall wellbeing may include intangible factors and thus is difficult to improve with income alone. Second, results based on this can be easily translated into measurable policy targets, such as the optimal amount of financial support needed for people with a mental illness. In the HILDA survey, the financial satisfaction variable was a rank order with a range from 0 for "totally dissatisfied" to 10 for "totally satisfied".

<u>Mental illness and covariates</u>

The HILDA survey included a direct question on mental illness "Do you have any long-term mental health condition – Any mental illness which requires help or supervision?". We chose a response to this question as the main measure of mental illness. On average, 5.6% of people responded to this question answered "yes". However, this variable

contained many missing observations. This question was not asked for 53% of the participants, and it was not available in the first two waves. Thus, an alternative measure of mental illness was constructed from the mental health component of the short-form 36 (SF-36) questionnaire. This questionnaire, developed by the RAND institution, contained 36 items to measure physical and emotional wellbeing (28). The mental health score of the SF-36 has been demonstrated as a valid measure of mental illness (29). This variable was also selected to measure mental illness in a previous Australian study using the same data set (30).

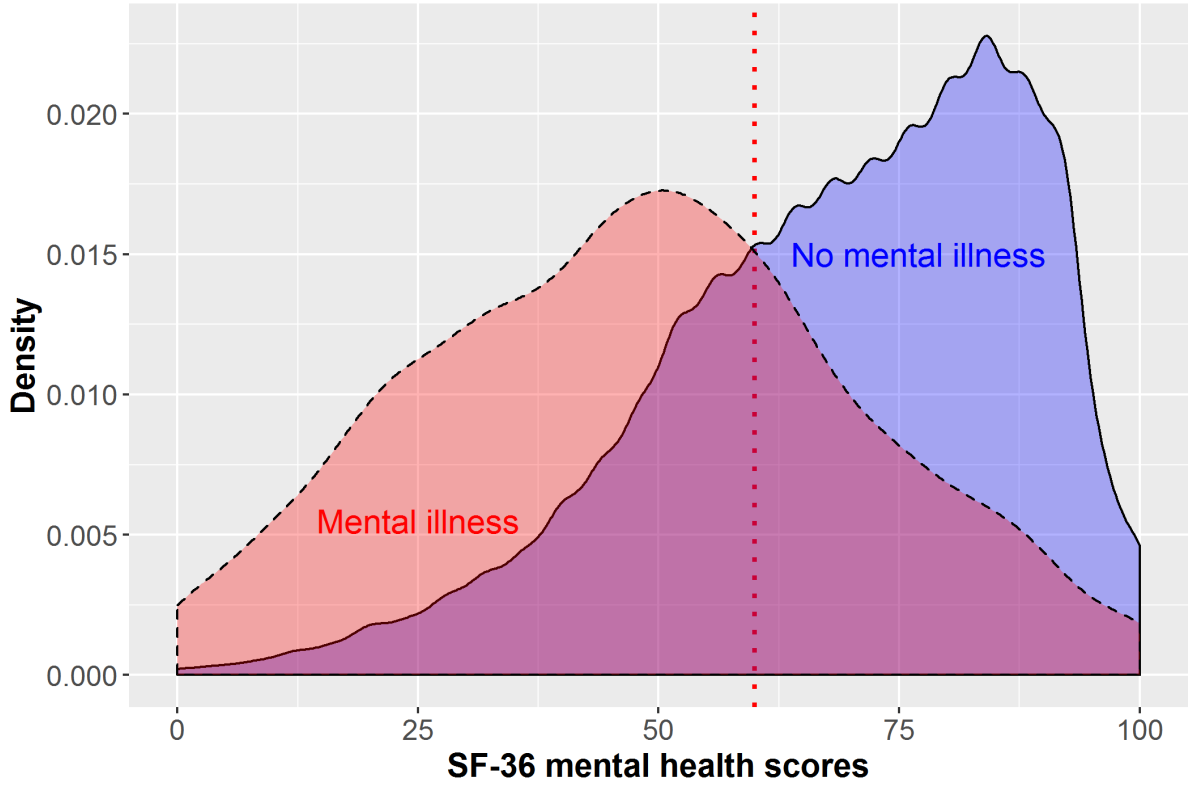

Figure 1. Distribution of SF-36 mental health scores by the mental illness status (N=57,985)

The HILDA data possessed a summary score of the SF-36 mental health component. This score ranged from zero (very poor mental health) to 100 (perfect mental health). The distribution of SF-36 mental health scores showed that those with mental illness have substantially lower scores than those without a mental illness despite considerable overlap (see Figure 1). This overlapping region might include those who exercised a preventing effort (i.e., seek help for mental illness despite score highly in SF-36 mental health – the right side of the overlapping region), and those who exercised a covering effort (i.e., do not seek help for mental illness despite score poorly in SF-36 mental health – the left side of

the overlapping region). Differences in the ability to measure mental health between the two indicators may also contribute to the overlapping region.

Based on the distribution of SF-36 scores for mental illness in Figure 1 and the prevalence of mental illness in the Australian population, an alternative measure of mental illness was defined as those with the SF-36 mental health score within the first quintile (i.e., a score less than or equal to 60). Thus, this choice of classification was in line with the Australian population prevalence that one in five adult Australians experienced some form of mental illness in the past 12 months (31). The selected cut-off threshold also lied in the middle of the intersection between the SF-36 distributions by the self-reported mental illness status (the vertical dotted line in Figure 1).

Other variables used in the analysis were age, gender, ethnicity, marital status, education level, employment of the respondents, household size, disposable income, and regions of residence. The annual income variable was adjusted for inflation using the Australian consumer price index with the reference period of 2016. Disposable income was converted to equivalised disposable income using the modified OECD-equivalence scale, which allocates a weight of 1.0 to the first adult, 0.5 to each of the remaining adults and 0.3 to each child (32).

4. Results

4.1 Explorative examination

First, the relationship between income and financial satisfaction by the mental illness status is explored to illustrate the cost estimation using the SoL approach. A smoothing plot in Figure 2 shows that individuals with mental illness have lower SoL than those without mental illness. Interestingly, at the lower end of the income spectrum (i.e., the log of income is less than 6), individuals without a mental illness earn less. Since disposable income includes all sources, financial support from the government may cushion the income of individuals with mental illness from falling past a certain threshold. At the high end of the income spectrum, those with a mental illness are projected to catch up with those without a mental illness, but the statistical confidence for this trend is low (i.e., large confidence intervals).

To increase the SoL of those with mental illness from the mean of 4.9 to that of people without a mental illness (i.e., move from A to B) their log of income needs to increase from the mean level of 10.38 to 11.88 per year. The parameter of log income (β_1) is the slope

at point A (i.e., the "rise"/"run" ratio AB/BC), while the parameter of mental illness ($-\beta_2$) is the gap in the SoL between the two groups (i.e., AB). Thus, the cost of mental illness ($-\beta_2/\beta_1$) is BC or 1.5 times of annual equivalised disposable income. However, this graph neither controls for any covariates nor controls for the potential endogeneity of income, and hence it may present over- or under-estimation of the cost of mental illness.

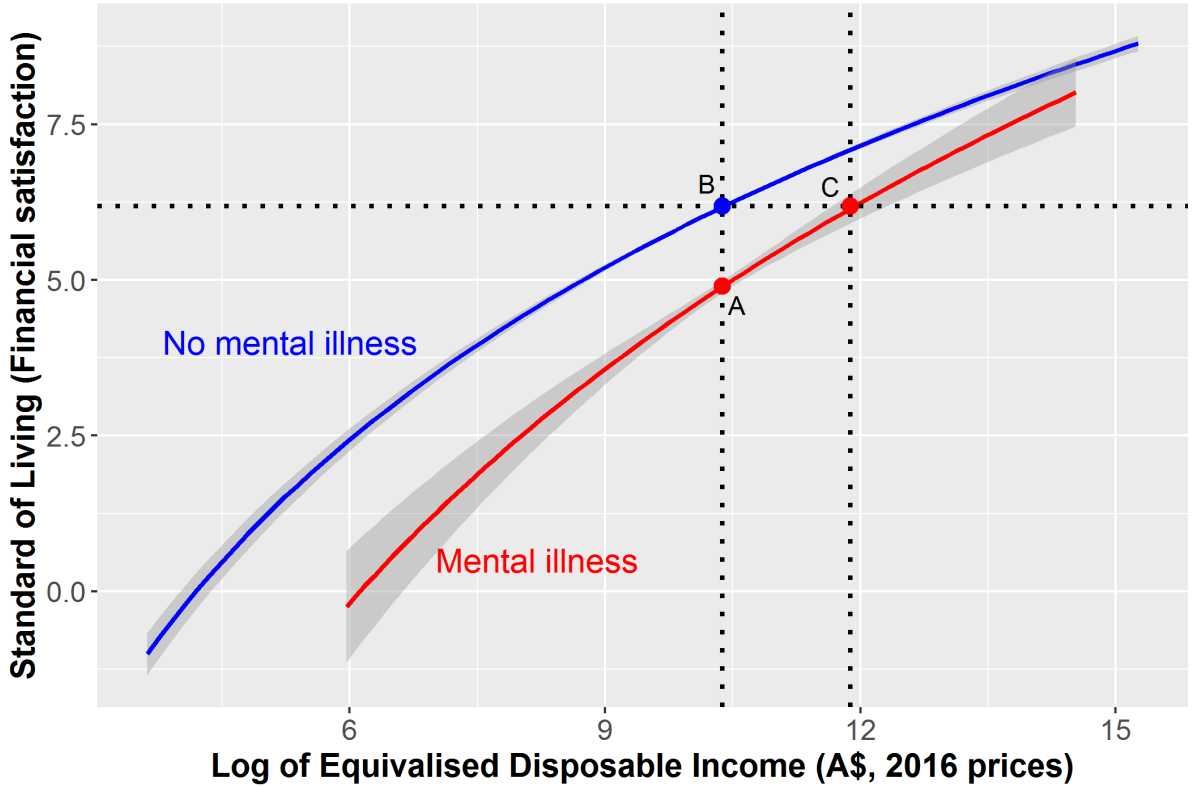

Figure 2. Income and SoL by self-reported mental illness status (shaded areas represent 95% confidence intervals. N=209,871)

The cost illustration is also explored by using the level of satisfaction with life as a proxy for SoL (Figure 3). Income alone may not help people with mental illness to achieve the same level of satisfaction with life as those without a mental illness (i.e., the horizontal line from point B does not intersect the red curve). Although cost estimates from this sketch may not be precise, it seems to confirm the hypothesis that life satisfaction may include intangible factors that are difficult to compensate by income alone (i.e., to move along the red curve in Figure 3).

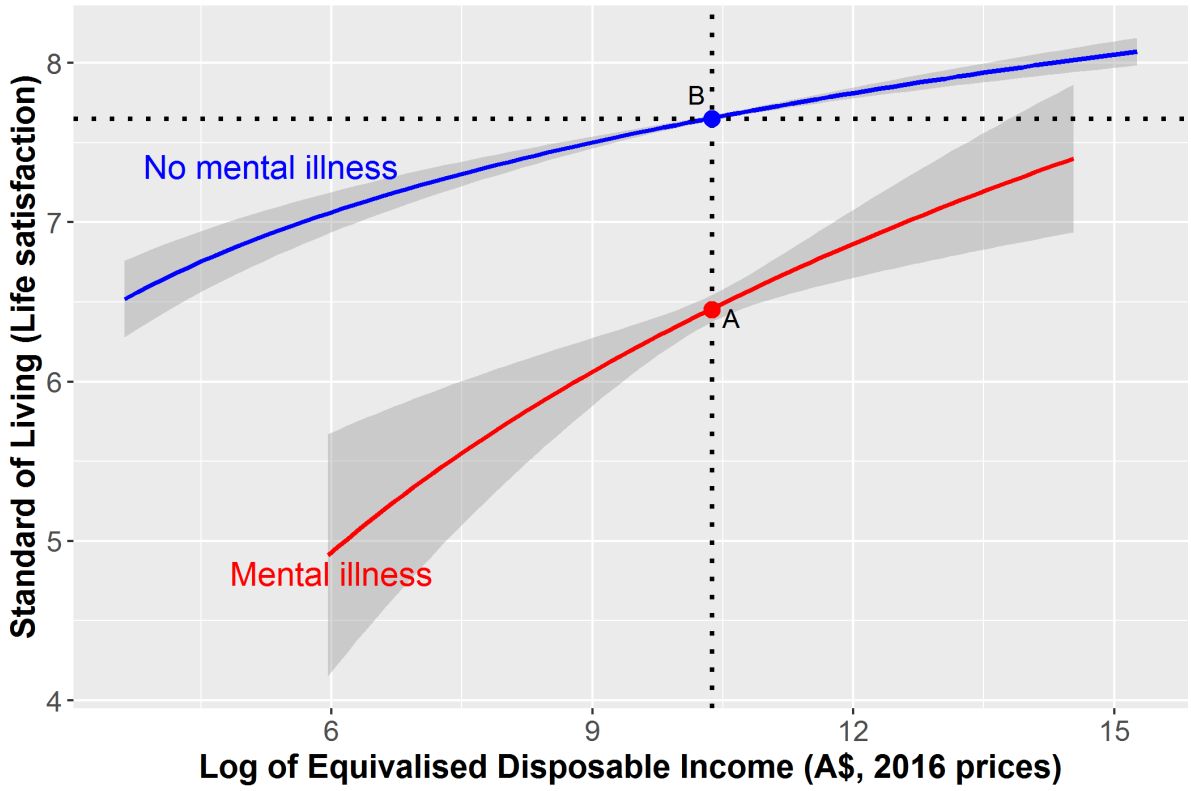

Figure 3. Income and SoL (measured by overall life satisfaction) by self-reported mental illness status (shaded areas represent 95% confidence intervals. N=209,871)

4.2 Extended random-effects estimates

Table 1 shows that both the current and lag period of income is positively associated with SoL and individuals with a mental illness have a significantly lower SoL. On average, the equivalised disposable income of individuals with mental illness needs to be 50% higher to have a similar level of SoL as those without a mental illness. The long-run costs, estimated as the ratio of lagged parameters, are three times higher than the short-run costs for self-reported mental illness.

Parameters of the between-wave mean of log income are not significantly different from zero, suggesting that a random-effects estimator is preferred. This finding is strengthened by the significance of the likelihood ratio test, which rejects the null hypothesis that parameters of the selected estimator (extended random-effects ordered logit) are similar to those obtained from an ordered logit estimator. Also, the standard deviation of the individual unobserved effects (δ_u) is significantly different from zero.

Table 1. Costs of mental illness (Main specification: Equation 6)

Covariates	Mental illness measures			
	Self-report		**SF-36 mental health score**	
	Coef.	SE	Coef.	SE
Current period				
Mental health status (β_2)	***-0.35	0.12	***-0.58	0.02
Log of income (β_1)	***0.70	0.05	***0.72	0.02
Short-run cost (-β_2/β_1)	**50%**		**80%**	
Lag Period				
Mental health status (β_4)	***-0.44	0.13	***-0.31	0.02
Log of income (β_3)	***0.29	0.05	***0.24	0.02
Long-run costs (-β_4/β_3)	**152%**		**129%**	
Wave-mean of log income	-0.87	0.91	0.35	0.24
Age	***0.02	0.00	***0.01	0.00
Sex (male=1)	0.12	0.09	0.01	0.04
Indigenous status (Y=1)	0.09	0.27	-0.06	0.12
Household size	-0.03	0.03	**-0.02	0.01
Education (Base=undetermined education level)				
Postgraduate	-1.27	1.80	-0.07	1.07
Grad diploma	-1.57	1.79	-0.03	1.07
Bachelors	-1.43	1.79	-0.24	1.07
Diploma	-1.47	1.79	-0.43	1.07
Certificate III or IV	-1.88	1.79	-0.46	1.07
Year 12	-1.73	1.79	-0.48	1.07
Year 11 and below	-1.74	1.79	-0.20	1.07
Employment (Base=unemployed)				
Employee	*0.47	0.26	0.04	0.11
Employee of own business	*0.52	0.29	*0.21	0.12
Employer/Self-employed	0.03	0.26	-0.11	0.11
Marital status (Base=never married and not in de facto)				
Legally married	***0.36	0.12	***0.14	0.04
De facto	0.14	0.11	***-0.12	0.03
Separated	***-0.81	0.19	***-0.93	0.06
Divorced	***-0.54	0.16	***-0.64	0.06
Widowed	-0.11	0.28	**0.24	0.12
SES status (Base=5th SEIFA quintile, highest SES)				
SEIFA Quintile1	**-0.26	0.12	0.03	0.04
SEIFA Quintile2	**-0.25	0.11	-0.02	0.03
SEIFA Quintile3	***-0.32	0.11	0.02	0.03
SEIFA Quintile4	**-0.22	0.11	-0.02	0.03
Time trend	0.02	0.02	**0.01	0.01
Constant	-4.89	9.68	***7.02	2.69
δ_u	***4.10		***3.48	
N	9,126		86,604	
Individuals	2,989		14,033	
Likelihood ratio test: $\chi^2(1)$	***2940		***30822	

Note: Significant levels: .01 - ***; .05 - **; SE=standard errors; Threshold parameters (μs) are not presented for brevity.

The results using the SF-36 mental health score show that the estimated short-run cost rises substantially to 80% of equivalised disposable income. Since the mental illness measured by SF-36 includes "consistent" and "covering" groups while the self-report mental illness includes "consistent" and "preventing" groups (see Table 2), the cost difference between SF-36 and self-reported mental illness is measured by the cost of "covering" minus the cost of "preventing". Thus, the higher estimated cost using SF-36 (i.e., $Cost_{SF\text{-}36}$ - $Cost_{Self\text{-}report}$>0)suggests that the cost associated with "covering" mental illness is larger than that of "preventing" mental illness (i.e., $Cost_{"covering"}$-$Cost_{"preventing"}$>0).

Table 2. Tabulation of mental illness by choices of measurements

		Self-report		
		Yes	No	Self-report total
SF-36	Yes	Consistent	Covering	Consistent+ Covering
	No	Preventing		
	SF-36 total	Consistent+ Preventing		SF-36 – Self-report= Covering-Preventing

In line with the standard practice in the health economics literature (16), we also estimate the long-run cost of mental illness. The findings show that the long-run costs are substantially higher, ranging from 129% to 152% of disposable income.

Parameters of other covariates are in line with observations in the descriptive statistics. Marital status matters. Those legally married have a level of satisfaction and financial situation higher than those who never married. However, parameters of ordered logit estimator cannot be interpreted directly as marginal effects. A line graph on the relationship between linear and probability predictions in Figure 4 makes the interpretation easier (the graph for SF-36 mental health measure of mental illness is similar and hence is not presented for brevity).

Positive parameters increase the mean linear prediction (dotted vertical line in Figure 4), leading to higher probabilities for a better SoL, proxied by the level of satisfaction with the financial situation. Negative parameters have reverse effects. For example, the parameter of legally married is 0.36 (i.e., the vertical dotted line moves to the right by 0.36), indicates that legally married increases the probability of having a financial satisfaction score >7 compared to those never married. In contrast, individuals who are separated (parameter of -0.8) or divorced (parameter of -0.5) have higher probabilities of having a score <5 on financial satisfaction compared to those who never married. Other significant determinants

include age, socioeconomic status (SES), and employment status. Results using SF-36 to measure mental illness is similar except that the household size becomes significant.

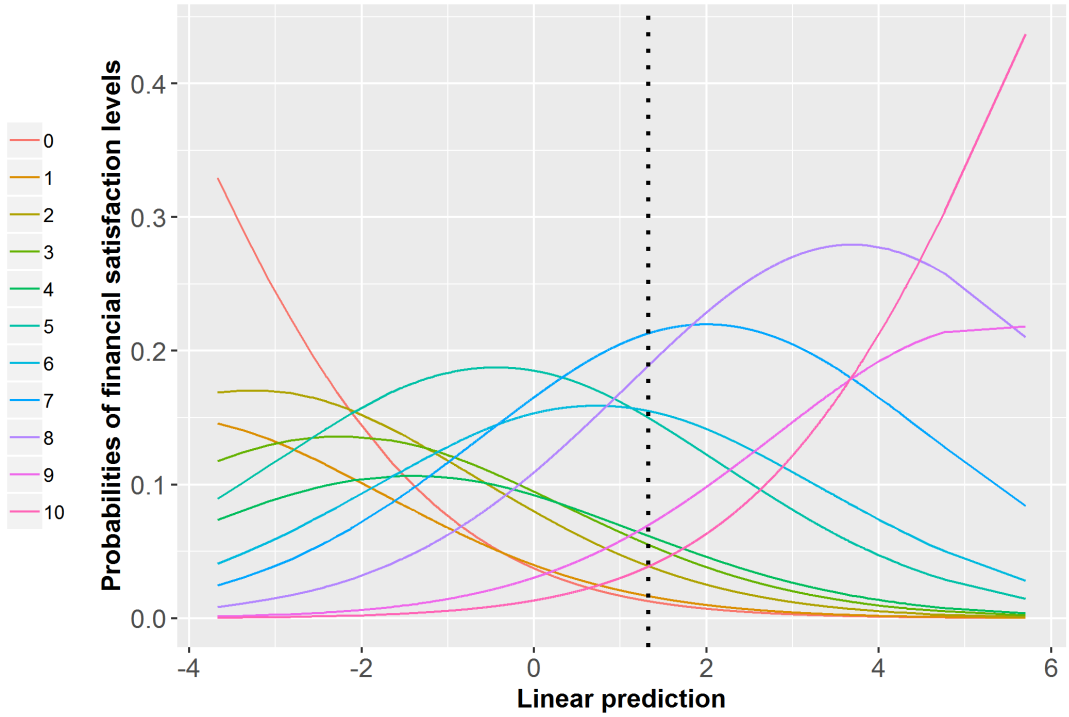

Figure 4. Linear and probability predictions, self-reported mental illness measure (colour lines represent probabilities of all financial satisfaction levels, ranging 0 to 10, N=9,126)

Robustness check

To check the robustness of results, the level of satisfaction with life is used as a proxy for SoL. The results in Table 3 confirm our expectation that this choice results in very high-cost estimates. The short-run cost of mental illness increases to four folds for self-reported mental illness and nine folds for SF-36 mental health scores.

Caution is needed when interpreting the results of this specification due to two reasons. First, the lag of income is not significant for self-reported mental health. Second, the wave-average of income is significantly different from zero for SF-36 measures of mental illness, suggesting that a random-effects estimator is not suitable. Thus, a fixed-effects ordered logit estimator using the "blow-up and cluster" (BUC) approach by Baetschmann, Staub (33) was also conducted for this specification. The results reveal a similar conclusion: costs for mental illness are much higher when the level of satisfaction with life is selected to measure SoL.

Table 3. Robustness test: using satisfaction with life to measure SoL

Selected parameters	Mental illness measures					
	Self-reported		SF-36 mental health score			
			Random Effects		Fixed Effects	
	Coef.	SE	Coef.	SE	Coef.	SE
Current period						
Mental health status (β_2)	***-0.59	0.13	***-1.37	0.02	***-1.19	0.03
Log of income (β_1)	***0.15	0.05	***0.15	0.02	***0.12	0.02
Short-run cost (-β_2/β_1)	4.00		9.38		9.87	
Lag period						
Mental health status (β_4)	***-0.39	0.13	***-0.54	0.02	***-0.32	0.02
Log of income (β_3)	0.01	0.05	***0.09	0.02	***0.08	0.02
Long-run cost (-β_4/β_3)	39.00		5.74		4.16	
Wave-average of log income	-0.72	0.94	***-1.74	0.25		
N	9,127		86,605			
Individuals	2,987		33,938			
Random-effects (δ_u)	***4.51		***4.36			
LR test: $\chi^2(1)$	***2939		***30822			

Note: Significant levels: .01 - ***; .05 - **; .1 - *. SE=standard errors. Other covariates include age, gender, ethnicity, education level, marital status and employment status of the respondent, household size, SEIFA quintile, and a time trend.

We also explore the robustness of our results by controlling for physical health, proxied by the SF-36 physical health score (see Table 4). The results revealed that physical health is a significant factor in financial satisfaction but its magnitude is negligible. As a result, the cost of mental illness remained robust, ranging from 53% for self-reported mental health and 89% for SF-36 mental health score.

Table 4. Robustness test: control for physical health

Covariates	**Self-report**		**SF-36 mental health score**	
	Coef.	SE	Coef.	SE
Current period				
Mental health status (β_2)	***-0.38	0.14	***-0.62	0.05
Log of income (β_1)	***0.72	0.06	***0.70	0.02
Short-run cost (-β_2/β_1)	**53%**		**89%**	
Lag Period				
Mental health status (β_4)	***-0.47	0.14	***-0.38	0.05
Log of income (β_3)	***0.29	0.06	***0.26	0.02
Long-run costs (-β_4/β_3)	**162%**		**146%**	
Physical health	***0.02	0.002	***0.02	0.001
N	9,126		86,604	

Note: Significant levels: .01 - ***; .05 - **; .1 - *. SE=standard errors. Other covariates include age, gender, ethnicity, education level, marital status and employment status of the respondent, household size, SEIFA quintile, and a time trend.

5. Discussions

Mental illness incurs substantial costs to individuals living with this health condition and to their families. Despite this there are only limited financial supports in place, the equivalised disposable income of people with mental illness needs to be higher at least 50% to raise their standard of living to a similar level of those without a mental illness. The short-run cost of mental illness estimated in this study is in line with that of other Australian studies: 97% retirement income (13); 30% of employment (30). The relatively higher cost estimate in the long-run may be due to the introduction of new medical technology (34) or ageing population (35).

Even in the short-run, the cost estimate of mental illness could be much higher if the overall life satisfaction was selected to proxy for standard of living. When no additional covariate was controlled for, income alone cannot bring the level of life satisfaction of those with mental illness to the same level as the remainder of the population. Thus, apart from income, productivity shifters such as better communication (36) are needed to improve the life satisfaction of individuals with a mental illness.

This study has several limitations on the measurement of mental illness. The direct question suffers from many missing observations. The relatively low prevalence of mental illness using this direct question (5.6%) suggested that many participants with mental health issues could have skipped this question to avoid being stigmatized. The threshold of SF-36 mental health score was selected based only on the prevalence of mental illness in Australia. Also, it is possible that the SF-36 mental health score may not cover all types of mental illness. Finally, the cost of mental illness in this study was only implicitly estimated and did not include intangible costs.

6. Conclusion

This paper examined mental illness costs in Australia using the SoL approach. We found that equivalised disposable income of individuals with mental illness needs to be 50% higher to reach the same standard of living as those without a mental illness. The estimated cost increases to 80% when using the first quintile score of the SF-36 mental health component to measure mental illness. One possible reason for this finding is that many

people may have poor mental health but have not looked for help. This finding suggests that a greater focus on de-stigmatising mental illness and promoting positive help-seeking behaviours by those suffering is required. The long-run estimated cost is three times larger than that in the short-run. The disposable income used in this study includes all sources of income; this finding suggests that current financial support for people with mental illness may not be enough to cover their extra expenses due to poor mental health. The upcoming National Disability Insurance Scheme (NDIS) is expected to improve the health outcomes and SoL of people with a disability, including mental illness. Thus, the findings from this study can be used as a reference for the future cost of mental illness estimation after the full implementation of the NDIS in Australia.

This study also revealed that financial support alone may not be sufficient to improve the standard of living of those with a mental illness to the same level of those without a mental illness. Thus, integration of financial with non-financial supports such as "beyond blue" (37), "RUOK" (38) and "Headspace" (39) programs in Australia would be more effective to improve the standard living of those with a mental illness.

Data Availability Statement

The data that support findings of this study are available upon request from the Melbourne Institute [https://melbourneinstitute.unimelb.edu.au/hilda/for-data-users]

Author Contributions

SN conceived the project idea, requested data, conducted analysis, and prepared manuscript

RK and BT discussed to expand the scope of analyses and edited the manuscript.

BV reviewed the literature, prepared data, and edited the manuscript.

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References

1. Mechanic D. Mental health and mental illness: Definitions and perspectives. 1999.
2. Australian Bureau of Statistics. 4329.0.00.006 - Mortality of People Using Mental Health Services and Prescription Medications, Analysis of 2011 data. 2017.
3. Laplagne P, Glover M, Shomos A. Effects of health and education on labour force participation. In: Commission P, editor. Melbourne2007.
4. Lim D, Sanderson K, Andrews G. Lost productivity among full-time workers with mental disorders. The Journal of Mental Health Policy and Economics. 2000;3(3):139-46.
5. Doran CM, Kinchin I. A review of the economic impact of mental illness. Australian Health Review. 2019;43(1):43-8.
6. Scott S, Knapp M, Henderson J, Maughan BJB. Financial cost of social exclusion: follow up study of antisocial children into adulthood. 2001;323(7306):191.
7. Reddihough DS, Meehan E, Stott NS, Delacy MJ, Medicine ACPRGJD, Neurology C. The National Disability Insurance Scheme: a time for real change in Australia. 2016;58:66-70.
8. Knapp M. Hidden costs of mental illness. The British Journal of Psychiatry. 2003;183(6):477-8.
9. Hu T-W. Perspectives: an international review of the national cost estimates of mental illness, 1990-2003. The journal of mental health policy and economics. 2006;9(1):3-13.
10. Hawthorne G, Cheok F, Goldney R, Fisher L. The excess cost of depression in South Australia: a population-based study. Australian and New Zealand Journal of Psychiatry. 2003;37(3):362-73.
11. Heijink R, Noethen M, Renaud T, Koopmanschap M, Polder J. Cost of illness: an international comparison: Australia, Canada, France, Germany and the Netherlands. Health Policy. 2008;88(1):49-61.
12. Trautmann S, Rehm J, Wittchen HU. The economic costs of mental disorders: Do our societies react appropriately to the burden of mental disorders? EMBO reports. 2016;17(9):1245-9.
13. Schofield DJ, Kelly SJ, Shrestha RN, Callander EJ, Percival R, Passey ME. How depression and other mental health problems can affect future living standards of those out of the labour force. Aging & mental health. 2011;15(5):654-62.
14. Marcotte DE, Wilcox-Gök V. Estimating the employment and earnings costs of mental illness: recent developments in the United States. Social Science & Medicine. 2001;53(1):21-7.
15. DeNavas-Walt C, Cleveland R, Webster BH. Income in the United States: 2002. In: Bureau USC, editor. Washington D.C.2003.
16. Tarricone R. Cost-of-illness analysis: what room in health economics? Health policy. 2006;77(1):51-63.
17. Cullinan J, Gannon B, Lyons S. Estimating the extra cost of living for people with disabilities. Health Economics. 2011;20(5):582-99.
18. Zaidi A, Burchardt T, Wealth. Comparing incomes when needs differ: equivalization for the extra costs of disability in the UK. Review of Income and Wealth. 2005;51(1):89-114.
19. Vu X-BB, Khanam R, Rahman M, Nghiem S. The costs of disability in Australia: a hybrid panel-data examination. University of Southern Queensland., 2019.
20. Cullinan J, Gannon B, Lyons S. Estimating the extra cost of living for people with disabilities. Journal of Health Economics. 2011;20(5):582-99.

21. İpek E. The Costs of Disability in Turkey. Journal of Family and Economic Issues. 2019.
22. Mundlak Y. On the pooling of time series and cross section data. Econometrica. 1978;46(1):69-85.
23. Summerfield M, Bevitt A, Freidin S, Hahn M, La N, Macalalad N, et al. HILDA User Manual – Release 16. University of Melbourne: Melbourne Institute of Applied Economic and Social Research; 2017.
24. Wooden M, Watson N. The HILDA survey and its contribution to economic and social research (so far). Economic Record. 2007;83(261):208-31.
25. Department of Social Services. Sample sizes and response rates for the Centre studies: Department of Social Services; 2018 [14 March 2019]. Available from: https://www.dss.gov.au/about-the-department/national-centre-for-longitudinal-studies/growing-up-in-australia-the-longitudinal-study-of-australian-children-lsac/sample-sizes-and-response-rates-for-the-centre-studies.
26. Groot W, Maassen van den Brink H. The compensating income variation of cardiovascular disease. Journal of Health Economics. 2006;15(10):1143-8.
27. Morciano M, Hancock R, Pudney S. Disability Costs and Equivalence Scales in the Older Population in Great Britain. Review of Income and Wealth. 2015;61(3):494-514.
28. Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. Medical Care. 1992.
29. McHorney CA, Ware JE, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. MEDICAL CARE-PHILADELPHIA-. 1993;31:247-.
30. Frijters P, Johnston DW, Shields MA. The effect of mental health on employment: evidence from Australian panel data. Health economics. 2014;23(9):1058-71.
31. Australian Bureau of Statistics. National survey of mental health and wellbeing: summary of results. Catalogue No. 4326.0. Canberra2008.
32. Borah M, Keldenich C, Knabe A. Reference income effects in the determination of equivalence scales using income satisfaction data. Review of Income and Wealth. 2016.
33. Baetschmann G, Staub KE, Winkelmann R. Consistent estimation of the fixed effects ordered logit model. Journal of the Royal Statistical Society: Series A (Statistics in Society). 2015;178(3):685-703.
34. Smith S, Newhouse JP, Freeland MS. Income, insurance, and technology: why does health spending outpace economic growth? Health Affairs. 2009;28(5):1276-84.
35. Pammolli F, Riccaboni M, Magazzini L. The sustainability of European health care systems: beyond income and aging. The European Journal of Health Economics. 2012;13(5):623-34.
36. Gelb BD, Corrigan PW. How managers can lower mental illness costs by reducing stigma. Business Horizons. 2008;51(4):293-300.
37. Hickie I. Can we reduce the burden of depression? The Australian experience with beyondblue: the national depression initiative. Australasian Psychiatry. 2004;12(sup1):s38-s46.
38. Maher B. RU OK?: The Role of Community in Suicide Prevention. Global Health Leadership: Springer; 2019. p. 79-90.
39. McGorry PD, Tanti C, Stokes R, Hickie IB, Carnell K, Littlefield LK, et al. headspace: Australia's National Youth Mental Health Foundation—where young minds come first. Medical Journal of Australia. 2007;187(S7):S68-S70.