Is it Vulnerability or Economic Insecurity that Matters for Health?

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Paper Prepared for the IARIW 33rd General Conference

Rotterdam, the Netherlands, August 24-30, 2014

Session 6D

Time: Thursday, August 28, Afternoon

Is it Vulnerability or Economic Insecurity that matters for Health?

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July 30 2014

This paper contrasts the mental and physical health impacts of vulnerability and economic insecurity. Vulnerability refers to economic risks for individuals just above the poverty line, while insecurity relates to the risk of significant unavoidable financial loss at *any* point along the income distribution. Using data from the first 11 waves of the Australian HILDA panel, we generate four alternative measures of real or perceived downside economic risk and employ fixed effects regressions to estimate their impacts on SF-36 mental and physical health indices. Our method also uses a high order series of polynomial interactions to allow the health effects to vary with income. We find that exposure to economic risk has consistently negative consequences for both mental and physical health – with the former effect being around three times the size of the latter. High incomes protect individuals almost completely from the negative *physical health* consequences but there are undiminishing negative implications for *mental health* at all income levels. Nonetheless poor and vulnerable people still face greater health costs due to a higher degree of risk exposure.

Key Words: Economic Insecurity, Vulnerability, Health, Income, Panel Data

JEL Classification: D69, I19, I31

1. Introduction

This IARIW session is about the time dimension of poverty and its implications – how and why the probability and duration of poverty spells might matter. The issue is important because when poverty is thought of in static terms, its impact on societal well-being is primarily due to the lower utility of those people who currently experience it. But when poverty is thought of in dynamic terms, and individuals have experiences of poverty which may potentially recur, then the implications of poverty will depend on both individuals' current experiences and their anticipations of future events. Seen in a dynamic context, poverty today affects the well-being of those who are currently poor, and it also influences

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the worrying that both today's poor and non-poor do about their possible poverty in future periods.[5]

Worrying about the future is stressful, and this stress may have adverse implications for mental and physical health. However when people worry about their economic futures, is it poverty that people are anxious about, or is it more generally the prospect of significant future economic losses? Are people economically anxious when they are concerned with destitution (implying that the health impacts of economic risks would likely be concentrated among the poor or near-poor)? Or do citizens at all income levels worry about the possibility of future losses (implying that health impacts would be observed throughout the income distribution)? How different are the poor, the near-poor and the middle class in terms of the health implications of their economic anxieties?

In the economics literature, this can be seen as the distinction between "vulnerability" and "insecurity". Vulnerability has been defined as "the existence and the extent of a threat of poverty and destitution" (Dercon 2005a, b). The broader concept of economic insecurity has been defined as "the anxiety produced by a lack of economic safety – i.e. by an inability to obtain protection against subjectively significant potential economic losses" (Osberg 1998:17).[6] The two concepts are clearly related, since the set of vulnerable individuals is a subset of the economically insecure (i.e. vulnerability concerns individuals who are already close enough to the poverty line that they might fall below, while individuals at any income level may feel insecure about the possibility of future loss). However, the distinction has important implications for social policy design. If vulnerability is regarded as the predominant social problem, old age pension or unemployment benefits may be set at a flat rate sufficient to prevent destitution, as in the social welfare system influenced by Beveridge.[7] But if economic insecurity is seen as the social problem, policy makers may prefer to set old age pension or unemployment benefits at some percentage of prior earnings, to maintain continuity of living standards and social position, as in the tradition of Bismark.

This paper therefore asks whether it is insecurity or vulnerability (or both) that matters for health and well-being. Using data from the Australian HILDA (Household Income and Labour Dynamics) panel survey, we estimate the health effects of a basket of economic risks while allowing the magnitudes of these effects to vary over the income distribution. By studying changes in the effect sizes, and by considering differing rates of risk exposure, we

[5] There a growing bodies of literature that examine economic insecurity and study the health impacts of economic risk. Prominent works on insecurity include Bossert and D'Ambrosio (2013) who provide an axiomatic structure for measurement, and Hacker (2006) who aggregates household level risks to measure insecurity in the US. Nicholls and Rehm (2014) and Rohde et al (2014) also provide empirical work. Papers on the relationship between insecurity and wellbeing include (but are not limited to) Ferrie (2001) Smith (2009) and Offer et al (2010) who consider the effects of insecurity on obesity , Green (2011) who considers happiness and Laszlo et al (2010) and Sverke et al (2002) who survey general health outcomes.

[6] The United Nations Department of Economic and Social Affairs (2008, p.vi) notes: "economic insecurity arises from the exposure of individuals, communities and countries to adverse events, and from their inability to cope with and recover from the costly consequences of those events."

[7] The distinction has been summarized as: "The aim of the Bismarck system is thus to assure a standard of living while the Beveridge system focuses on securing a subsistence level." (DICE, 2008:70) A concrete example is unemployment benefits, which are earnings-related in Canada, but set as a flat rate benefit in Australia.

are able to determine whether or not income acts as a buffer against the health consequences of economic risk.

The paper is structured as follows. Section 2 outlines our hypotheses while Section 3 introduces the data. Section 4 describes the econometric methodology and Section 5 presents and interprets the results. Section 6 concludes while supplementary material summarizing the data appears in the appendices.

Vulnerability, Income Insecurity and Health

We begin by using the concept of income losses to develop hypotheses on the broader relationship between economic risk and health. When the well-being consequences of uncertainty are analysed within a standard neo-classical perspective of risk-aversion, the starting-point involves a concave utility function in which current period well-being (U) depends on current consumption (C), as in $U = u(C)$.[8] If one defines a future period's consumption as C^*, the utility consequences of a future loss are simply $[u(C) - u(C^*)]$. The size of any fall in utility depends on the curvature of the function, but there is nothing special about poverty – neither present nor future utility is affected by whether or not consumption is less than some poverty line (Z).

In this model, consumption is constrained by income this period (Y) and by future income (Y^*). However, if individuals can smooth by borrowing in low transitory income periods and lending in transitorily prosperous periods, the operative constraint is that lifetime consumption (C_L) cannot exceed lifetime income (Y_L) – i.e. $C_L \leq Y_L$. In this instance income fluctuations will have no impact on well-being, and the effects of both insecurity and vulnerability on health outcomes can be expected to be zero as long as the lifetime income exceeds subsistence.

Our alternative hypothesis is that consumption smoothing options are imperfectly available, and that future income losses therefore affect well-being both when they are experienced and when they are anticipated. We hypothesize that in any given period, being aware of the possibility of such future losses induces stress (S) for individuals which has an adverse impact on their health outcomes (H). We recognize that health in any given period also depends heavily on other personal and contextual characteristics denoted by vector X, and propose the following general equation governing health status

[1] $$H = \alpha_0 + \alpha_1 S + \alpha_2 X + \varepsilon \qquad \alpha_1 < 0$$

Holding determinants X constant, we obtain health as a function of stress and random events:

[2] $$H = \alpha_0 + \alpha_1 S + \varepsilon$$

[8] The Constant Relative Risk Aversion specification $u(C) = C^{\alpha}$ is popular. Note that we simplify the notation by omitting the time subscript to denote the current period.

But what is it that affects S? In the context of income risk, we define the margin between an individual's current level of material comfort and the poverty line as $M = Y - Z$ and the size of a possible future loss as $L = Y - Y^*$, then one can decompose the cumulative density of the frequency distribution of possible future losses [$f(L)$] into the density of probability of loss that is less than the individual's margin with respect to poverty [$f_1(L \mid L < M)$] and the density of the probability of loss that will push the individual into poverty [$f_2(L \mid L \geq M)$]. If stress is determined primarily by "vulnerability" then only future losses that produce poverty will cause stress:

[3a] $$S = \beta_1 ([f_2(L \mid L \geq M)]) \qquad \beta_1 > 0$$

hence $$H = \alpha_0 + \alpha_1\beta_1 ([f_2(L \mid L \geq M)]) \qquad \alpha_1 \beta_1 < 0$$

Conversely the probability of a future loss that does not push the person into poverty – i.e. is less than the individual's margin with respect to poverty [$f_1(L \mid L < M)$] - should fail to predict health outcomes. However, if the prospect of unavoidable significant income losses stresses everyone and "economic insecurity" is the relevant welfare concept, then we expect to observe:

[3b] $$S = \beta_2 \{f1(L \mid L < M) + f_2(L \mid L \geq M)\} \qquad \beta_2 > 0$$

hence $$H = \alpha_0 + \alpha_1\beta_2\{f_1(L \mid L < M) + f_2(L \mid L \geq M)\} \qquad \alpha_1 \beta_2 < 0$$

Equations [3a] and [3b] therefore differentiate the health impacts of economic risk. Only vulnerable individuals will have high values for $f_2(L \mid L \geq M)$ and hence this perspective predicts that the health consequences should be concentrated amongst these individuals. Conversely individuals at all income levels can have non-trivial values for $f_1(L \mid L < M)$ and hence the insecurity perspective predicts negative responses to prospective income losses along the income distribution.

While we have focussed on threats to income to describe our hypotheses, the above conceptual framework can be generalized to account for any type of economic risk. That is, rather than focussing explicitly on income losses we can think of risk exposure in terms of the multitude of economic hazards that may potentially be sources of stress. Such risks include (but are not limited to) the possibility of losing one's job, facing a decrease in asset values, or lacking access to a suitable safety net. As these types of variables are commonly employed in the literature on economic risk and health, they are used throughout this paper. Thus our empirical method will look for differing health responses to exposure to these forms of risks over the income distribution, and be especially concerned with the prospect of structural change around the poverty line.

2. Data

Data come from the HILDA (Household Income and Labour Dynamics in Australia) survey – a high quality panel data set comparable to the US based Panel Study of Income Dynamics (PSID) or German Socioeconomic Panel (SOEP). Like these data sets HILDA contains a rich set of variables on individual economic and health outcomes, as well as a large number of observations on opinions, life events, demographics and family backgrounds. The survey is approximately nationally representative and tracks around 7,000 households and 20,000 individuals over 11 years (to date) from 2001 until 2011.

We use two main measures of health based on the SF-36. This is an extensively validated (e.g. Ware, 2000) and widely employed generic health assessment tool which asks 36 questions on the respondent's vitality, physical functioning, body pain, health perceptions, physical, emotional and social functioning, and mental health. These are aggregated to form subscales and we employ the aggregate mental health and physical functioning scales as summaries of these alternative health concepts.

To quantify individual or household-level economic downside risk, we take four measures based on (i) negative labour market outcomes, and (ii) more general assessments of household security. Most households depend on their labour market income to meet household expenses, so labour market hazards are important determinants of financial stability (Greenhalgh and Rosenblatt, 1984; Sverke et al., 2006; Green, 2011). The first variable used is a direct survey question which asks for a level of agreement with the statement "I have a secure future in my job". As the question assesses job security, we invert the scale to measure perceived job insecurity. Our second measure is more objective – an estimate of the latent probability, conditional on an assumedly exogenous set of covariates, of job loss within a year obtained using a probit model.

However as the possibility of being sacked is only one of multiple economic hazards, we also look to broader indicators of risk exposure. First is the respondent's answer to a subjective question on the ease with which householders could raise emergency funds. For the first eight waves of the panel, respondents are asked to state the predicted ease with which $2,000 may be raised at short notice (updated to $3,000 for the last three waves).[9] This variable thus quantifies an individuals perceived inability to handle risk, rather than the likelihood of a specific risk occurring.

The second general measure we use is a dichotomous indicator of whether or not members of the household have sought financial assistance from friends or family – which is really a compound indicator of the presence of economic stress and also the respondent's lack of access to the public safety net or the private financial market to smooth consumption. This indicator is slightly different to the previous three in that it measures current distress rather

[9] In order to ensure that this change of scale does not unduly influence results, the responses in the final three waves are deflated by the ratio of mean scores across the discontinuity, such that there is no differential in averages across these two years.

than prospective loss, however as economic distress need not confined to those around or below the poverty line we are still interested in its potential effects on health.

To control for external sources of variation in health we take a standard set of variables including the age, education level, household size, marital status and regional area of the individual. Income is also included and is of particular importance as we wish to consider the effects of risk while controlling for current levels of material comfort. We use household post-government income throughout after standardizing using the square root of the number of household members. We also employ dummies to indicate a set of life events which could conceivably influence health. These include becoming married, separating from one's spouse, victimhood of violence, and pregnancies, births, and deaths (spouses or children – SC, other relatives – RF or friends – FR within the last 12 months. Lastly it is noted that our methodology will implicitly incorporate time-invariant characteristics such as gender, race and fixed personality characteristics and hence there is no need to include them in the model. Descriptive statistics of all variables are presented in Appendix 1.

3. Econometric Methodology

The 11 waves of HILDA data form a panel consisting of $i \in [1, \dots, N]$ individuals observed over time periods $t \in [1, \dots, T]$. Let $M_{it} \in \{0,1, \dots ,100\}$ and $P_{it} \in \{0,1, \dots ,100\}$ denote the mental and physical summary scores from the SF-36. Similarly the risk/distress measures are denoted $JI_{it} \in \{1,2, \dots ,7\}$, $JL_{it} \in [0,1]$ $EF_{it} \in \{1,2, \dots ,4\}$, and $FH_{it} \in \{0,1\}$ for the *job insecurity*, *probability of job loss*, *inability to raise emergency funds*, and *seeking financial help* measures respectively. To retain consistency across both the health and risk measures we use the following *z* transformations throughout

$$H_{it}^{*} = \frac{H_{it} - \bar{H}}{\sigma_H} \qquad I_{it}^{*} = \frac{I_{it} - \bar{I}}{\sigma_I}$$

where H^{*} and I^{*} refer generically to the transformed health and risk measures. In all cases these variables have means of zero and variances of one, and hence may be given a standard-deviations-from-mean interpretation.

The objective is to model the effect of I_{it}^{*} on health index H_{it}^{*}. To control for endogeneity we employ a fixed effects estimator and a large collection of explanatory variables. The fixed effects specification eliminates all time-invariant heterogeneity while our controls will remove other explainable within-individual variations in health. However our models are still vulnerable to endogeneity arising from changes in an individual's health precipitating fluctuations in risk/distress.

The specification used throughout is

$$H_{it}^{*} = X_{it}\beta + \sum_{j=0}^{J} \gamma_j \, I_{it}^{*} \times \tilde{x}_{it}^{j} + \alpha_i + u_{it} \qquad j = 0 \dots J$$

where X_{it} is a $1\times q$ vector of controls, β is a $q \times 1$ vector parameters, α_i is the individual-specific effect and u_{it} is the error. As income plays a special role it is denoted $\tilde{x}$, while $\gamma_{0,}\gamma_1, \ldots, \gamma_J$ are scalars. The rationale for this specification is that it allows the marginal effect of the risk measure to vary with income, as I^*_{it} is interacted with the polynomial in $\tilde{x}$. While this is a fully parametric estimator, it mimics semiparametric methods in that it allows this marginal effect to take on a wide variety of forms including increasing, decreasing, concave, convex, and non-monotonic with up to $J-1$ turning points. Such a flexible specification is required to detect any sharp changes in the health effects of risk that may occur (for example around the poverty line).

Differentiating H^*_{it} with respect to I^*_{it} gives the marginal effect $\phi(\tilde{x})$

$$\phi_{it} = \sum_{j=0}^{J} \gamma_j \times \tilde{x}_{it}^{j} \qquad j = 0 \ldots J$$

If $J = 0$ then a constant marginal effect of γ_0 is implied. If $J = 1$ then ϕ varies linearly with $\tilde{x}$. Greater values give additional flexibility, which must be offset against the loss of degrees of freedom. We use the AIC to guide the optimal polynomial order, but look to employ the same specification across regressions to retain comparability. Given that low polynomial orders implicitly impose a limited set of possible shapes for this marginal effect, we err on the side of caution by using a fairly large value of $J = 6$ throughout. This specification appears to provide surplus parameters for most, albeit not all models. Nonetheless given that $\gamma_j \times \tilde{x}_{it}^{j}$ will be highly collinear with other terms in the polynomial, we refrain from placing too much emphasis on individual coefficient significance and instead look to joint tests and bootstrap intervals to establish significance.

4. Estimation

To model the health impacts of the economic risk measures we estimate the above model for each set of variables. Our general specifications employ a full set of covariates, however as a test for robustness, we also estimate a second set of models omitting the life event dummies (denoted L12 to indicate occurrence in the last 12 months). Table 1 reports results when mental health is the dependent variable and Table 2 when physical health is the dependent variable. The models are fitted by OLS using heteroskedasticity/cluster robust standard errors, and a number of generic supporting statistics are also included.[10] In all instances the regressions are significant, and the combined interacting effects of the risk measures with income also reject the null of no effect at standard levels.

Table 1 indicates that the determinants of within-individual variations in mental health tend to match prior expectations. Most of the control variables (aging, education, income,

[10] These are the sample size (n), the coefficient of determination (R^2), the overall significance of the regression (F –Regression), a joint hypothesis test on the significance of the insecurity and income interactions (F –Joint γ_j=0) and the proportion of the variance explained by the individual specific effects (ρ).

household size, regional population density and marital status) lack consistent statistical significance, although they are generally of the expected signs. Aging has a generally positive coefficient, indicating that average mental health scores were increasing over time, while increasing income and education also resulted in slightly better scores. Positive changes in household size had consistent (although insignificant) negative effects while living in a city (higher population density) had the reverse effect. In addition, the life event variables also exhibited the expected signs, with adverse events (separations, deaths, victimhood of violence) having strongly significant negative coefficients, while generally desirable events (marrying and becoming pregnant) showed significant positive signs.

Similarly the results for physical health in Table 2 were also as anticipated. Aging had a consistently negative significant effect, while increasing income coincided with improvements. Contrary to the results for mental health, individuals in larger households had better physical health, while a reversed coefficient for population density was also apparent. Turning to the life-event variables we see that deaths of family members or friends tended to reduce physical health, as did becoming a victim of violence. Becoming pregnant decreased the physical health of individuals in the subsequent 12 months as expected, while giving birth seemed to increase the health of individuals subsequently. The two opposite findings are consistent in the sense that giving birth by nature must be associated with the end of pregnancy, so the difference between the coefficient values may be picking up the health impacts of pregnancies that did not end in childbirth, either due to abortion or miscarriage.

Table 1. Fixed Effects Estimates of Effects of Risk/distress Measures on *Z* Transformed SF-36 Mental Health Scores

Variable	Job Insecurity		Probability of Job Loss		Nil Emergency Funds		Seek Financial Help	
Constant	-0.1018	-0.1752	-0.0979	-0.0760	-0.0389	-.0805	-0.0979	-0.1755
Age	0.0020	0.0029**	0.0009	0.0000	0.0007	0.0007	0.0020	0.0031**
Education	0.0032	-0.0001	0.0040	0.0042	0.0024	-0.0005	0.0040	0.0004
Income	4.6E-07**	5.3E-07***	3.7E-07*	5.3E-07**	4.8E-07**	5.3E-07**	5.1E-07**	5.3E-07**
HH size	-0.0035	-0.0017	-0.0115**	-0.0057	-0.0033	-0.0016	-0.0075	-0.0058
Pop density	0.0193	0.0159	0.0055	0.0070	0.0143	0.0114	0.0060	0.0053
Married	-0.0292*	0.0590***	-0.0543***	0.0251	-0.0386*	0.0495***	-0.0224	0.0626***
L12 Pregnancy	0.0962**		0.0975***		0.0946***		0.0942**	
L12 Birth	0.0315		0.0288		0.0285		0.0341*	
L12 Death SC	-0.4036***		-0.4064***		-0.4164***		-0.4140***	
L12 Death RF	-0.0599***		-0.0597***		-0.0617***		-0.0651***	
L12 Death FR	-0.0291**		-0.0296**		-0.0297**		-0.0263**	
L12 Violence	-0.2685***		-0.2649***		-0.2661***		-0.2865***	
L12 Separation	-0.3068***		-0.3096***		-0.3003***		-0.2992**	
L12 Marriage	0.0877***		0.0885***		0.0852***		0.0771***	
L12 Retire	0.0912		0.0772		0.0641		0.0941	
$I^*\times Inc^0$	-0.0916***	-0.1055***	-0.0926***	-0.0919***	-0.1453***	-0.1242***	-0.0976***	-0.0975***
$I^*\times Inc^1$	1.6E-06	2.7E-06*	1.2E-06	1.2E-06	2.8E-06	1.5E-06	3.2E-06	2.4E-06
$I^*\times Inc^2$	-5.4E-11	-8.0E-11**	-3.5E-11	-3.6E-11	-4.3E-11	-1.9E-11	-6.8E-11	-4.9E-11
$I^*\times Inc^3$	5.7E-16	8.2E-16*	3.4E-16	3.7E-16	1.6E-16	-6.7E-17	5.8E-16	3.8E-16
$I^*\times Inc^4$	-2.6E-21	-3.6E-21*	-1.3E-21	-1.5E-21	3.8E-22	1.4E-21	-2.1E-21	-1.1E-21
$I^*\times Inc^5$	5.1E-27	7.3E-27	2.3E-27	2.7E-27	-2.6E-27	-4.8E-27	3.1E-27	1.2E-27
$I^*\times Inc^6$	-3.8E-33	-5.4E-33	-1.4E-33	-1.8E-33	3.1E-33	4.7E-33	-1.6E-33	-2.8E-34
n	11959	12799	11959	11959	11959	12799	11829	12676
R^2	0.0621	0.0610	0.0494	0.0469	0.0525	0.0514	0.0415	0.0408
F –Regression	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F –Joint γ_j=0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ρ	0.6574	0.6500	0.6591	0.6586	0.6571	0.6491	0.6610	0.6524

Note: Estimates are reported for physical health where variables Job Insecurity, Probability of Job Loss, Inadequate Access to Emergency Funds and Seeking Financial Help from Family Members or Friends are altered across rows. Cluster robust standard errors are used and asterisks ***, ** and * denote significance at 1%, 5% and 10% respectively.

Table 2. Fixed Effects Estimates of Effects of Risk/distress Measures on *Z* Transformed SF-36 Physical Functioning Scores

Variable	Job Insecurity		Probability of Job Loss		Nil Emergency Funds		Seek Financial Help	
Constant	0.3932***	0.2846**	0.4174***	0.3833***	0.4109***	0.3076**	0.3111**	0.2192
Age	-0.0123***	-0.0125***	-0.0127***	-0.0122***	-0.0129***	-0.0132***	-0.0114***	-0.0118***
Education	0.0051	0.0120	0.0051	0.0055	0.0052	0.0120	0.0083	0.0148
Income	3.2E-07	3.3E-07*	4.2E-07	3.5E-07	3.6E-07	4.2E-07	6.2E-07**	6.3E-07***
HH size	0.0138**	0.0185***	0.0113*	0.0151**	0.0142**	0.0187***	0.0091	0.0148**
Population density	-0.0216	-0.0242*	-0.0250	-0.0253	-0.0227	-0.0252*	-0.0323**	-0.0331**
Married	0.0038	-0.0080	-0.0020	-0.0139	0.0016	-0.0102	0.0109	-0.0056
L12 Pregnancy	-0.1087***		-0.1089***		-0.1092***		-0.1110***	
L12 Birth	0.0749***		0.0753***		0.0740***		0.0862***	
L12 Death SC	-0.0003		-0.0011		-0.0043		-0.0149	
L12 Death RF	0.0011		0.0013		0.0008		0.0087	
L12 Death FR	-0.0306**		-0.0307**		-0.0307**		-0.0231	
L12 Violence	-0.0946**		-0.0935**		-0.0932**		-0.0767*	
L12 Separation	0.0144		0.0149		0.0165		0.0332	
L12 Marriage	0.0069		0.0069		0.0057		-0.0040	
L12 Retire	0.0067		0.0051		-0.0016		0.0176	
$I^*\times Inc^0$	-0.0443	-0.0442*	-0.0603**	-0.0587**	-0.0788**	-0.0612*	-0.0948***	-0.0580*
$I^*\times Inc^1$	1.2E-06	1.1E-06	1.7E-06	1.6E-06	4.7E-06*	3.1E-06	6.3E-06***	3.5E-06
$I^*\times Inc^2$	-1.7E-11	-1.4E-11	-3.2E-11	-2.8E-11	-1.3E-10*	-9.2E-11	-1.8E-10***	-1.2E-10*
$I^*\times Inc^3$	1.3E-16	1.1E-16	3.5E-16	3.1E-16	1.5E-15**	1.2E-15	2.2E-15***	1.7E-15**
$I^*\times Inc^4$	-4.9E-22	-4.7E-22	-1.8E-21	-1.6E-21	-7.9E-21**	-6.4E-21*	-1.2E-20***	-9.5E-21***
$I^*\times Inc^5$	8.7E-28	9.7E-28	4.0E-27	3.7E-27	1.8E-26**	1.6E-26*	2.7E-26***	2.3E-26***
$I^*\times Inc^6$	-5.9E-34	-7.3E-34	-3.2E-33	-3.0E-33	-1.5E-32**	-1.3E-32**	-2.2E-32***	-1.9E-32***
n	11958	12799	11959	11959	11959	12799	11829	12676
R^2	0.0474	0.0467	0.0484	0.0465	0.0524	0.0516	0.0486	0.0480
P(F) –Regression	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
P(F) –Joint γ_j=0	0.0643	0.0153	0.0101	0.0104	0.0164	0.0059	0.0000	0.0000
ρ	0.6405	0.6457	0.6402	0.6405	0.6394	0.6444	0.6464	0.6499

Note: Estimates are reported for Mental Health where variables Job Insecurity, Probability of Job Loss, Inadequate Access to Emergency Funds and Seeking Financial Help from Family Members or Friends are altered across rows. Cluster robust standard errors are used and asterisks ***, ** and * denote significance at 1%, 5% and 10% respectively.

The Marginal Effect of Risk on Health

Given that the models presented in Tables 1 and 2 appear to function appropriately, we now examine the influence of the economic risks on health. For each equation the estimated function $\hat{\phi}(\tilde{x})$ is plotted below based on coefficients $\hat{\gamma}_j$, $j = 0 \ldots J$. The analysis below is based on the specifications that include the life-event dummies; however the findings are generally similar if they are excluded (available from the authors upon request). Furthermore to conduct inference we use clustered bootstrap standard errors determined as follows:

1. Resampling with replacement is conducted from clusters $i \in [1, \ldots, N]$. This retains the covariance between z_i, X_i and $\tilde{x}_i$ without needing it to be explicitly imposed. These bootstrap samples are labelled $b = 1,2, \ldots, B$.
2. Parameters $\hat{\beta}^*$ and $\hat{\gamma}_j^*$ are estimated for pseudo-samples $b = 1,2, \ldots, B$.
3. The marginal effects $\hat{\phi}^*(\tilde{x};\ \hat{\gamma}^*)$ are calculated from (2) over a grid of values for $\tilde{x}$.
4. The confidence interval is then $\hat{\phi} \pm 2 \times \hat{\sigma}_{\hat{\phi}^*}$.

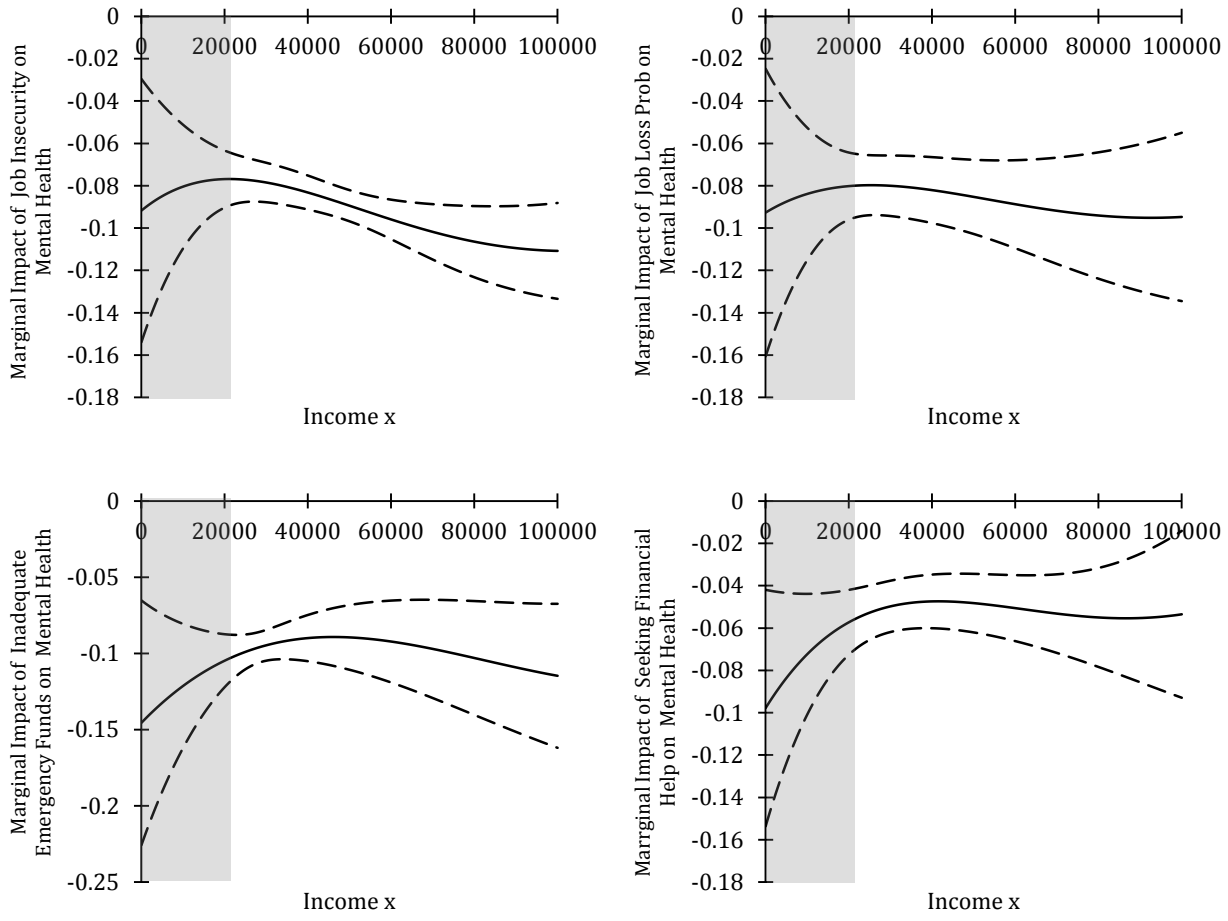
The solid lines in Figure 1 show the estimated marginal effects of the four risk measures on mental health, while the dashed lines give the confidence intervals. Income is on the horizontal axes, up to a value of AUD $100,000 per year. This covers approximately 96% of the sample. Values below a poverty line of AUD $21,000 – set equal to half the median income – are shown in grey. For interpretation it is important to note that the average income over all individuals throughout the period is equal to approximately AUD $48,000.

The top left panel presents the impact of the normalized self-assessed job insecurity. Subject to our assumptions of exogeneity, a standard deviation increase in this measure lowers an individual's mental health score by around 0.08 to 0.1 standard deviations, or around 1.2 to 1.5 SF-36 units. For individuals below the poverty line, the negative effect of job insecurity on mental health is stronger as income declines toward zero. However, one should be cautious in reading too much into the point estimate for the very low income segment of the population because of the large standard errors surrounding our estimates (possibly reflecting the small sample size at very low incomes). For the non-poor, the point estimates suggest that the impact of job insecurity on mental health either does not decrease with income or even increases. Once again, interpretation of the findings should take the standard errors into account. However, these results clearly do *not* support the hypothesis that the health consequences of job insecurity are limited to low-income individuals – people of higher income are equally or possibly more affected by potential job loss. If high annual incomes tend to be accompanied by occupational status, identity and career expectations, it may be understandable that job insecurity is more stressful – high-income persons might have 'more to lose' from job loss and hence might experience greater negative impacts on mental health as a result.

The other three panels of Figure 1 are broadly consistent with the first. The mental health consequences of the latent probability of job loss, lack of adequate emergency funds and requiring financial help are all strongest for individuals below the poverty line, and tend to range from around -0.06 to -0.08 for persons at the mean of the income distribution. When

the more general risk or distress indicators are considered there are slightly smaller mental health impacts for middle income Australians, although in no cases did the coefficient size approach zero. Hence, results for all four measures imply that the mental health consequences of risk or distress appear at all income levels.

Figure 1. Impacts of Economic Risk Measures on Mental Health over Income



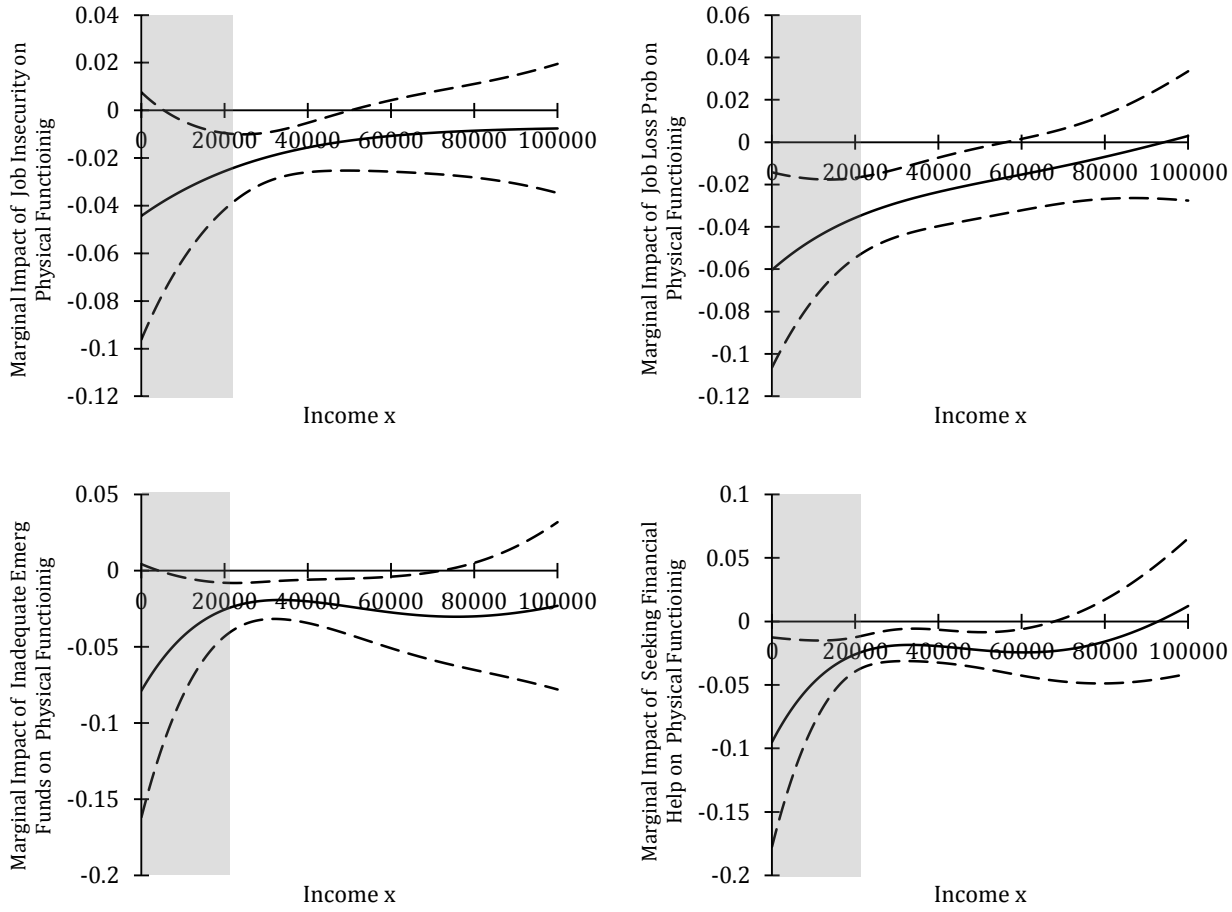
Note: In all cases the vertical axes show the impact of the risk/distress measure on mental health. The horizontal axes show the change in effect size over income, where incomes below the poverty line are highlighted in grey. The top left panel gives the effect of job insecurity, the top right panel the effect of the latent probability of job loss, the bottom left ease of ability to raise emergency funds, and the bottom right seeking financial aid from friends and family. Confidence intervals based on ±2 standard errors are depicted with dashed lines and are obtained with cluster bootstraps.

Analogous results for transformed SF-36 physical functioning scores are given in Figure 2. Again, point estimates of the influence of self-assessed job insecurity in the top left panel show a negative marginal effect over all values of the income distribution. However, the effect is largest for those the furthest below the poverty line, and diminishes monotonically as income grows. As a consequence, for incomes in excess of roughly AUD $50,000 the health response is statistically insignificant, and the magnitude becomes trivial relative to sampling

error after AUD $80,000. Unlike the results for the mental health, the physical reactions to insecurity diminish towards zero as income increases.

This pattern of physical health impacts that decline with increasing income can also be seen for the other measures, where there are statistically significant, negative impacts on health for most of the population – not just for poor or near poor people. However, the marginal effect for the forecast probability of job loss approaches zero as income rises and generally become statistically insignificant at around AUD $60,000 (77.1% of observations are below $60,000). Similarly the marginal effects of inadequate access to emergency funds and requiring financial help from family members or friends tend to lessen with income, and become indistinguishable from zero above approximately AUD $70,000, (about 1.5 times the average income, 85.3% of respondents). In general, these impacts are of smaller magnitude than for mental health, with persons at the mean experiencing a standard deviation shock seeing their physical health deteriorate by around 0.02 standard deviations.

Figure 2. Impacts of Economic Risk Measures on Physical Health over Income



Note: In all cases the vertical axes show the impact of a risk/distress measure on physical health. The horizontal axes show the change in effect size over income, where incomes below the poverty line are highlighted in grey. The top left panel gives the effect of job insecurity, the top right panel the effect of the latent probability of job loss, the bottom left ease of ability to raise emergency funds, and the bottom right seeking financial aid from friends and family. Confidence intervals based on ±2 standard errors are depicted with dashed lines and are obtained with cluster bootstraps.

Given these results, does a half-the-median-income poverty line represent a point of structural change for the health effects of insecurity? Considering all four measures we fail to see this pattern emerge unanimously. Instead, for both the Inadequate Emergency Funds and Seeking Financial Help indicators, the poverty line coincides with a diminished slope, suggesting that financial risk/distress may become less problematic as incomes increase above the poverty line – but that economic risk still matters for most of the income distribution.

The Health Consequences of Poverty and Vulnerability Relative to Economic Safety

To further contrast the health impacts of economic risk or distress around the poverty line, we divide individuals into three mutually exclusive and collectively exhaustive groups: *poor* (i.e. incomes below $21,000 – 9.8% of the population), *vulnerable* (incomes from $21,000 to $39,000 – 33% of the population) and *safe* (i.e. at least temporarily safe from poverty –- incomes in excess of $39,000 – 57.2% of the population). The value of $39,000 is chosen because the poverty line plus the standard deviation of incomes based upon within-individual variation represents a plausible upper limit for vulnerability – i.e. vulnerable individuals are those that lie within a standard deviation income shock from the poverty line, while safe individuals lie outside this range.

We then estimate the same models presented in Tables 1 and 2, however rather than employing the polynomial interaction terms, dummy variables are used to estimate a health impact for each measure over each group. This approach disallows changes in effect size within the groups, but enables a simple assessment of the relative sensitivities. The coefficient estimates on the insecurity measures over the three groups are presented in Table 3.

Table 3: Health Sensitivities to Economic Risk – Income Groups

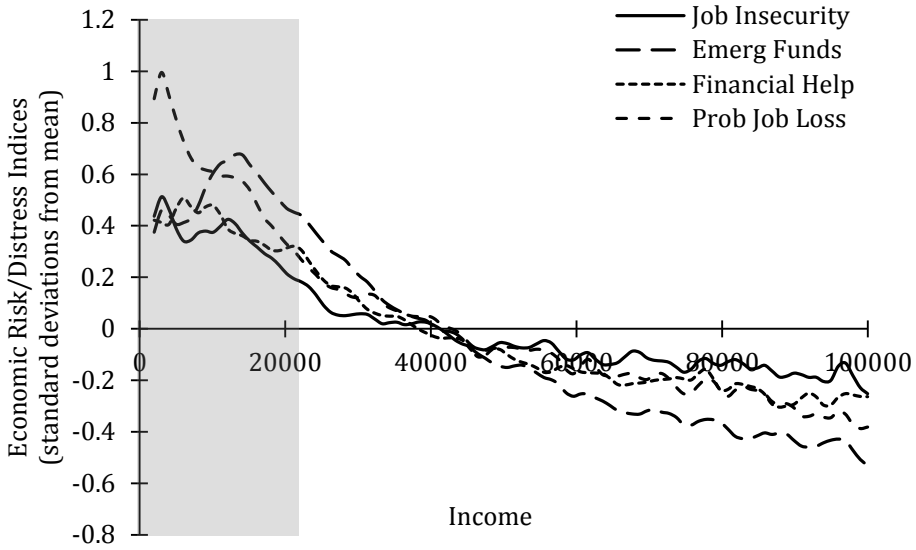
Group	Mental Health				Physical Health			
	JOB INSEC	EMERG FUNDS	FIN HELP	JOB LOSS	JOB INSEC	EMERG FUNDS	FIN HELP	JOB LOSS
Poor	-0.074	-0.109	-0.066	-0.077	-0.020	-0.041	-0.032	-0.034
Vulnerable	-0.081	-0.098	-0.050	-0.081	-0.020	-0.016	-0.025	-0.028
Safe	-0.094	-0.091	-0.049	-0.088	-0.013	-0.027	-0.015	-0.017

Note: The first row gives the estimate of the impact of the specified risk measure on individuals below the poverty line, the second row gives the same value for individuals within a standard deviation shock of the poverty line, and the last row presents individuals beyond a standard deviation shock above the poverty line. Hypothesis tests indicate that that the baseline impacts (individuals within the 'safe' group) are significant while the changes relative to this baseline generally are not.

Results from Table 3 can be used to contrast the *total* health impacts of each risk across the three income groups. Currently the small differences in effect size only capture the relative sensitivities amongst the subgroups and are not indicative of the degree to which risk differs between them. It is therefore plausible that economic risk and distress is much more harmful

for poor and vulnerable people due to a greater level effect, rather than a greater degree of sensitivity. To illustrate the changing nature of our measures over the income distribution, Figure 3 presents kernel regressions of each standardized measure against income. As shown, individuals at the lower end of the distribution have markedly higher levels of risk exposure than those at the higher end, and there is a strong degree of similarity in trends across the four measures.

Figure 3. Risk/Distress Exposure over the Income Distribution



Note: The vertical axis gives the risk measure in standard deviations from the sample mean. The horizontal axis depicts income, while the grey section signifies incomes below the poverty line. All regression lines are obtained using fixed bandwidth Gaussian kernels.

In order to estimate the total health impacts of each measure, we take the product of the sensitivity estimates and the degree of exposure. This could be achieved by multiplying the regression equations shown in Figures 1 and 2 with those depicted in Figure 3. However for the sake of analytical clarity we simply employ the coefficients from Table 3 and the corresponding subgroup averages for each group. To provide context, each estimate is standardized relative to persons in the 'safe' income group such that the results represent health costs due to risk exposure, relative to economic safety. Results are presented in Table 4.

Table 4: Aggregate Health Impacts – Income Groups

Income Group	Mental Health				Physical Health			
	JOB INSEC	EMERG FUNDS	FIN HELP	JOB LOSS	JOB INSEC	EMERG FUNDS	FIN HELP	JOB LOSS
Poor	-0.031	-0.077	-0.030	-0.050	-0.007	-0.028	-0.013	-0.019
Vulnerable	-0.013	-0.040	-0.013	-0.023	-0.002	-0.009	-0.005	-0.012
Safe	0	0	0	0	0	0	0	0

Note: Each row is based upon the product of the marginal effect of insecurity with the average for that income group. As the insecurity measures are standardized at zero, this estimate is renormalized to give aggregate impacts relative to persons in the 'safe' income group.

Table 4 suggests that the realized values for economic risk reduce the total mental health of individuals in the category *poor* by around -0.05 standard deviations, ranging between -0.03 and around -0.08 depending upon the measure used, relative to those in the *safe* category. Individuals in the vulnerable category experienced a reduction of around -0.02 standard deviations relative to *safe* individuals. These estimates can be placed in context by considering the parameter estimates on the life event dummies reported in Table 1. By averaging coefficients across the rows, we see that persons who experienced the death of a relative in the last 12 months experienced a shock of approximately -0.06 standard deviations, while the death of a spouse or child has an impact of about -0.41. Similarly separation from one's spouse lowered the mental health index by around -0.30 standard deviations, and hence the impacts of exposure to economic risk are relatively small when compared to these highly stressful events. For physical health, the greater level of risk exposure for *poor* people resulted in outcomes around 0.02 standard deviations lower than the safe group, while for vulnerable people this figure was around -0.01.

These health gaps can be further separated using an Oxaca-Blinder type decomposition into the relative contributions of the parameters (the sensitivities of each group to economic risk) and the endowments (the degree of risk exposure). As we are only interested in the impacts of the risk indices, we impose the same set of parameters for all control variables and only employ the changing coefficients from Table 3. Thus we cannot fully decompose the total differences in health between the poor, vulnerable and safe groups; however we can decompose the differentials in health associated with each measure. If *P* and *V* denote poor and vulnerable groups the below expression is used

$$\hat{\beta}^V \bar{I}^V - \hat{\beta}^P \bar{I}^P = \left(\hat{\beta}^V - \hat{\beta}^P\right)\bar{I}^P + (\bar{I}^V - \bar{I}^P)\hat{\beta}^P + \left(\hat{\beta}^V - \hat{\beta}^P\right) \times (\bar{I}^V - \bar{I}^P)$$

where $\hat{\beta}^V$ and $\hat{\beta}^P$ are the estimated slope coefficients on the risk measures for the two subgroups and $\bar{I}^V$ and $\bar{I}^P$ are risk endowments. The LHS gives the explainable gap in health outcomes, the first term on the RHS is the contribution of the parameters and the second gives the contribution of the endowments. The final term is an interaction of both parameters and endowments. The decompositions are done for all three combinations of income group (V-P; S-P and S-V, where S denotes the safe group) with the poorer subgroup used as the baseline in each instance. Note that this choice of reference implies that a positive value indicates a shortfall in health.

Table 5: Oaxaca-Blinder Decompositions of Health Shortfalls

Subgroups		Mental Health				Physical Health			
		JOB INSEC	EMERG FUNDS	FIN HELP	JOB LOSS	JOB INSEC	EMERG FUNDS	FIN HELP	JOB LOSS
V-P	Parameters	-2.23E-03	5.58E-03	5.69E-03	-2.23E-03	-3.24E-05	1.34E-02	2.61E-03	2.65E-03
	Endowments	1.85E-02	3.54E-02	1.53E-02	2.76E-02	5.03E-03	1.33E-02	7.45E-03	1.21E-02
	Interactions	1.79E-03	-3.41E-03	-3.73E-03	1.64E-03	2.59E-05	-8.17E-03	-1.71E-03	-1.95E-03
	Total	1.80E-02	3.76E-02	1.73E-02	2.70E-02	5.02E-03	1.85E-02	8.34E-03	1.28E-02
S-P	Parameters	-6.25E-03	9.48E-03	6.02E-03	-5.36E-03	2.13E-03	7.16E-03	6.23E-03	8.02E-03
	Endowments	2.97E-02	8.08E-02	3.27E-02	4.82E-02	8.08E-03	3.04E-02	1.59E-02	2.11E-02
	Interactions	8.03E-03	-1.32E-02	-8.43E-03	6.87E-03	-2.74E-03	-9.99E-03	-8.72E-03	-1.03E-02
	Total	3.15E-02	7.71E-02	3.03E-02	4.97E-02	7.47E-03	2.76E-02	1.34E-02	1.88E-02
S-V	Parameters	-8.01E-04	1.52E-03	1.15E-04	-8.33E-04	4.32E-04	-2.42E-03	1.25E-03	1.43E-03
	Endowments	1.23E-02	4.11E-02	1.31E-02	2.18E-02	3.06E-03	6.59E-03	6.50E-03	7.56E-03
	Interactions	1.95E-03	-3.06E-03	-2.49E-04	1.72E-03	-1.05E-03	4.88E-03	-2.69E-03	-2.95E-03
	Total	1.34E-02	3.95E-02	1.30E-02	2.27E-02	2.45E-03	9.05E-03	5.05E-03	6.04E-03

Note: V-P denotes the health difference between the vulnerable and poor groups, S-P between the safe and poor groups and S-V the safe and vulnerable groups. The row "Total" gives the differential in health scores (in standard deviations) between each group due to each measure. This is decomposed into the sum of the parameter effect (the first row), the endowment effect (the second row) and the interaction effect (the third row).

The first four rows show the decomposition for the difference between the poor and vulnerable groups. The last of these rows indicates that insecurity lowers the mental health of the poor relative to the vulnerable by about 2.5% of a single standard deviation, relative to the overall SF-36 mental health distribution. Assessing the relative impacts we see (by averaging across the four measures) that the contribution of the parameters to this effect is very small, around 7% the size of the endowments. This result confirms that poor people are not much more sensitive to risk than the vulnerable, and therefore the health gap is driven almost entirely by differences in exposure. The findings are similar for the comparisons between the poor and safe groups, and the vulnerable and safe. The total explainable mental health gap is largest between the poor and safe groups and is around 4.7% of a standard deviation in size. In this instance the effect of the parameters is only 2% of the size of the endowment effect. Similarly for the shortfall occurring between the vulnerable and safe groups, the endowment effect explains the entire health gap.

For physical health the results are quite different. Even though the health gaps are small in each case (normally around 0.5% of a standard deviation for each comparison) the relative effects of endowments and parameters are approximately equal. Again averaging across the subgroups we see that for the poor-vulnerable and poor-safe comparisons, the parameters are about 98% and 101% the size of the endowments, while for the vulnerable-safe comparison the parameter effect is about 70% of the endowment effect. Consequently it appears that an increasing income lowers an individual's risk exposure and their physical health sensitivity to risk by around the same amount.

5. Conclusion

This paper has examined the interacting effects of income and economic risk upon mental and physical health. Summarizing results obtained over four different measures of economic risk or distress; we find that an individual's mental health score is affected by exposure to economic hazards at all levels of the income distribution. Indeed there is little evidence that this effect size changes at all, and hence we conclude that there is nothing particularly special about poverty or vulnerability in this context. Conversely, the physical health impacts of risk exposure do appear to diminish with income, however it is only the top 20% of the Australian distribution (persons with household disposable incomes over $65,000 per year) that are protected. Again there is little evidence of any form of structural change around the poverty line, and individuals who are neither poor nor vulnerable to poverty are likely to be affected.

While our set of economic risks lower the health of all individuals in a fairly uniform manner, this does not imply that economic insecurity is equally problematic for everyone. People at the low end of the income distribution experience much higher levels of exposure and hence their health impacts are much greater. Our results suggest that at current levels, economic risks lower a poor individual's SF-36 health attainments by a few percentage points of a standard deviation, relative to those currently safe from poverty. For mental health these differences are almost entirely due to the increased level of risk, while for physical health both an increased degree of sensitivity and a higher degree of exposure equally explain the shortfall for poor people.

Relative to other determinants of stress such as the death of a relative or separation from a spouse, the effects of our economic risks appear to be quite small. However we must also bear in mind that these highly stressful life events only occasionally. Conversely economic risks can easily affect a large fraction of the population, and may continue over many years with accumulating impacts on physical and mental health. It is therefore likely that exposure to economic risk has non-trivial health impacts for a large proportion of Australians, and not just those that are poor or close to the poverty line.

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Appendix A1: Data Description

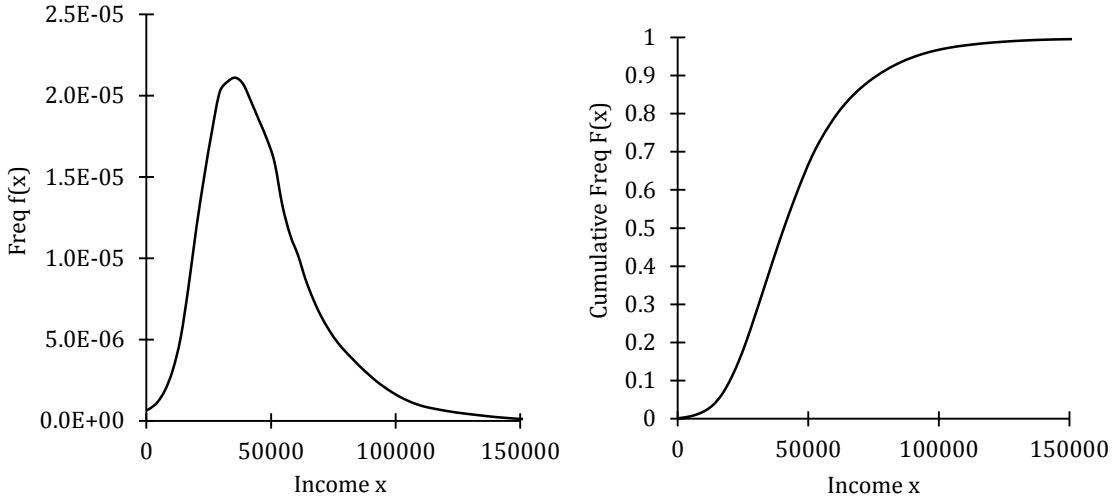
Table 3. Descriptive Statistics – All Variables

Variable	Obs	Waves	Mean	Standard Dev	Range
SF-36 Mental Health	61,952	1-11	75.897	15.496	0-100
SF-36 Physical Health	61,952	1-11	89.553	16.432	0-100
Job insecurity	61,952	1-11	5.051	1.664	1-7
Probability job loss	55,569	1-11	0.025	.0213	0-1
Inadequate emergency funds	61,952	1-11	1.548	0.882	1-4
Sought financial help	56,269	1-9, 11	0 .117	0.322	0-1
Age	61,952	1-11	42.56	10.24	25-65
Education	61,952	1-11	13.66	2.194	10-18
Income	61,952	1-11	48,605	29,183	0-507835
HH size	61,952	1-11	3.000	1.374	1-13
Population density	61,952	1-11	0.507	0.780	0-4
Married	61,952	1-11	0.614	0.487	0-1
L12 Separation	55,569	2-11	0.037	0.189	0-1
L12 Pregnancy	55,569	2-11	0.060	0.238	0-1
L12 Birth	55,569	2-11	0.038	0.190	0-1
L12 Death SC	55,569	2-11	0.004	0.064	0-1
L12 Death RF	55,569	2-11	0.107	0.309	0-1
L12 Violence	55,569	2-11	0.082	0.274	0-1
L12 Marriage	55,569	2-11	0.011	0.104	0-1
L12 Retire	55,569	2-11	0.030	0.172	0-1

Note: All health scores and insecurity scores are reported unstandardized. Observation counts refer to totals over all 11 years. Means of categorical variables refer to the proportion of sample with the defined characteristics

Appendix A2: The Australian Income Distribution

Figure 4. The Distribution of Pooled Real Disposable Household Income: 2001-2011



Note: The left panels shows the Probability Density Function (PDF) for income while the right panel shows the Cumulative Frequency Distribution (CDF). The horizontal axis gives household income taken after taxes and transfers, and standardized by the square root of the household size. Values are in 2011 Australian dollars. Models are fitted using a two-stage adaptive kernel density estimator and Gaussian kernels.