The Transmission of Mental Health within Households: Does One Partner's Mental Health Influence the Other Partner's Life Satisfaction?

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The transmission of partner mental health to individual life satisfaction: estimates from a longitudinal household survey

1. Introduction

Valuations of health conditions serve an important role of informing decision-makers of the relative value for money of interventions and policies designed to improve health and well-being. However, health conditions have substantial spillover effects on the family of the individual who directly experiences the conditions, and these effects should be taken into account when evaluating the impact of such conditions. A challenge however is to identify a suitable valuation method with which to incorporate these spillover effects.

One of the most common health conditions that occur in populations worldwide is poor mental health (Vigo et al 2016). There are various mechanisms through which mental health is likely to have an impact on partners' well-being (Doran & Kinchin 2017). First of all, individuals derive utility from the health of their partners. For example Jacobson (2000), who provides an interesting generalization of the Grossman model, in which family, rather than an individual, is the producer of health. Second, individuals with poor mental health are more likely to drop out of the labour market and this may impose additional financial stress on the family (Schofield et al 2011). Third, individuals with poor mental health may need care and supervision, and this may lead to greater risk of depression amongst carers (Joling et al. 2010; Mentzakis et al. 2011; Ask et al 2014). Last, mental ill-health can cause additional problems within the family, such as increased family conflicts (Burke 2003).

This study investigates the impact of partner's mental health on individual life satisfaction, using a large longitudinal dataset of Australian couples, and calculates the compensation needed for individuals living with a partner in poor mental health. Understanding the impact of mental health on family members is important, as they are likely to be the primary source of care for individuals affected, and can be responsible for choosing among different treatment options.

Therefore, if there are substantial spillover effects on family members, the care of people affected by the condition can be compromised, and the overall impact on the family is likely to be higher (in terms of well-being; social networks; labour supply, etc.). The existing economics literature has largely neglected the analysis of important spillover effects from individual mental health to the well-being of their partners, and therefore this study aims to fill this important gap.

To the best of our knowledge, this is the first paper to estimate the impact of one person's mental health on their spouses or partners, using longitudinal data and controlling for unobserved heterogeneity, and providing a monetary valuation of these events. For an individual living with a partner in poor mental health, we calculate the amount of additional income that would be just sufficient such that their life satisfaction would then be equivalent to a similar individual living in similar circumstances whose partner did not have that condition (for a recent health example, see Howley 2017).

Our results show that individuals living with a partner in poor mental health experience a substantial drop in life satisfaction, and results are stable in all of the different specifications of the model, controlling for partners' and family's characteristics, life events, and long term health conditions. There is however a risk that potential confounders may affect these results, even when we use estimation with panel data and individual fixed effects, since this only deals with bias associated with time-invariant confounders. Hence, while the results can be taken as further evidence of a robust relationship between partners' mental health and individual life satisfaction, we are not able to draw strong causal inferences.

The impact of partners' mental health is larger than the impact of negative life events (including being victim of violence, property crime, or experiencing death or illness of a relative). The implied compensatory income is substantial, and ranges from around AUD 50,000 (USD 33,000) to around AUD 76,000 (USD 50,000), depending on how poor mental health is defined. Further, we find no evidence of adaptation to poor mental health.

The rest of this paper is organized as follows. Section 2 describes the existing literature on the cost of mental health. Section 3 presents the data and the mental health and well-being indicators. Section 4 discusses the estimation methods and Section 5 presents the main results. Section 6 concludes.

2. Literature review

The effects of poor mental health on individuals' lives and economic outcomes have been widely documented and analysed in the economics literature. Poor mental health is a significant predictor of negative economic outcomes, such as reduced education and labour market success (see for example Fletcher, 2010; Smith and Smith, 2010; Johnston et al., 2014, among many others). Individuals who are in poor mental health may experience reduced productivity (Bubonya et al., 2017) and increased probability of being out of the education system or the labour market at a young age (Cornaglia et al., 2015).

Poor mental health imposes a substantial cost on society and on health care systems around the world. Mental, neurological and substance use disorders account for over 10% of the global burden of disease, measured in years lost, and account for over 25% of years lived with a disability (World Health Organisation, 2013). Recently, the cumulative global impact of mental disorders in terms of lost economic output has been estimated around US$ 16 trillion over the next 20 years, or more than 1% of global GDP over this period (Bloom et al., 2011).

In Australia, mental illness is one of the main leading causes of disability, accounting for approximately 27% of years lost due to disability. Almost one in five Australians had experienced symptoms of a mental disorder in a 12 month period, with a higher incidence of anxiety and depression disorders, followed by affective and substance use disorders (ABS, 2007).

Mental health conditions impose substantial costs to the individuals experiencing them, including costs for treatment, difficulties in the labour market and difficulty in family relationships. Calculating the monetary costs associated with these conditions is a particularly complex task, and recent developments in valuation methodology have shown that measures of subjective well-being, such as life satisfaction, are particularly useful in this context, as they capture the relative effects of mental health conditions more accurately, taking into account all different domains of individual lives that are affected by the condition (Fujiwara and Dolan, 2014).

However, the impact of mental health of family members on individual well-being has been largely unexplored. Pascual-Saez et al. (2019) perform a cross-sectional analysis of the association between partners' mental health and individual well-being for older Europeans using SHARE data, and show that there are important spillover effects. However, this study does not consider the effect of unobserved individual and partner characteristics and the possibility that these traits may be driving the results.

Existing studies use longitudinal data and fixed effects to analyse the correlation between partners' health behaviours and characteristics, such as smoking and obesity, and show that individuals tend to sort themselves in the marriage market and choose partners with similar health behaviours and lifestyles (see for example Clark and Etile', 2011, using the German panel GSOEP; Brown et al., 2014 and Sabia et al., 2018, using the Australian panel HILDA, among others). Similarly, Powdthavee (2009) uses the British Household Panel Survey to analyse the correlation in partners' life satisfaction and shows that there are positive and significant spillover effects between partners' life satisfaction, due to assortative mating and shared home environment. Fletcher (2009) uses the National Survey of Midlife Development in the United States (MIDUS) and a model with individual fixed effects to analyse mental health spillover effects among working couples and show that spousal mental well-being is likely to

have significant and economically meaningful effects on individual mental health. De Mello and Tiongson (2009) use data from the 1972–2006 U.S. General Social Survey (GSS) to investigate the value of individual and family members' health and show that there is a significant link between individual well-being and the health of family members.

A separate strand of literature investigates the relationship between parental mental health and children outcomes, showing that poor maternal mental health is a significant predictor of a wide range of negative outcomes, including lower education and earnings, higher incidence of emotional problems, and higher likelihood of crime (Schepman et al., 2011; Johnston et al., 2014).

This study makes three new contributions to the prior economics literature on family health and spillover effects. First, we investigate the impact of partners' mental health on individuals' life satisfaction using longitudinal data, and therefore shed some light on the broad consequences of mental illness on other family members, rather than on the individual directly affected. To the best of our knowledge, this is the first study in the economics literature to adopt this approach and to investigate the effects of poor mental health on the well-being of partners, considering the effect of unobserved individual and partner characteristics.

Second, we calculate the monetary compensation for an individual living with a partner experiencing a long term mental condition, using recent methodology that takes into account the potential measurement error and endogeneity of income.

Last, we explore the richness of our dataset and investigate the potential protective effects of coping mechanisms (in particular social networks) for individuals living with partners in poor mental health.

3. Data

This study uses data from fifteen waves of the HILDA Survey, which is a household representative longitudinal study of the Australian population that started in 2001, including 13,969 individuals in 7,682 households in wave 1 (Wooden and Watson, 2002).

The estimation sample includes over 96,000 observations[1] of almost 16,000 couples. The sample has been constructed by including all individuals with a partner in HILDA (married or cohabiting couples) and excluding individuals with missing information on partner's mental health and other essential individual and family characteristics (see Table 4 for descriptive statistics). Individuals in all age groups are included in the analysis. We limit the analysis to the sample of individuals who do not experience a long term mental health condition themselves in the current wave, in order to avoid the risk of life satisfaction being affected by both individual and partner's mental health conditions. We have tested the stability of our main results by including all individuals and controlling for individual mental health and the pattern of findings is unchanged. However, individual mental health is potentially endogenous in this analysis (Howley 2017) and we have decided not to include it in the main model. Additional results are available from the authors on request.

At each wave, all respondents in HILDA answer the following question about their life satisfaction: All things considered, how satisfied are you with your life? Answers vary on a scale from 0 to 10, where 0 means "totally dissatisfied" and 10 means "totally satisfied".

Life satisfaction is a measure of subjective well-being that has been extensively used in the economic literature to evaluate the impact of health conditions and, more broadly, life events on individuals (see for example Howley, 2017; Frijters et al., 2011; Powdthavee and van den Berg, 2011; among many others).

Table 1 summarises the distribution of life satisfaction in the estimation sample. In general, the majority of respondents (around 96%) report a moderately high level of life satisfaction (between 6 and 10). The proportion of

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[1] The complete sample from 15 waves of HILDA includes 217,882 observations of responding individuals. 82,786 observations are excluded because these refer to non-partnered individuals. A further 17,045 observations are excluded because they miss the information about mental health (usually because of missing self-completion questionnaire) and 2,992 observations are excluded because they refer to individuals who have a mental health condition (excluded to avoid sample selectivity issues, as explained above). The remaining 18,891 observations are excluded because they have missing values in one or more independent variables included in the analysis.

individuals reporting low satisfaction (0-4 on a 0-10 scale) is less than 2%, but increases to over 3.5% when we analyse the distribution of life satisfaction for individuals whose partners experience long term mental health conditions.

Table 1 here

We use the information provided by each individual when answering the HILDA survey and then link partners by using the partners' identifiers (couples are in the sample as long as they remain together, because we need to observe both partners' health and well-being). In this way, we are able to collect information about partners' mental health by using answers reported by each individual (instead of relying on possibly misreported partners' information).

In this analysis, we use specifi measures of mental health (see Table 2 for descriptive statistics of these conditions in the estimation sample). In particular, at each wave individuals are asked the following question "Do you have any long-term health condition, impairment or disability (such as these) that restricts you in your everyday activities, and has lasted or is likely to last, for 6 months or more?" and they can select various options. The two conditions we use in this analysis are: "any mental illness which requires help or supervision" and "a nervous or emotional long term condition which requires treatment".

A potential limitation of this way of measuring mental health is the large number of individuals living with undiagnosed mental conditions. For this reason, we also test the stability of our results using a broader definition of mental health, and, specifically, using the continuous mental health scale from SF-36 (see Appendix Table A3). The SF-36 consists of eight scaled scores, which are derived as weighted sums of the questions in the respective sections of the survey. Each scale is then expressed on a 0-100, where lower scores represent more disability.

Table 2 here

Our main model (Specification 1) includes an extensive set of independent variables, to consider factors that may influence life satisfaction, such as individual long term health

conditions, education, gender, employment and marital status, number and age of children, geographic remoteness, year binary variables, age groups, and life events that took place in the last 12 months (personal injury or illness, serious illness of a family member, victim of physical violence, death of a close relative or family member, victim of a property crime). We also estimate two additional specifications (Specifications 2 and 3) of the model, including additional variables, such as partners' long term conditions, satisfaction with relationship with partner, and possible strategies to help the individual to deal with partners' mental health, such as presence of social networks, and engagement in social activities. The complete list of variables included in the model is reported in Table 3; and Table 4 reports descriptive statistics of the main variables in the analysis.

Table 3 and 4 here

4. Estimation

In this study, we estimate life satisfaction (measured on a 0-10 scale) as a function of partner's mental health (PMH), individual and household characteristics X, and income windfall Y.

Therefore, we model an underlying indirect life satisfaction function (LS) as follows:

$$LS = F(PMH, X, Y) \tag{1}$$

We use this model to estimate the monetary compensation that would be required to return a partner of an individual in poor mental health to her/his pre-illness life satisfaction. A similar method has been used in previous literature to evaluate costs of various important life events (Frijters et al., 2011), the impact of disability (Oswald and Powdthavee, 2008; Jones et al., 2018), as well as for other intangible non-market goods, such as crime (Johnston et al., 2017), air pollution (Van Praag and Baarsma, 2005; Levinson, 2012), natural disasters (Carroll et al., 2009) terrorism (Frey et al., 2009) and informal care (Van den Berg and Ferrer-i-Carbonell, 2007; Mentzakis et al., 2012).

We follow Frijters et al. (2011), Fujiwara and Dolan (2014) and Johnston et al. (2017) and include a measure of a positive income shock in the model. This is an alternative approach to the inclusion of the logarithm of annual

income[2] as a separate variable in the life satisfaction equation (Groot and Maassen van den Brink, 2004 and 2006; Carroll et al. 2009; de Mello and Tiongson, 2009; McNamee and Mendolia, 2014; Powdthavee and van den Berg, 2011). A positive income shock is measured with a binary variable equal to 1 if the individual experienced a "major improvement in finances" (defined as reporting a **"major improvement in finance"** *and* **an increase in the household gross income).** Frijters et al. (2011) show that this approach overcomes the challenges of correctly estimating the relationship between income and life satisfaction. More specifically, it addresses potential measurement error in income, which, if uncorrected, can lead to underestimates of the effect of income on life satisfaction, and, as a consequence, overestimation of the monetary valuation (see Clark et al, 2008 for a thoughtful discussion of the methodological difficulties of analysing the relationship between income and life satisfaction). For these reasons, and following this existing literature, income (or the logarithm of it) is not included in the life satisfaction equation, in order to avoid the over-estimation of the relevant compensatory values.

The use of unexpected financial improvements or "positive income shock" in effect treats income as exogenously determined, and avoids the need to assume that variations in income are completely independent of changes in partner's health status. This is important as many observed changes in income are possibly related to changes in health or to changes in other life circumstances (i.e. changes in employment situation, marital separation, etc.), which may also have a relationship with partner's mental health status.

Results from an OLS model may be biased because of individuals' unobserved characteristics that may affect both life satisfaction and partner's health (such as personality traits, risk attitudes, time preferences, etc.). Further, people may answer life satisfaction questions in a different way, depending on their own interpretation of the meaning of the scores. Therefore, life satisfaction is estimated in a model with individual fixed effects, in order to take into account individual unobserved characteristics that might have an effect on life satisfaction and do not vary over time, such as personality traits, cultural background, risk aversion, ability, etc.:

$$LS_{it} = \alpha + \beta_1 PMH_{jt} + \beta_2 Y_{it} + \beta_3 X_{it} + c_i + \varepsilon_{it} \qquad (2)$$

where life satisfaction depends on partner's mental health (PMH_{jt}), individual characteristics X, and income shock Y. The parameter c_i is an individual fixed effect that takes into account time-invariant unobserved heterogeneity.

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[2] For completeness, we also estimate alternative results using the classical valuation model and including the logarithm of equivalised household income in the model. Results are presented in Tables A8 and A9 and confirm the findings from Frijters et al. (2011), showing that compensatory values calculated using this method are likely to be overestimated because of substantial measurement error and underestimation of the income coefficient in the life satisfaction equation. See Frijters et al (2011) for a detailed explanation of this issue.

Unfortunately, the data does not include any quasi-experimental variation across the sample that can be exploited to address potential selection on unobservables and it is challenging to identify an instrumental variable that is correlated with partner's mental health but uncorrelated with the error terms in the individual life satisfaction equation. Interpretation of results from this model therefore relies on the assumption that the time-dependent error term in the life satisfaction equation is independent of changes in partners' mental health, conditional on the regressors included in the model and on the individual fixed effect. This assumption will not hold if there are unobserved random shocks that affect partners' mental health and individual life satisfaction at the same time.

We adopt a series of strategies in order to ensure the stability of our estimates and to reduce the possibility that our main results are driven by unobserved time-varying shocks or selection bias. Further, we caution against inferring causality from the estimated models that do not contain time-invariant fixed effects, but we do emphasize instead the robustness of the statistically significant relationships that arise.

First, we focus on the effect of partners' long term diagnosed mental illness, and specifically on conditions that require supervision and treatment, and we exclude individuals who experience similar conditions themselves. These conditions are less likely to be affected by unobserved time varying characteristics.

Second, we control for a wide set of individual and family characteristics, as well as for negative life events (such as being the victim of violence, property crime, death or serious illness of a family member, etc.)[3]. Variables that do not vary over time (i.e. gender, ethnicity, country of birth etc.) are automatically dropped when estimating a model with individual fixed effects.

Third, we conduct additional robustness tests, showing that individual satisfaction in other domains (e.g. satisfaction with job, working hours, local community and children etc.) is not affected by partners' mental illness (Table A6). These tests provide further evidence showing that time-varying unobservables are adequately controlled for and that the main results are not driven by unobserved characteristics affecting both individual well-being and partner's mental health.

Lastly, we control for occurrence of separation or divorce at the next wave, and therefore take into account the risk that serious negative mental health spillovers may lead to separation.

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[3] We also run additional sensitivity tests, by adding other independent variables which could capture time-varying correlated unobservables, which may affect both partners. These variables include: index of relative socio-economic advantage/disadvantage (SEIFA 2011); prosperity index; individual satisfaction with job, neighbourhood, safety, and community inclusion; feelings of time pressure. These variables are not included in the main model as they are potentially endogenous with respect to life satisfaction. Results from these tests are available on request.

We use the parameter estimates from (2) to estimate the monetary compensation values of partner's mental health, following the approach presented in Frijters et al. (2011), Au and Johnston (2015), and Johnston et al. (2017). More specifically, as explained above, the model includes an income shock binary variable Y (defined as a "**major improvement in finance**"[4] ***and* an increase in the household gross income**), and we use the coefficient estimate from this variable (β_2) to calculate the following life satisfaction ratio:

$$LSR = -\frac{\beta_1}{\beta_2} \qquad\qquad (3)$$

We then convert the LSR into a monetary value by multiplying it by the estimated mean change in income associated after a "major improvement in finances" in our sample. This value is calculated regressing the financial improvement variable on household income and in the estimation sample, the figure is approximately 73,000 $.

A similar methodology has been used in previous studies to calculate the implied monetary compensation for life events such as marriage breakup, major illness, death of a relative or friend (Frijters et al, 2011) or to estimate the compensation for crime victims (Johnston et al., 2017). In this context, Au and Johnston (2015) have shown that the financial improvement variable is not statistically associated with receipt of accident or illness insurance, workers compensation, life insurance, or redundancy payments, suggesting therefore that this variable does not appear to be influenced by time-varying characteristics that might also affect health status. Further, Johnston et al (2017) use HILDA data and verified that income shocks are not correlated with individual socio-economic characteristics, after controlling for individual-area fixed effects.

As a further check on the data used in this paper[5], we verified that receiving a positive income shock in the next 12 months was not determined by household income and socio-economic status, or by any major illness or long term health condition in the previous period, and any other life event (apart from death of a relative, consistent with the idea of financial improvements being partly related to inheritances), once we control for fixed effects (see Appendix Table A2).

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[4] The exact question is: "We now would like you to think about major events that have happened in your life over the past 12 months. For each statement cross YES or NO to indicate whether each event happened in the last 12 months" – "Major improvement in financial situation (e.g. won lottery, received an inheritance)".

[5] Our analysis is focused on the impact of partners' (and not individuals) mental health on individual life satisfaction, and it seems unlikely that positive income shocks are correlated with partners' mental health conditions. We have run an additional sensitivity test, controlling for the receipt of disability benefits for individuals or partners, and main results are unchanged.

We run three different specifications of the model, including the basic set of covariates in Specification 1, adding other partners' long term conditions in Specification 2, and individual's coping strategies in Specification 3 (see Table 3 for details).

Lastly, to examine adaptation, we estimate a model including partner's mental health conditions at previous years and a series of interactions between current and past partner's mental health[6].

$$LS_{it} = \alpha + \beta_3 PMH + \beta_4 PMH_{t-1} + \beta_5 PMH_{t-2} + \beta_6 PMH_{t-3} + \beta_7 PMH * PMH_{t-1} +$$

$$\beta_8 PMH * PMH_{t-2} + \beta_9 PMH * PMH_{t-3} + \beta_{10} PMH_{t-1} * PMH_{t-2} + \beta_{11} PMH_{t-1} * PMH_{t-3} +$$

$$\beta_{12} PMH_{t-2} * PMH_{t-3} + \beta_{13} Y_{it} + \beta_{14} X_{it} + \varepsilon_{it} + c_i \qquad (4)$$

The estimation of the model from Equation (4) allows us to test whether individuals' life satisfaction adapt to prolonged periods of partner's poor mental health.

5. Results

The main results from the estimation are presented in Tables 5-7.

Partners' mental health has a large and significant association with the life satisfaction of individuals in the estimation sample. The size of the association slightly decreases when we include additional independent variables. However, the coefficients of partners' mental well-being remain significantly different from zero in all cases.

Table 5 here

In Table 5 we analyse the impact of long term mental health conditions, and in particular mental illness requiring help or supervision, and nervous or emotional condition requiring treatment. We find a significant moderate negative association between having a partner in poor mental health and own life satisfaction[7]. The effects range from -0.08 points for nervous or emotional condition (6% of a standard deviation of life satisfaction) to -0.12 points for a long term mental illness which requires help or supervision (around 10% of a standard deviation of

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[6]The number of partners suffering mental illness in 3 consecutive years is very small in the estimation sample (less than 0.5% for long-term mental illness and less than 0.8% for long-term nervous or emotional condition) and therefore we only include interactions between pairs of years in the model.

[7] These results are similar in magnitude and size to results obtained by estimating the model without individual fixed effects.

life satisfaction)[8]. This effect is similar to the negative impact of individual's unemployment status (-0.13 points), and higher than the effect of many negative life events (including being victim of property crime, or experiencing death or illness of a relative, ranging between -0.03 and -0.07 points) (see Appendix Table 1). These results are consistent with the relevant literature, and in particular with Fletcher (2009), who show that a one unit increase in spouse mental health (on a scale 0-5) increases the respondent's mental health by a third of a standard deviation.

As already explained, we also estimated the impact of partner's mental well-being using a broader definition of mental health, using the mental health score from SF-36. Results are reported in Table A3 and confirm that partner's mental health has a substantial impact on individual well-being. In particular, an increase of one standard deviation in partner's well-being improves individual life satisfaction of 0.08 (on a 0-10 score) or 6% of a standard deviation. Further, we have examined the impact of living with a partner with mental health score in the bottom quartile of the SF-36 distribution, in order to take into consideration the role of potentially undiagnosed mental health issues. These results are not reported for parsimony, but are available on request and very consistent with the ones presented in Table 5.

Partners' other long term health conditions have a very limited impact on individual life satisfaction (see Appendix Table A1) and the inclusion of these variables slightly decreases the association with mental health.

In Specification 3, we investigate the role of satisfaction with the partner, and coping strategies, which could support the individual living with a partner who suffers from poor mental health, such as being member of a sport or community club, or having a network of friends or relatives. Caution should be used when looking at the impact of these variables, as they are potentially endogenous with respect to life satisfaction. Interestingly, as shown in Table

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[8] The results are calculated without using sample weights. However, results using sample weights were very similar and are available on request.

A1, all these variables have a significant association with individual life satisfaction, but the size of the coefficient of partner's poor mental health is only slightly reduced when these controls are included. Therefore, even if the individuals can potentially benefit from the various coping mechanisms, the association between partner's poor mental health and own life satisfaction remains strong.

We also explore the dynamic effect of the onset of partner's mental health conditions following the framework of Powdthavee (2009), and analyse the impact of partner's mental health in future years on current life satisfaction. Results are reported in the Appendix (Table A4) and show that individuals' life satisfaction decreases up to 3 years before partners actually report a diagnosed mental health condition. The effect is particularly strong for long term mental conditions, requiring help and supervision, in the year before the condition is actually recorded. This result is consistent with the possibility that partners start having symptoms before the effective onset and diagnosis of the condition. This result also shows that the estimates presented in previous tables are likely to be biased towards zero, as individuals are likely to start feeling the effect of partner's mental illness in waves when there are no declared partner mental health problems.

The independent variables included in the model follow the literature in the field (see for example Blanchflower and Oswald, 2008; Green, 2011, among others) and the main findings on the covariates included in the model (see Table A1) are generally consistent with previous studies investigating the determinants of life satisfaction (see for example Winkelmann and Winkelmann 1998, Clark et al. 2001; Frey and Stutzer 2000; Frijters et al. 2004; Mendolia and McNamee, 2014; Kristoffersen, 2018). Labour force participation is definitively associated with increased life satisfaction, with respect to unemployment. As expected, negative life events, such as personal injury, illness or death of a family member and being a victim of crime, are

significantly associated with decreased individual life satisfaction (-0.07 to -0.19 points in life satisfaction).

Appendix Table A2 reports result from an important additional robustness check. We follow Au and Johnston (2015) and show positive income shocks are not related to household income and socio-economic status, or any major illness or life event (apart from death of a relative, consistent with the idea of financial improvements being partly related to inheritances), once we control for fixed effects. This test shows that individuals who receive unexpected financial improvements are not systematically different from the overall sample.

We also test the sensitivity of the main results by excluding life events and divorce, which may potentially be endogenous to partner's mental health. Results are consistent with the main findings and are presented in Table A5.

In Table A6, we address the possible risk that results may be driven by reverse causality or by unobserved time-varying characteristics that may affect both individual life satisfaction and partner's mental health. If this is the case, partner's mental illness could (for example) affect life satisfaction in many other domains (not clearly related to partner's illness), such as satisfaction with work, children, etc. because of the effect of these unobserved variables. To test for this effect, we regress partner's mental health on individual life satisfaction in other specific life domains, such as work, children and community. These insignificant effects show that reverse causality is unlikely to drive the main results and that unobservable traits affecting life satisfaction are unlikely to be associated with partner's mental health.

The monetary valuations associated with partner's poor mental health are presented in Table 6. The third column shows the life satisfaction ratios, calculated according to (3). For example, a LSR ratio of 1.05 indicates that the negative life satisfaction effect of this measure of partner's poor mental health is equivalent to 1.05 times the positive effect of a major improvement in finances. The fourth column shows the one-off income windfall that is equivalent to each condition (for example, around A\$76,000 for a partner suffering from long term mental illness that requires help or supervision) and is calculated by multiplying the LSR ratio by the average value of financial improvement in the estimation sample (\$72,743). These values suggest, for example, that individuals living with a partner who has a long term mental illness that requires help and supervision, would need an extra A\$76,000 (or over USD 50,000)

income to return to the same level of life satisfaction they would have if their partner did not suffer from that condition.

Table 6 here

Lastly, we estimate Equation (4) in order to analyse whether people adapt to partners' poor mental health conditions[9]. Results from this estimation are presented in Table 7, presenting a model where we control for past partner's mental illness, as well a series of interactions between past and current mental health. The inclusion of these variables allows us to estimate the extent of adaptation (if any). Results from Table 7 show that there is no evidence of adaptation to partner's poor mental health. In the model, past poor mental health and all the interactions between current and past poor mental health have a non-significant association with individual current life satisfaction[10]. This clearly shows that the majority of the negative effect of partner's mental illness is captured by current conditions (while individuals seem to recover well when partner's poor mental health disappears) and that individuals do not adapt when their partners have been ill for more than a year.

Table 7 here

6. Discussion

This paper analyses the relationship between partner's mental health and individual life satisfaction, using the Household, Income and Labour Dynamics Survey of Australia, estimating a fixed effects model in order to control for characteristics of individuals that do not vary over time. We extend the very limited literature in the field by analysing spillover effects of mental health on partners' well-being using longitudinal data and estimating the monetary valuation of partner's mental health. We find that living with a partner with a long term mental illness has a negative association with life satisfaction and that the implied monetary valuations of losses are

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[9] Table A7 in the Appendix presents a cross tabulation of partners' mental health condition at the current and previous waves.
[10] The only exception is the interaction between partner's having a long-term mental illness which requires help or supervision at t-2 and t-3, which is significant with a negative sign (and therefore shows a strengthening of the effect, and not adaptation).

also substantial. Further, we show that individuals do not adapt to living with a partner in poor mental health.

These results are broadly consistent with the literature in the field, showing that there is a strong correlation between partners' physical and mental health (see for example De Mello and Tiongson, 2009; Fletcher, 2009; Powdthavee, 2009; Clark and Etile', 2011; Brown et al., 2014; Sabia et al., 2018, among others).

The negative association between partner's mental health conditions and life satisfaction is not unexpected if one considers the various transmission channels through which the health status of a family member can affect individual well-being. First of all, individuals may derive utility from their partner's well-being, and are expected to suffer a substantial decrease in life satisfaction if their partner is unwell. In addition, partner's mental health deterioration could be associated with her/his increased chances of leaving the labour market and this may imply a drop in household income, as well as a negative effect on the partner's perceived role in society. Further, the negative effect of mental illness may be mediated through a variety of other factors, such as increase in family conflicts, and increased need for care and supervision. These spillover effects may drive further reductions in partners' life satisfaction and well-being.

The present study adds to the existing literature which calculates monetary compensations of health conditions in several ways (see for example Groot and Maassen van den Brink, 2004 and 2006). First, we focus the attention on partner's (rather than individual's) conditions and explicitly acknowledge the important effects of mental health on the family. Second, we use a very large sample (over 97,000 observations from almost 16,000 individuals) and are able to control for a very extensive set of partners' and family's characteristics. Last, we directly address the issue of measurement error in income and therefore are able to generate potentially more reliable estimates of the cost of partner's mental illness.

These results have important implications for mental health policies, and in particular suggest that interventions aimed at supporting individuals with mental illness can have positive strong spillover benefits on their partners and families, as the well-being of partners is directly affected by individual's mental health. We expect similar (but possibly lower) effects for families and friends of individuals living alone.

Our estimates are consistent with those calculated in studies that address potential measurement error in income. For example, Frijters et al. (2011) calculate a monetary value for "serious personal injury or illness" of around A\$105,000, using data from six waves of HILDA. Further, Fujiwara and Dolan (2014) estimate an annual compensation

of GBP£44,237 to compensate individuals affected by depression and anxiety. However, all these studies are focused on individual conditions and none of them considers the negative effect of partners' illness.

A potential limitation of our analysis is that the fixed effects estimates only control for time-invariant effects, and it is possible that other time-varying shocks affect both partners' mental health and individual life satisfaction. However, it is difficult to adopt analytical solutions to these problems as there is no quasi-experimental variation that could be used to deal with these issues. Furthermore, there is a lack of suitable instrumental variables with the power to predict changes in partners' mental health without having an effect on individuals' life satisfaction. For these reasons, we have run multiple sensitivity tests to show the stability of our results, and we have controlled for a wide set of independent variables, including individual and family characteristics, and important life events which can affect life satisfaction and mental health. Further, we have primarily focused on the life satisfaction impact of long term mental conditions.

Our estimates suggest that mental illness imposes a substantial burden on well-being of the partner of the individual experiencing the condition. The strength of the association between partner mental health and partner well-being provides further evidence of the importance of spillover effects and, together with the lack of adaptation, suggests that the impact of mental health problems is significant. Research on longer–term effects on other family members, e.g. the magnitude of impacts on children as they grow older, would further add to our knowledge on the extent of even longer lasting impacts. In addition, research on the effects of other health conditions (including physical health, as well as mental health) on partners and family members could be useful to complement the evidence provided in our study.

Knowledge of the magnitude of spillover effects is important from a policy-maker's perspective, as the benefits of effective mental health interventions will be larger with the inclusion of such effects. Further, their inclusion can also inform the development of interventions and policies for mental health. With policy-makers and funders within the mental health field increasingly interested in identifying cost-effective interventions that can be delivered at scale,

policies such as improvements to urban environments and greater provision of greenspace are attracting more attention (Bakolis et al 2018; White et al 2013). The evaluation of such policies requires a method by which to identify and value wider effects on health and well-being. The method we present is one possible approach, and further work on establishing whether the technique is able to identify such effects from policies that impact on mental health is required.

The authors declare that they have no conflict of interest.

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