THE EFFECT OF OWN LIFE EVENTS ON OWN MENTAL HEALTH

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6th June 2011

Abstract

In this paper, we use seven years of data (Waves 2 to 8 for the period 2002-2008) from the Household, Income and Labour Dynamics in Australia survey to estimate the effect of nine life-events on mental health for individuals aged 15 and over. Our analysis has three focal points: whether individuals adapt to life events, the one-off income required to compensate individuals for experiencing a life event, and the investigation of the effects of measures of social support, with a particular focus on marital status, kids, friends, and social network. To investigate these issues we use fixed effect models. There is no adaptation to having a serious illness and being a victim of violence. As a result, the monetary compensations required for constant utility are higher for these events compared to other events where adaptation is complete. Being married significantly buffers against the adverse effect of having a serious illness (e.g. reduces it by 12 per cent) and being a victim of violence (e.g. reduces it by 10.7 per cent).

Keywords: mental health; life events; valuation; Australia.

JEL classification: I0

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1 Introduction

What are the mental health effects of social shocks, health shocks, labour shocks, and financial shocks? Do individuals adapt to these shocks? What are the monetary values of the shocks? Can social support buffer against adverse mental health impacts of stressful life events? These are the questions that this paper addresses.

The significance of these questions is obvious. Individuals are confronted with many ups and downs throughout their life and the effects of these events on mental health are still unknown. The psychology literature has shown that individuals adapt to shocks in a hedonic treadmill. After a while, individuals usually come back to the level of wellbeing they were before the shock occurred. Common events which have been investigated include marriage, bereavement, household dynamics, financial shocks, and labour shocks. From these studies, it generally appears that adaptation to unemployment is bad and remains negative (Clark et al. 2008); there is an anticipation to marriage (Zimmermann and Easterlin 2006); and financial shocks are at best incomplete (Frijters, Johnston, & Shields 2011). Finally, there appears to be full adaptation to divorce (Oswald and Gardner 2006).

Here we focus on nine life events that are of general interest to policy makers and health researchers. These include health shocks, labour market shocks, social shocks, and financial shocks. The literature on the determinants of mental health has shown strong associations between financial hardship and depression (Butterworth, Rodgers, & Windsor 2009; Bridges and Disney 2010), lottery wins and mental wellbeing[1](Gardner and Oswald 2007), stroke and depression (Bergensen et al. 2010), violence and mental health (Vinck and Pham 2010), and unemployment and mental health (Mandal, Ayyagari, & Gallo 2010; Mandal 2010). However, very few studies have investigated how people adapt to these events[2] using a measurement of mental health.

[1] This finding also relates to the wide literature on income and wellbeing. For discussion on this topic, see, for example, Diener & Oishi (2000), Easterlin (2001), Frey & Stutzer (2002), and Boes & Winkelman (2004).

[2] We found papers on adaptation to stressful events in the life satisfaction literature. See Easterlin (2001) for adaptation to income, Oswald and Powdthavee (2008b) for adaptation to disability, Frijters, Johnston, & Shields (2011) for the effects of various events on life satisfaction, and Clark et al. (2008) for adaptation to unemployment.

One of the practical implications of using longitudinal statistical techniques to investigate adaptation is in courts of law (Oswald and Powdthavee 2008b). For instance, one may ask the compensation required to award an individual who has had a bad life event. If adaptation occurs, then the sums required to compensate people for stressful events will be lower.

The papers closest to the present study are Clark et al. (2008), Powdthavee (2009), and Frijters, Johnston, & Shields (2011)[3]. Clark et al. (2008) look at lags and leads in life satisfaction using data from the German panel data. They measure the life satisfaction effects of yearly life events by including a series of dummies in a fixed-effect regression, with a focus on unemployment. Similarly, Powdthavee (2009) investigates what happens to different areas of life before and after disability using yearly data from the British panel data. However the author expands on Clark et al. (2008) paper by proposing a two-layer model to examine lead and lag effects of disability on seven satisfaction domains. Of interest here, Powdtavee (2009) finds no adaptation to severe disability in health satisfaction and significant lead effect to becoming disabled. Frijters, Johnston, & Shields (2011) go through a similar exercise, but they consider all life events in a single fixed-effect regression and use quarterly life events data. The current study expands on these three papers by looking at the mental health effects of similar life events, by seeking evidence of adaptation to these events, and by estimating monetary values of these effects using the 'life satisfaction' valuation method as presented in Frijters, Johnston, & Shields (2011).

Our empirical analysis uses data from the Household, Income and Labour Dynamics in Australia (HILDA) survey. Our measure of mental health is an aggregate of four domains: role-emotional, social-functioning, vitality, and mental health[4]. Subjective measures of

[3] We also found a study that looks at the effect of crime on life satisfaction and estimates the monetary values of these effects using the life satisfaction approach. See Cohen (2008). However, this study uses multiple sources of data and did not look at adaptation to crime in a systematic way, unlike Clark et al. (2008) and Frijters, Johnston, & Shields (2011).

[4] Please note the double notation of mental health. The SF-36 is a questionnaire that consists of items or questions organized across eight dimensions. These are physical functioning, role physical, bodily pain, general health perceptions, vitality, social functioning, role-emotional, and mental health. These eight dimensions can further be grouped in two summary measures: physical health and mental health.

wellbeing have been increasingly used over the past decades with more studies using self-reported outcomes such as satisfaction with life (Blanchflower and Oswald 2008; Clark et al. 2008; Easterlin and Pagnol 2008; Oswald and Powdthavee 2008a; 2008b; Frijters, Johnston, & Shields 2011), self-assessed health (Contonyannis, Jones, & Rice 2004), and happiness (Easterlin 2001) rather than objective measures such as GDP per capita.

Here, we also want to consider the process through which social support has a beneficial effect on mental health. Specifically, we investigate whether self-reported level of social support can attenuate negative health impacts of stressful live events. Numerous studies have shown that the existence of close relationships (e.g. spouse, friends and family members) and the extent to which one's interpersonal relationships provide particular resources result in healthier individuals than those with few supportive social contacts. In this study, we define four forms of social support (e.g. marital status, number of own resident children, perceived circle of friends, and social network) and assess whether their presence in individuals' living environment can buffer the adverse impacts of stressful life events on mental health.

The rest of the paper is organized as follows. Section 2 presents the data and definitions used in this empirical analysis. Section 3 presents the models used to assess the mental health effects of life events. Section 4 presents the empirical results. Section 5 presents the method for valuing life events. Section 6 presents the empirical results for the buffer model before concluding.

2 Data and definitions

The data used in this analysis are drawn from waves 2-8 of the Household, Income and Labour Dynamics in Australia (HILDA) survey[5]. The HILDA is a multidisciplinary database first conducted in 2001 on a representative sample of 7,682 households and 19,914 individuals (aged 15 and more). It comprises information on health-related

We use the summary measure of mental health which is the aggregate measure of the four aforementioned domains.

[5] As more waves become available, new results can be generated from the models presented here.

variables, e.g. self-reported health, physical functioning, role-emotional, general health, mental health, and health-related behaviour (e.g. smoking); labour-market variables, e.g. current and past work activity, job characteristics, retirement age; and economic variables, e.g. sources and composition of current income, wealth and consumption. Other variables include education, housing, and social support variables, e.g. transfers of income and assets, and family benefits. Of particular interest for the present study is that the HILDA provides detailed information on each respondent's health and life-course events. These are collected via the Short-Form 36 questions (SF-36 henceforth) which is part of the Self-Completion Questionnaire (SCQ).

Our sample covers the period 2002-2008. It consists of all individuals who completed a self-completion questionnaire in Waves 2 to 8 inclusive[6]. Our pooled sample has 74,003 year-person observations.

The key variable here is mental health defined as the aggregate of 1) vitality, e.g. feeling tired, feeling worn out, feeling full of life, and having a lot of energy; 2) social functioning, e.g. how emotional problems interfere with social activities; 3) role-emotional, e.g. changes in amount of time spent on work as a result of any emotional problems; and 4) mental health, e.g. being a nervous person, being calm and peaceful, feeling down, being a happy person, and feeling so down in the dumps[7]. The dependent variable 'mental health' ranges from zero to 400, where higher scores imply frequent positive affect, absence of psychological distress and limitations in usual social/role activities due to emotional problems. For more on the SF-36 see (Brazier, Roberts, & Deverill 2002; Ware 2007).

Our prime objective is to examine how mental health scores move around the time of a number of stressful life events. Nine different life events were addressed in this study:

[6] While Wave 1 and Wave 9 were available at the time of writing, Wave 1 is not considered in here as it did not include life events variables and this work is in the process of incorporating data from Wave 9.

[7] Social functioning consists of two items, vitality consists of four items, role emotional consists of three items, and mental health consists of five items. These four dimension scores are transformed onto a 0-100 scale and our key variable is just the sum of these four components. Thus, these four components are of equal importance.

1. Serious illness or injury,
2. Death of a friend,
3. Victim of physical violence (e.g. assault),
4. Victim of property crime (e.g. theft, housebreaking),
5. Promoted,
6. Retired from the workforce,
7. Fired or made redundant by an employer,
8. Major improvement in financial situation (e.g. won lottery, received an inheritance), and
9. Major worsening in financial situation (e.g. bankrupt).

In the SCQ, respondents are told:

> *"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 either the YES box or the NO box to indicate whether each event happened during the past 12 months. If you answer "YES", then also cross one box to indicate how long ago the event happened or started"*.

Information for these events is collected quarterly as followed: 0-3 months ago, 3-6 months ago, 6-9 months ago, and 9-12 months ago.

As we are using a fixed-effect approach, we require that each individual be observed before and after the event occurs. Here, we consider occurrences of life events on a 6-month basis. For example, if the individual had a serious illness in the six months preceding the interview, then $ILLNESS_t = 1$; alternatively if the individual had a serious illness in the past 6-12 months, then $ILLNESS_{t-1} = 1$ and $ILLNESS_t = 0$. Longer lags are defined analogously. The same procedure is applied to the eight other life events.

The nature of the HILDA dataset allows us to follow individuals' mental health both before and after the event occurs. We use data from seven waves of the HILDA dataset and could potentially follow individuals for up to six years before or after the event occurred. However, due to attrition, most individuals can only be followed for a shorter period. Thus, in our empirical analysis, we focus on two years preceding the event for anticipation, and two years following the event for adaptation. Further, we define two

other dummies, *more than two years* and *more than two years from now* to capture events that happen outside the 4-year period. If individuals did not participate in four consecutive waves, we use missing variables to indicate that data on life events were not available for those periods. In the regressions we control for gender (female vs. male), age and age squared, and education (total years of education). Finally, the reference period for the fixed-effect regression is any time *two years from now*.

The second objective is to assess which form of social support buffers against the effect of adverse events on mental health. Social support has been measured in a variety of ways: involvement in community-based activities (Fletcher and Shaw 2000), having someone to confide in (Tan 2007), quality of the communication between family members (Almgren, Magarati, & Mogford 2009), marital support (Wyke and Ford 1992; Joutsenniemi et al. 2006; Dolan, Peasgood, & White 2008), number of supportive friends (Waxler-Morrison et al. 1991; Cornwell and Waite 2009), and social network (Lee and Robbins 1998). There is a general agreement that individuals with high levels of connectedness and greater social support are less likely to experience anxiety. Here, we consider four variables for social support: being married, having kids living in the household, having friends, and social network.

The marital status should qualify as a buffering variable since married individuals are consistently found to have higher life satisfaction and wellbeing (Waxler-Morrison et al. 1991; Wyke and Ford 1992; Lund et al. 2002; Joutsenniemi et al. 2006; Dolan, Peasgood, & White 2008). We define marital status as a dummy variable that equals 1 if the individual is currently married. In the pooled panel, 51.56% of the sample is married. Other members in the household such as kids are also expected to provide moral support to individuals. Thus we define a quantitative variable that accounts for the number of kids living in the household at the time of interview. In the pooled panel, the number of kids residing in the household ranges from 0 (62.06%) to 12; 14.02% of individuals have one child and 15.53% have two children living in the household. Further in the SCQ, respondents are asked to rate the following statements:

I seem to have a lot of friends.

When I need someone to help me out, I can usually find someone.

Thus we define ‘friendship’ as a seven-point scale indicator for whether or not the respondent currently has a lot of friends., where 1 = Strongly disagree (4.66%) and 7 = Strongly agree (13.41%). In the pooled panel, the average score is 4.59. We define ‘social network’ analogously, e.g. whether the respondent has a some form of social support where 1 = Strongly disagree (2.22%) and 7 = Strongly agree (33.28%). In the pooled data the average score is 5.61.

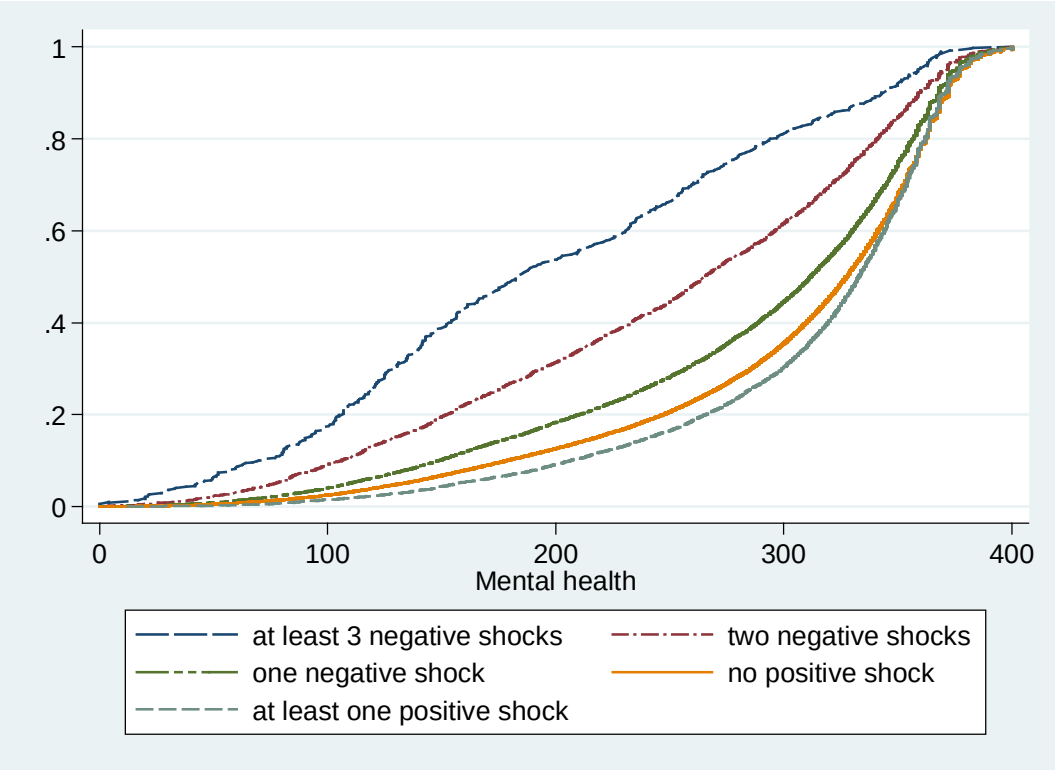
Descriptive statistics

Table 1 provides the number of occurrences in the resulting sample for each life event used in the ensuing analyses. For each of these events we have a number of occurrences, with death of a friend being the most common event followed by having a serious illness or injury, being promoted, and being victim of crime. In Table 1 we also provide the mean characteristics of individuals, conditional on having experienced a life event. Most mean outcomes appear consistent with our expectations. As one can see, the average age of respondents who had a serious illness is 48 while of those whose friend past away is 50. This is consistent with the fact that older adults are more likely to experience bereavement and encounter health problems (Cornwell and Waite 2009). Also, the mean household income of those who were promoted is around $91,600 while that of those who were retired is roughly $23,000. Finally, the average age in the pooled data is 43, with more female (53%) than male (47%), more employed (66%) than non-employed, and with an average household income of $59,000.

Figure 1 displays the relationship between mental health and life shocks by showing the empirical cumulative density functions of mental health by number and type of shocks, pooled over seven waves. The y-axis shows the proportion of observations with mental health score below the values given on the x-axis. We consider the following events as negative shocks: serious illness or injury, death of a friend, victim of violence victim of crime, being fired, and worsening in finances; and positive shocks: being promoted, retired from the workforce, and improvement in finances. If a positive relationship exists between mental health and positive shocks, we would expect the proportion of

observations with mental health below a particular level to be higher when there is no positive shock (i.e. compared to having at least one positive shock). Alternatively, we would expect the cumulative density functions for numerous negative shocks to be successively above those for positive shocks. This is observable in Figure 1. If we compare the distribution of mental health across the number of negative and positive shocks, we can observe stochastic dominance.

Figure 1 - Empirical cumulative density function of mental health by shocks for the pooled sample, 2002-08



Note: The lines represent the cumulative density functions of mental health for a given number of positive and negative shocks.

Table 1 - Occurrences of the nine life events in the pooled sample

	Number of	Means - Conditional on Occurrence of Life Event								
Life events	occurences	Age	Female	Employed	HH income	Number of kids	Kids in the HH	Married	Friends	Social support
Serious illness or injury	5,669	48.17	0.50	0.52	45.993	1.79	0.57	0.48	4.42	5.36
Death of a friend	6,923	50.40	0.53	0.53	43.362	1.94	0.57	0.52	4.90	5.68
Victim of violence	1,163	31.23	0.52	0.60	51.001	1.05	0.57	0.18	4.37	5.01
Victim of crime	3,458	38.41	0.49	0.71	60.544	1.36	0.72	0.41	4.52	5.47
Retired	1,169	56.43	0.50	0.16	23.595	2.25	0.40	0.64	4.43	5.53
Promoted	4,437	33.34	0.46	0.98	91.667	0.96	0.67	0.41	4.69	5.71
Fired	1,987	35.41	0.42	0.65	57.489	1.12	0.63	0.35	4.36	5.33
Finances improve	2,103	42.89	0.52	0.74	67.534	1.59	0.72	0.51	4.66	5.70
Finances worsen	1,850	41.86	0.52	0.58	38.985	1.76	0.82	0.40	4.07	4.88
Total sample	**73,731**	**43.51**	**0.53**	**0.66**	**59.233**	**1.65**	**0.73**	**0.52**	**4.59**	**5.61**

Notes:

1. Values for female, employed, and being married are in percentages.
2.'HH income' denotes household disposable income in '000$
3.Friends and social support are scores out of 7.
4. Means for the total sample are unconditional.

3 Methodology

In our empirical analysis, we choose to investigate the effects of events on mental health on a biannual basis and thus create new life events dummy variables that indicate the number of 6-month periods before or after the event occurred.

The least squares model

We have the following OLS model:

$$MH_{it} = \alpha_0^* + \alpha_1^* \gamma_{it}' + \alpha_2^* Z_i' + \sum_{k=1}^{9} \sum_{s=-4}^{5} X_{ik,t+s} \beta_{k,t+s}^* + u_{it}^*$$

$$MH_{it} = \alpha_0^* + \alpha_1^* \gamma_{it}' + \alpha_2^* Z_i' + \sum_{k=1}^{9} \sum_{s=-4}^{-4} X_{ik,t+s}' \beta_{k,t+s}^* + \sum_{k=1}^{9} X_{ik,t}' \beta_{k,t}^* + \sum_{k=1}^{9} \sum_{s=1}^{5} X_{ik,t+s}' \beta_{k,t+s}^* + u_{it}^* \quad (1)$$

Where MH_{it} is the mental health of individual i in period t; Z_i is a vector of fixed individual characteristics, such as gender; γ_{it} is a vector of time-varying individual characteristics such as age and education; u_{it} is *iid* noise. The time period s runs in 6-month. Therefore the term $\sum_{k=1}^{9} X_{ik,t}' \beta_{k,t}$ contains the life events of individual *i* occurring in the six months preceding the interview (i.e. anywhere in the last six months); $\sum_{k=1}^{9} \sum_{s=-1}^{-4} X_{ik,t+s}' \beta_{k,t+s}$ contains the life events that occurred in 6-month period preceding the current one and the term $\sum_{k=1}^{9} \sum_{s=1}^{5} X_{ik,t+s}' \beta_{k,t+s}$ contains events that will occur in future time-periods (e.g. next 6 months, next 6-12 months, etc.).

The fixed effect model

In the fixed effect model, we effectively follow the individual over time. The fixed effects estimation allows the individual intercept to be correlated with other regressors and implies that the remaining coefficients pick up variation with the same person over time.

The fixed effect model is as follows:

$$MH_{it} = v_i + \alpha_1 \gamma'_{it} + \sum_{k=1}^{9} \sum_{s=-4}^{4} X_{ik,t+s} \beta_{k,t+s} + u_{it}$$
$$MH_{it} = v_i + \alpha_1 \gamma'_{it} + \sum_{k=1}^{9} \sum_{s=-4}^{-4} X_{ik,t+s} \beta_{k,t+s} + \sum_{k=1}^{9} X'_{ik,t} \beta_{k,t} + \sum_{k=1}^{9} \sum_{s=1}^{4} X'_{ik,t+s} \beta_{k,t+s} + u_{it} \quad (2)$$

The item v_i is a fixed individual effect and all the others are defined as above. Our reference period is any time two years after the time of interview.

The difference between the first and the second equation is the individual fixed effect v_i which is only included in the second equation. We will also exploit the difference between the two equations to get at the question of the selectivity of the events and will follow the methodology presented in Frijters, Johnston, & Shields (2011):

- The anticipation effect of a life event is defined as the effect of having an event happening in the future. This is in essence the effect of unobserved variables relevant to the event that the respondent already has and reacts to. Thus, we can define the anticipation effect as $\beta_{k,t+1} - \beta_{k,t+4}$
- The adaptation effect after a life event is defined as the decline in mental health effect over time after the event has occurred. If we define $\beta_{k,t}$ as the 'full' effect of an event k in the period it happens, and if we see the long-run effect $\beta_{k,t-4}$ of an event k as the effect still remaining long after it occurred, then we can define the adaptation effect after an event k as $\beta_{k,t-4} - \beta_{k,t}$
- The selection effect of a life event refers to the principle that such events do not happen randomly across the population but that some individuals are more prone to them than others. If we compare the effect of an event k a long time before it occurs for the equation without the fixed effects $\beta^*_{k,t+4}$ versus the one with fixed-effects $\beta_{k,t+4}$, then we can define the selection effects as $\beta^*_{k,t+4} - \beta_{k,t+4}$.

Cross-restriction on the vector of parameters

Model 1 and Model 2 consider all nine life events in a single model. We can create a model that instead compares individuals who experienced a specific life event L_j to those who experienced that specific life event L_j and all other life events L_k where $k \neq j$.

To eliminate the fixed individual effect v_i in equation (2), we take the first difference of both the dependent variable MH_{it} and the set of all independent variables. Thus we obtain:

$$\left(MH_{it} - MH_{i,t-1}\right) = \sum_{k=1}^{9}\sum_{s=-4}^{4}\left(X_{ik,t+s} - X_{ik,t+s-1}\right)\beta_{k,t+s} + \left(\varepsilon_{it} - \varepsilon_{i,t-1}\right)$$

$$MHD_{it} = \sum_{k=1}^{9}\sum_{s=-4}^{4} XD_{ik,t+s}\beta_{k,t+s} + \omega_{it}$$

Where $MHD_{it} = MH_{it} - MH_{i,t-1}$

$$XD_{ik,t+s} = X_{ik,t+s} - X_{ik,t+s-1}$$

We choose a specific life event XD_j and run the following model on the remaining life events XD_k where $k \neq j$ and perform the regression for all life events.

Thus we have the following model:

$$MHD_{it} = \alpha_0 + \sum_{s=-4}^{4} XD'_{ij,t+s}\beta_{j,t+s} + \sum_{k=1}^{8}\left(\alpha_k \sum_{s=-4}^{4}\beta_{j,t+s} XD_{k,t+s}\right) + \omega_{it} \quad (3)$$

Where α_k is the effect of having a life event k as a proportion of experiencing life event j, $\forall k \neq j$.

4 Empirical results

We present the results of models 1-3 using data from Waves 2-8 of the HILDA dataset for the period running 2002-08. The matrix of estimated OLS coefficients are shown in Table 5, the matrix of estimated fixed effect coefficients are shown in Table 2, and the results of model 3 are shown in Table 6. For ease of presentation, we present our method

in detail for the fixed effect model above, followed by the summary results for the cross-restriction model.

Main results

The first five rows of Table 2 (Table 5) deal with the lagged effects of each life event for the pooled sample. These include a set of five dummy variables of different durations for each life event: for instance, these indicate whether the individual had a serious illness or injury in the last 6 months preceding the interview, 6-12 months ago, and so on. The next four (five) rows in Table 2 (Table 5) present the lead effects of the nine life events on mental health.

The estimated fixed effect coefficients in Table 2 show that having a serious illness or being victim of violence are significantly associated with lower mental health, regardless of their duration. The separate coefficients on victim of violence of different duration ($\hat{\beta}_{t-5}$ to $\hat{\beta}_t$ in model 2) are increasing as we move forward in time presenting larger effect if the event happened in the 6 months preceding the interview. Serious illness and victim of violence of 2 or more year duration are significantly associated with lower mental health, showing no evidence of adaptation to these events. Conversely, estimated fixed effect coefficients of worsening in finances show evidence of complete adaptation to negative financial shocks within 18 months while those of victim of crime, being fired and being promoted show that these events have a sharp impact effect all which however largely dissipate after 6 months. Last we find no lag effect for death of a friend on mental health in the HILDA data.

Table 2- Fixed-effects estimates of the effect of life events on mental health

6-month period	Serious illness or injury		Death of a friend		Victim of violence		Victim of crime		Retired		Fired		Promoted		Finances improve		Finances worsen	
<-24	-7.120***	(-6.02)	1.922*	(1.77)	-6.034**	(-2.24)	-1.394	(-0.91)	-0.819	(-0.35)	-0.630	(-0.33)	0.984	(0.74)	3.295*	(1.85)	-2.833	(-1.44)
-18 to -24	-10.65***	(-7.57)	-1.307	(-0.94)	-7.902**	(-2.26)	-0.211	(-0.11)	-4.650*	(-1.76)	0.728	(0.30)	1.288	(0.74)	3.923*	(1.72)	-2.763	(-1.14)
-12 to -18	-6.970***	(-5.31)	-0.103	(-0.09)	-8.320***	(-2.80)	-0.947	(-0.58)	0.701	(0.23)	-0.916	(-0.42)	-0.00368	(-0.00)	4.426**	(2.17)	-6.385***	(-2.73)
-6 to -12	-22.58***	(-17.13)	-1.805	(-1.38)	-21.59***	(-6.61)	-1.896	(-1.00)	-8.527***	(-3.47)	-1.325	(-0.57)	1.834	(1.12)	1.487	(0.69)	-24.54***	(-10.86)
0 to -6	-31.21***	(-25.59)	-0.893	(-0.87)	-23.93***	(-8.58)	-5.347***	(-3.48)	2.346	(0.81)	-4.311**	(-2.08)	4.238***	(3.30)	2.296	(1.21)	-25.16***	(-11.89)
Next 6 mths	-2.841**	(-2.20)	0.0599	(0.06)	-8.253***	(-2.72)	-4.391***	(-2.65)	1.589	(0.51)	-1.067	(-0.48)	4.023***	(2.95)	0.194	(0.10)	-7.791***	(-3.42)
Next 6-12 mths	-10.63***	(-7.48)	-0.390	(-0.28)	-11.84***	(-3.29)	0.00744	(0.00)	-9.866***	(-3.74)	-9.760***	(-3.80)	1.647	(0.93)	-2.145	(-0.92)	-3.696	(-1.49)
Next 12-18mths	1.007	(0.71)	1.739	(1.46)	-8.916***	(-2.58)	-4.876***	(-2.65)	-2.300	(-0.68)	2.826	(1.15)	0.265	(0.17)	-0.489	(-0.22)	1.223	(0.48)
Next 18-24mths	1.884	(1.19)	0.387	(0.25)	-4.774	(-1.16)	0.692	(0.28)	1.894	(0.65)	-5.841**	(-2.01)	0.377	(0.19)	-5.023*	(-1.96)	-3.006	(-1.06)

Additional variables:	Years of education	0.908*	(1.66)
	Age	2.967***	(6.91)
	Age sq./100	-2.115***	(-6.62)

N =74,003

t statistics in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

The lead fixed effect estimates in Table 2 show that individuals who will be confronted to a negative shock within the next 6 months usually report significantly lower mental health (e.g. serious illness, victim of crime, victim of violence, worsening in finances) and those who will be promoted within the next 6 months report significantly higher mental health. There are substantial lead effects for serious illness but mostly for being victim of violence, with the latter up to 18 months in the future significantly reducing mental health.

Figure 2 presents smoothed graphs of the estimated coefficients obtained in model 1 and model 2. Each graph has two lines. The dashed line shows the coefficients from the OLS model while the solid line shows the coefficients from the fixed-effects model. The graphs show that the fixed effect estimates are usually higher than the OLS estimates for negative events (e.g. serious illness, death of friend, victim of violence, victim of crime, and worsening in finances) and generally lower for positive events (e.g. retiring from the workforce and improvement in finances). This is clear evidence of a significant degree of selection.

Our conclusions from the analysis of anticipation, adaptation and selection to various life events are therefore threefold:

1. Negative shocks reduce mental health while positive shocks improve mental health, as it is typically found;
2. There is no evidence of habituation to major negative events such as having a serious illness or injury and being a victim of physical violence in the HILDA data; and
3. Future occurrence of these same events significantly reduces individuals' current mental health.

Figure 2- Effects of life events on mental health (Dashed line = OLS)

Note: Period t indicates the 6 months preceding the interview, period $t-4$ represents the period *more than 2 years ago*, and period $t+4$ indicates that the event k happens 18-24 months after the interview. The lines represent the smooth values of the estimated coefficients of model 1 and model 2. The dashed line represents the OLS estimates and the solid line represents the fixed effect estimates.

Cross-restriction results

In model 3, we choose to estimate the effects of eight life events as a proportion of the effects of the life event of 'having a serious illness or injury'. Estimates in Table 6 show that the effect of being victim of violence is 62 per cent that of having a serious illness. Also, the effect of a major worsening in finances is 76.7 per cent that of having a serious illness. From these estimates, it appears that having a serious illness has the largest impact on mental health.

5 Valuing life events

Here we estimate the monetary values required to compensate individuals for the occurrence of life events. The compensation scheme uses experience utility. Similar work and applications are found in Kahneman & Sugden (2005), Luechinger & Raschky (2009), and Luechinger (2010).

We use the fixed effect estimates of the life event we wish to value $\{\hat{\beta}_{t-4}, \hat{\beta}_{t-3}, ..., \hat{\beta}_{t+3}, \hat{\beta}_{t+4}\}$ and the fixed effect estimates of 'having a major financial improvement' $\{\hat{\gamma}_{t-4}, \hat{\gamma}_{t-3}, ..., \hat{\gamma}_{t+3}, \hat{\gamma}_{t+4}\}$ as presented in Table 2 to value the life events. The basic idea is one of compensation. For instance, how much of an increase in income should an individual receive in the instance of a 'bad' life event to offset the negative effect of the shock, while keeping the individual at the same level of mental health as in the absence of the 'bad'? Similarly, in the case of a 'good' life event, one can also determine the shadow price of the 'good' by deriving how much income a person would be willing to give up in order to obtain the 'good' life event.

We consider DMH(LE) to be the net marginal welfare of a specific life event we wish to value and compare it with DMH(FNI) the marginal effect of the life event 'having a major financial improvement'. We get:

$$DMH(LE) = \beta_{t-4}\left(\sum_{s=4}^{13}(1+d)^{-s/2}\right) + \sum_{s=1}^{3}\beta_{t-s}(1+d)^{-s/2} + \beta_t + \sum_{s=1}^{3}\beta_{t+s}(1+d)^{s/2}$$

$$DMH(FNI) = \gamma_{t-4}\left(\sum_{s=4}^{13}(1+d)^{-s/2}\right) + \sum_{s=1}^{3}\gamma_{t-s}(1+d)^{-s/2} + \gamma_t + \sum_{s=1}^{3}\gamma_{t+s}(1+d)^{s/2}$$

$$\frac{DMH(LE)}{DMH(FNI)} = \frac{\beta_{t-4}\left(\sum_{s=4}^{13}(1+d)^{-s/2}\right) + \sum_{s=1}^{3}\beta_{t-s}(1+d)^{-s/2} + \beta_t + \sum_{s=1}^{3}\beta_{t+s}(1+d)^{s/2}}{\gamma_{t-4}\left(\sum_{s=4}^{13}(1+d)^{-s/2}\right) + \sum_{s=1}^{3}\gamma_{t-s}(1+d)^{-s/2} + \gamma_t + \sum_{s=1}^{3}\gamma_{t+s}(1+d)^{s/2}}$$

This ratio essentially indicates how many financial improvements are required to offset another life event (Frijters, Johnston, & Shields 2011). The above compensation scheme assumes that the estimates β_{t-4} and γ_{t-4} reflect persistent effect on the length of the study period (2002-2008). We do the calculations for an annual discount rate d of 10 per cent. We use the mean windfall income derived from a major improvement in finances to assign a monetary value to these ratios. The mean windfall income for a major financial improvement is $86,885.98 for the whole sample. Here we also calculate the probabilities that the ratios are positive using the bootstrap method over 1,000 replications. The complement gives us the probability that the ratios are negative.

Results for valuation of life events

The estimated compensations for each life event on the whole sample and on different sub-samples are presented in Table 3. The first column shows the discounted mental health ratios of each event relative to that of a major financial improvement. The largest estimate is for 'being victim of violence' and equals -5.599. This estimate indicates that the mental health effect from being a victim of violence is 5.599 times larger than the positive discounted mental health effect from a major improvement in finances.

The second column of Table 3 shows the probability that the discounted mental health ratios are positive. As expected, the probabilities of a positive ratio when the DMH ratio is positive is generally greater than 0.5, and the probabilities of a positive ratio when the DMH ratio is negative is usually less than 0.5.

The last column of Table 3 shows the one-off windfall income needed to compensate individuals for experiencing the life event under consideration. The highest compensations required are for being a victim of violence ($486,000) and having a serious illness ($451,000). These are the two events that had significant long run effects on mental health and no adaptation. In the sub-samples, we find that the one-off windfall required for constant utility increases for individuals with higher household income and is generally greater for men than women.

Table 3 - Valuing life events

	Income shock		
Life event of individual *i*	DMH of self	Probability for positive ratio	Value
(a) all			
Financial improvement	1.000		$ 86,885.98
Serious illness	- 5.198	0.131	$ (451,643.06)
Friend died	0.457	0.697	$ 39,701.20
Victim of violence	- 5.599	0.131	$ (486,470.08)
Victim of crime	- 1.100	0.210	$ (95,555.46)
Retired	- 0.988	0.250	$ (85,876.60)
Fired	- 1.047	0.252	$ (90,988.30)
Promoted	0.837	0.802	$ 72,699.31
(b) Below mean HH income			
Financial improvement	1.000		$ 87,556.72
Serious illness	- 2.117	0.09	$ (982,663.08)
Friend died	0.536	0.84	$ 20,541.67
Victim of violence	- 1.701	0.13	$ (1,238,215.75)
Victim of crime	- 0.539	0.20	$ (210,148.39)
Retired	- 0.493	0.22	$ (561,590.12)
Fired	- 1.235	0.11	$ (42,661.71)
Promoted	0.569	0.83	$ 173,945.87
(c) Above mean HH income			
Financial improvement	1.000		$ 86,128.70
Serious illness	- #####	0.44	$ (1,141,070.05)
Friend died	- 3.992	0.38	$ (343,825.08)
Victim of violence	- #####	0.42	$ (2,085,606.47)
Victim of crime	- 0.479	0.52	$ (41,224.59)
Retired	- 7.160	0.44	$ (616,657.12)
Fired	#####	0.56	$ 1,320,567.43
Promoted	2.880	0.62	$ 248,023.09
(d) Women			
Financial improvement	1.000		$ 103,219.40
Serious illness	- 4.028	0.18	$ (415,803.35)
Friend died	0.534	0.56	$ 55,151.13
Victim of violence	- 3.712	0.16	$ (383,198.10)
Victim of crime	- 0.822	0.32	$ (84,880.51)
Retired	0.481	0.56	$ 49,649.50
Fired	- 1.279	0.18	$ (132,059.31)
Promoted	0.603	0.82	$ 62,198.34
(e) Men			
Financial improvement	1.000		$ 74,318.41
Serious illness	- #####	0.366	$ (834,087.41)
Friend died	0.235	0.482	$ 17,435.83
Victim of violence	- #####	0.369	$ (1,051,001.29)
Victim of crime	- 2.400	0.386	$ (178,374.59)
Retired	- 6.414	0.373	$ (476,679.40)
Fired	- 0.487	0.485	$ (36,211.39)
Promoted	1.987	0.591	$ 147,645.78

6 Further analysis

To test the 'buffering hypothesis', we add a series of control variables in our fixed-effect model 2. These include: being married, number of own-resident children, having lots of friends and ability to find someone when in need of help. Table 7 presents the fixed effect estimates of life events on mental health with the control variables. We find that all control variables are highly significant and positive for most (e.g. married, friends and social support) but negative for own resident children. Also estimates for the effects of life events are usually lower when the control variables are included. This is true for the following events: serious illness or injury, victim of crime, retirement, being fired and worsening in finances. However, the estimates for the life events 'victim of violence' and 'promoted' are slightly larger when the control variables.

Further models

Alternatively, we can write a model that investigates by how much a form of social support buffers against the adverse effect of a life event. We define a new least square model for a life event k:

$$MH_{it} = \beta_0^* + \sum_{s=-4}^{5} X_{ik,t+s}\beta_{k,t+s}^* + \sum_{m=1}^{4}\phi_{m,t}^*\left(\sum_{s=-4}^{5}\beta_{k,t+s}^* Y_{im,t}\right) + u_{it}^* \qquad \forall k \in \{1,...,9\}$$

We then take the first difference to obtain the fixed-effect. We would anticipate that $\phi_{m,t} \prec 0$ if the variable for social support m buffers the adverse impacts of the life event k under consideration.

The resulting sample is 57,027 person-year observations and the fixed effect estimates are presented in Table 4. We find that the effect of serious illness on mental health is lower for married individuals than for non-married individuals (i.e. reduced by 12 per cent) and for individuals with a larger social group (as defined by friends and social network). Similarly, being married reduces the effects of being a victim of violence by roughly 11 per cent and the effects of a major worsening in finances by 13 per cent.

Interestingly, having more kids in the household has no buffering effect. In some instances, the estimate of this latter $\phi_{m.,t}$ is positive (although insignificant), demonstrating that having kids may worsen the effects of negative life events such as a 'major worsening in finances'.

Table 4 - Cross-restrictions with control variables

Life events	Married	Kids in the household	Friends	Social Network
Serious illness	-0.120***	0.0281	-0.0363***	-0.0494***
Death of a friend	2.218	-0.160	0.665	0.912
Victim of violence	-0.107***	0.0180	-0.0327***	-0.0447***
Victim of crime	-0.896	0.0982	-0.270	-0.371
Retired	-0.379	0.0816	-0.114	-0.156
Promoted	0.389	-0.0619	0.117*	0.160*
Fired	-0.274	0.0322	-0.0822	-0.113
Finances improve	0.369	-0.299	0.110	0.152
Finances worsen	-0.128***	0.0266	-0.0398***	-0.0546***

N=57,027

="* p<0.10 ** p<0.05 *** p<0.01"

7 Concluding remarks

In this paper, we have investigated the effects of nine life events on mental health using data from seven waves (2002-08) of the Household, Income and Labour Dynamics in Australia (HILDA) survey. The length of the panel enables us to follow the same individual over time and to derive models that measure the adaptation and anticipation effects of these events. This is particularly relevant when estimating implicit utility-constant trade-offs between the experience of a given life event and a major financial improvement.

Here, we have considered financial shocks, labour shocks, health shocks, and social shocks. We have estimated the effects of these events on a biannual basis, up to two year before the event occurs and up to two year after the event occurs. This enables us to estimate the full effect of a life event and is crucial in the valuation of non-traded goods based on experience utility.

The events that have the greatest impact in terms of mental health are having a serious illness, a major worsening in finances, and being victim of violence. Further analysis revealed that the effects of a major worsening in finances are roughly 77 per cent of being seriously ill while those of being a victim of violence are around 62 per cent.

While we found complete adaptation to a major worsening in finances within 18 months and adaptation within 6 months to the following events: being a victim of crime, being fired and being promoted, there is no evidence of adaptation to having a serious

illness and being victim of violence. These findings are reflected in the estimated monetary compensation for these events. When there is full adaptation to a given event, the income compensation for that particular event is lower than if there was no adaptation. The largest compensations are for having a serious illness and being a victim of violence. This shows that studies which have failed to consider anticipation and adaptation have less than optimal results.

Finally, we found that being married reduces the effects of having a serious illness by 12 per cent and the effects of a major worsening in finances by almost 13 per cent.

Acknowledgements

"This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author and should not be attributed to either FaHCSIA or the Melbourne Institute."

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Appendix

Table 5 - OLS estimates of the effect of life events on mental health

6-month period	Serious illness or injury		Death of a friend		Victim of violence		Victim of crime		Retired		Fired		Promoted		Finances improve		Finances worsen	
<-24	-20.46***	(-20.62)	0.755	(0.83)	-19.97***	(-9.90)	-2.485**	(-2.30)	0.211	(0.12)	1.132	(0.78)	3.288**	(2.92)	6.758***	(5.06)	-23.72***	(-15.28)
-18 to -24	-28.75***	(-16.98)	-4.469***	(-2.62)	-21.77***	(-5.51)	-6.104***	(-2.67)	-10.57***	(-3.36)	-1.534	(-0.54)	2.836	(1.31)	8.374***	(3.06)	-18.86***	(-6.51)
-12 to -18	-17.91***	(-11.80)	-2.259*	(-1.77)	-24.44***	(-7.49)	-5.081***	(-2.88)	7.880**	(2.12)	0.130	(0.05)	0.431	(0.27)	4.230*	(1.83)	-24.91***	(-9.21)
-6 to -12	-40.90***	(-27.49)	-5.551***	(-3.70)	-32.43***	(-9.72)	-5.986***	(-2.90)	-14.91***	(-5.35)	-3.050	(-1.20)	4.408**	(2.32)	4.207*	(1.72)	-39.51***	(-15.45)
0 to -6	-44.29***	(-33.50)	-4.254***	(-3.79)	-38.37***	(-13.71)	-7.917***	(-5.07)	5.005	(1.52)	-4.833**	(-2.25)	5.254**	(3.78)	3.281	(1.59)	-43.94***	(-19.18)
Next 6 mths	-15.60***	(-10.31)	-1.963	(-1.53)	-20.00***	(-5.82)	-7.519***	(-4.07)	12.07***	(3.16)	-0.746	(-0.29)	5.047**	(3.16)	1.357	(0.57)	-26.56***	(-9.87)
Next 6-12 mths	-26.05***	(-15.19)	-1.231	(-0.71)	-20.49***	(-4.90)	-2.488	(-0.99)	-11.80***	(-3.69)	-12.86***	(-4.22)	4.084*	(1.87)	0.367	(0.13)	-16.62***	(-5.47)
Next 12-18mths	-11.88***	(-6.80)	0.423	(0.29)	-22.53***	(-5.41)	-7.706***	(-3.48)	6.922	(1.64)	1.826	(0.61)	1.119	(0.61)	1.594	(0.58)	-20.67***	(-6.62)
Next 18-24mths	-12.56***	(-6.31)	1.577	(0.79)	-9.521*	(-1.87)	-2.744	(-0.87)	-0.103	(-0.03)	-8.764**	(-2.40)	2.185	(0.87)	-5.186	(-1.60)	-14.93***	(-4.17)
24months+	-11.41***	(-9.17)	3.652***	(3.26)	-11.55***	(-3.90)	-0.953	(-0.57)	6.145***	(2.70)	-1.459	(-0.69)	1.265	(0.91)	2.778	(1.55)	-15.67***	(-7.60)

Additional variables	Years of education	2.476***	(16.07)
	Age	0.0438	(0.56)
	Age sq./100	-0.256***	(-3.13)

N =74,003

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 - Cross-restrictions on the vector of parameters

Time periods	Serious illness of violence	
<-24	-3.727**	(-2.34)
-18 to -24	-5.874***	(-3.78)
-12 to -18	-4.586***	(-2.95)
-6 to -12	-21.07***	(-12.21)
0 to -6	-29.61***	(-17.43)
Next 6 mths	-2.602*	(-1.66)
Next 6-12 mths	-8.158***	(-4.81)
Next 12-18mths	1.347	(0.98)
Next 18-24mths	2.714*	(1.77)
Restrictions		
Serious illness		
Death of a friend	0.0338	(1.16)
Victim of violence	0.623***	(7.95)
Victim of crime	0.101**	(2.49)
Retired	0.0598	(0.81)
Fired	0.0677	(1.24)
Promoted	-0.0645*	(-1.74)
Finances improve	-0.0379	(-0.75)
Finances worsen	0.767***	(11.71)

N = 57,027
t statistics in parentheses
* p<0.10 ** p<0.05 *** p<0.01

Table 7 - Fixed effects estimates with control variables of social network

6-month period	Serious illness or injury		Death of a friend		Victim of violence		Victim of crime		Retired		Fired		Promoted		Finances improve		Finances worsen	
<-24	-6.870***	(-5.88)	2.055*	(1.92)	-4.376	(-1.64)	-1.284	(-0.85)	-0.945	(-0.41)	-0.330	(-0.17)	0.900	(0.69)	3.385*	(1.92)	-2.943	(-1.51)
-18 to -24	-10.67***	(-7.69)	-1.507	(-1.10)	-6.314*	(-1.83)	-0.379	(-0.20)	-5.078*	(-1.95)	1.600	(0.67)	1.148	(0.67)	3.981*	(1.77)	-2.651	(-1.11)
-12 to -18	-6.471***	(-4.99)	-0.193	(-0.18)	-6.358**	(-2.17)	-0.595	(-0.37)	0.261	(0.08)	-0.758	(-0.35)	-0.173	(-0.13)	4.369**	(2.16)	-6.717***	(-2.91)
-6 to -12	-22.25***	(-17.09)	-2.228*	(-1.73)	-20.27***	(-6.28)	-1.526	(-0.82)	-7.776***	(-3.20)	-1.238	(-0.54)	1.480	(0.92)	1.806	(0.85)	-23.08***	(-10.34)
0 to -6	-31.02***	(-25.76)	-1.014	(-1.00)	-22.47***	(-8.16)	-5.029***	(-3.32)	2.403	(0.84)	-4.079**	(-1.99)	3.911***	(3.08)	1.883	(1.01)	-24.44***	(-11.69)
Next 6 mths	-2.548**	(-2.00)	0.272	(0.25)	-8.122***	(-2.71)	-3.994**	(-2.45)	1.211	(0.39)	-0.811	(-0.37)	3.962***	(2.94)	0.448	(0.22)	-8.228***	(-3.66)
Next 6-12 mths	-10.78***	(-7.68)	-0.693	(-0.50)	-10.80***	(-3.04)	-0.225	(-0.11)	-9.753***	(-3.74)	-9.998***	(-3.94)	1.629	(0.93)	-1.766	(-0.77)	-3.957	(-1.61)
Next 12-18mths	1.170	(0.83)	1.887	(1.61)	-7.496**	(-2.20)	-4.634**	(-2.55)	-2.775	(-0.84)	2.621	(1.08)	0.182	(0.12)	-0.0749	(-0.03)	0.920	(0.37)
Next 18-24mths	1.779	(1.14)	0.372	(0.24)	-3.540	(-0.87)	0.704	(0.29)	2.072	(0.72)	-6.131**	(-2.13)	0.577	(0.30)	-5.390**	(-2.13)	-3.272	(-1.17)

Additional variables:	No. yrs of education	0.868	(1.61)
	Age	3.035***	(7.08)
	Age sq./100	-2.307***	(-7.16)
Control variables:	**No. own resident children**	-1.659***	(-3.01)
	Married	4.655***	(4.18)
	Friend	3.725***	(20.61)
	Social support	4.841***	(27.60)

N =74,003

t statistics in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$