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IS IT VULNERABILITY OR ECONOMIC INSECURITY THAT MATTERS FOR HEALTH?

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Abstract

This paper contrasts the mental and physical health impacts of vulnerability and economic insecurity. Vulnerability refers to exposure to economic risks for individuals just above the poverty line, while insecurity relates to risk exposure at any point in 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 series of polynomial interactions to allow the effect sizes to vary non-linearly with income. Baseline estimates show that economic risks have consistently negative consequences for both mental and physical health, with the former effect being around three times the size of the latter. However our main finding is that increasing incomes do little to mitigate the sensitivity of health to these risks. Nonetheless poorer people still face larger health costs than richer people due to greater degrees of exposure. Combining these estimates reveals that differentials in economic risk over the income distribution are quantitatively meaningful and explain about 10% of the income-health gradient.

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

JEL Classification: D69, I19, I31

1 Introduction

Since the late 1990s, social scientists have become increasingly aware that economic risks can be damaging for an individual's health. It is well-known, for example, that insecure employment generates a range of negative outcomes (De Witte, 1999; Ferrie, 2001; Ferrie et al,. 1998; Sverke et al., 2002) while other hazards such as income instability and a lack of access to health insurance have been shown to be similarly harmful (Barnes and Smith, 2011; Finkelstein et al., 2011; Smith et al., 2009; Wilper et al., 2009). Although a number of plausible explanations for these results exist, it is generally hypothesized that the anxieties that individuals feel when contemplating their financial futures play a fundamental role. As these anxieties are widespread and often severe[1] it follows that economic risks can have serious epidemiological implications (Astell-Burt and Feng, 2013; Stuckler et al., 2009).

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[1]Survey data indicate that such worries rank amongst the most concerning for households. See for example research by Gallup (www.gallup.com) and the international General Society Survey (http://www3.norc.org/gss+website).

However despite a large volume of research, there are a number of important details concerning the relationship between risk exposure and health that remain poorly understood. The purpose of this paper is to shed light upon one of these details, namely the potential for an individual's ability to tolerate risk to be a function of their economic status. We test this idea by generating two contrasting hypotheses on the nexus between loss and wellbeing. The first hypothesis is that it is the fear of experiencing direct financial hardship (i.e. falling into poverty) that damages health. Such a relationship is plausible given the empirical literature and predicts that any negative health effects should diminish with income, as persons who are currently well-off will be less susceptible to destitution in the near future. Alternatively, it is possible that individuals are always affected by the prospect of losses, irrespective of their economic circumstances. This hypothesis suggests a markedly different relationship between income and health and predicts that an individual's sensitivity to risk should be independent of their current income level.

These two hypotheses represent established concepts within the economics literature. The former is known as vulnerability (Calvo and Dercon, 2005; Dercon, 2005; Dutta et al., 2011) and the latter as economic insecurity (Bossert and D'Ambrosio, 2013; Hacker, 2006; Hacker et al., 2011; Osberg, 1998). Despite important distinctions existing between these concepts, there are no works (to our knowledge) that explicitly contrast their health impacts and one must turn to more tangential literature to gauge the *a priori* plausibilities of each. Vulnerability is consistent with neoclassical models of utility and presuppose that it is the *level* of an economic outcome that determines wellbeing. If risk affects health by making individuals feel vulnerable then fear of absolute deprivation is the key mechanism, where outcomes are assessed against discrete thresholds (i.e. poverty lines) below which welfare will be severely compromised. Such thresholds clearly exist with respect to basic needs such as food, clothing and shelter, and therefore vulnerability is the dominant welfare concept in developing countries where absolute shortfalls are common. However vulnerability may also be relevant for developed countries if a certain level of status is required for individuals to satisfy behavioral norms and participate fully in society (Saunders, 2003).

Alternatively if economic insecurity affects health, this implies that all people can be susceptible and that various relative effects are likely to be important. For instance if an individual habituates to a certain standard of living then losses may be equally severe at all income levels. This idea is at the heart of Prospect Theory (Kahneman and Tversky, 1979) which states that uncertain outcomes are measured relative to a subjective status quo rather than their absolute levels, and that it is the potential for *deviations* from this baseline that matter. Empirical evidence for habituation and other relative effects can be variously found in Van Praag and Frijters (1999), Di Tella et al. (2007), Kimball and Willis (2006) and Clark et al. (2008) while there is an abundance of experimental data that confirm predictions from Prospect Theory in laboratory settings (Barberis, 2013).

Since theoretical arguments can be made in favor of both vulnerability and economic insecurity affecting health, there is considerable ambiguity about which concept is the more relevant. Answering this question has important implications for the formulation of policy as the two concepts mirror contrasting ideals for social insurance programs. If it is only vulnerability to poverty that is damaging, then social assistance should be set at a flat rate and be targeted exclusively at poorer individuals, as in Beveridgean welfare systems. However if everyone is susceptible to risk, then policy makers may prefer to make social assistance a function of prior economic status. Such a policy would maintain continuity of living standards and social position as per the tradition of Bismark. Since both Beveridgean and Bismarckian systems compete for dominance in developed countries (Cremer and Pestiau, 2003), establishing which most effectively protects against economic risks addresses a fundamental question in the construction of social safety nets.

The paper is structured as follows. In Section 2 we introduce the data used to test our hypotheses and define a number of different measures of risk. Section 3 presents our models and provides estimates of the health effects of each risk as a non-linear function of the income level. Section 4 uses Oaxaca-Blinder type decomposition methods to assess the relative importances of sensitivities and levels of exposure to risk in differing income groups, while Section 5 considers the the effects of economic risk on the income-health gradient. Lastly Section 6 offers some concluding comments and discusses the policy implications of our results.

2 Data

Data for the study come from the HILDA (Household Income and Labour Dynamics in Australia) survey, which is a high quality panel data set comparable to the US based Panel Study of Income Dynamics (PSID) or the 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 annually since 2001.

Our analysis employs two measures of health. As mental outcomes are likely to be particularly responsive to risk perceptions this is our main variable of interest, however due to potential flow-on effects we also include physical outcomes as a secondary health concept. Both variables are measured using the SF-36 survey which is an extensively validated (e.g. Ware, 2000) and widely employed generic health assessment tool. The questionnaire asks 36 questions measuring vitality, physical functioning, body pain, health perceptions, physical, emotional, social and mental functioning, and aggregates the responses into subscales ranging from 0 to 100 where higher scores indicate better outcomes.

To quantify individual-level risk we develop a basket of four conceptually diverse indices designed to capture differing forms of economic threats. Such an approach is important as (i) risk is a multifaceted phenomena which cannot be simply represented with a single index (such as one capturing only income losses), and (ii) it is possible that different types of risk could impact upon health in contrasting ways. Our first two measures are objective (i.e. statistical) estimates of important hazards obtained using probit models. The first is the estimated probability of household income declining by 50% or more one year in the future, and is thus a latent form of Hacker's (2006) downside-volatility measure. The second index also captures a latent forward-looking risk, this time of the probability of job loss in the coming year. As most households depend on their labour market income to meet household expenses, such labor market hazards are important determinants of financial stability (Greenhalgh and Rosenblatt, 1984; Sverke et al., 2006).

In addition to these objective indices we also employ two subjective measures of risk exposure. Subjective measures possess some advantages over objective indices in that they capture unobservable but subjectively important phenomena such as preferences, tolerance levels and the presence of mitigating factors, although they are also disadvantaged in having no natural units of measurement. The first subjective variable asks for a level of agreement (on a seven point scale) with the statement "I have a secure future in my job". After inverting, the variable forms a subjective analogue to the objective probability of job loss given above, and hence allows for comparisons between the effects of perceived risks and actual risks. The second subjective measure is a four point self-assessment on the ease with which emergency funds may be raised at short notice. While this does not constitute a direct risk *per se*, the variable still predicts future financial distress as it quantifies an inability to handle an economic hazard should it occur. Such a measure is important as it does not impose the form with which this hazard takes and therefore captures anxieties associated with any potential economic pitfalls.

Lastly we also take a standard set of variables that may control for external sources of variation in health. These include 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 the log of real household post-government income throughout (in 2001 Australian dollars) and standardize 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, relatives and friends) within the last 12 months. Finally it is noted that as our methodology will only exploit longitudinal variations in our data, all time-invariant characteristics such as gender, race and fixed personality characteristics will be automatically incorporated.

3 Methods

Once the data are obtained the annual waves are merged to form a panel consisting of $i \in [1, ..., N]$ individuals observed over time periods $t \in [1, ..., T]$. Let $M_{it} \in \{0, 1, ..., 100\}$ and $P_{it} \in \{0, 1, ..., 100\}$ denote the mental and physical summary scores from the SF-36 survey, while the risk indices are denoted $IL_{it} \in [01]$, $JL_{it}[0, 1]$ $JI \in \{0, 1, ..., 7\}$ and $EM \in \{0, 1, ..., 4\}$ for the *income loss*, *job loss*, *job insecurity* and *inadequate emergency funds* measures respectively. Since the indices are distributed differently with contrasting units of measurement we retain consistency by using the following z transformations throughout

$$H_{it}^* = \frac{H_{it} - \bar{H}}{\sigma_H} \qquad\qquad R_{it}^* = \frac{R_{it} - \bar{R}}{\sigma_R} \qquad\qquad (1)$$

where H^* and R^* refer generically to the transformed health and risk measures. This gives all variables means of zero and variances of one such that standard-deviations-from-means interpretations can be employed.

The first objective of the paper is to estimate the effect of R_{it}^* on H_{it}^* while allowing for non-linear interactions with income level x. By doing so we are able to ascertain the degree to which incomes protect against the negative impacts of each risk, and hence contrast the concepts of vulnerability and insecurity. If risks are only detrimental for individuals below or close to the poverty line this would indicate that it is the threat of absolute deprivation that is corrosive for health. Conversely if there is no structural change in this relationship then high income individuals who are in no danger of absolute deprivation would still be negatively affected.

To contrast these two hypotheses we estimate Fixed Effects regression models using the data outlined above. The choice of model is driven by a desire to remove unobservable time-invariant heterogeneity which makes our estimates much more representative of causal impacts than empirical associations. The specification is

$$H_{it}^* = X_{it}^{'}\beta + \sum_{j=0}^{k} \gamma_j R_{it}^* \times x_{it}^j + \alpha_i + \varepsilon_{it} \qquad\qquad (2)$$

where X_{it} is a $q \times 1$ vector of controls, β is a $q \times 1$ vector parameters, α_i is the individual-specific effect and ε_{it} is an i.i.d error. Income is denoted x_{it} while $\gamma_0, ..., \gamma_k$ are scalars. The rationale for this specification is that it allows the marginal effect of R_{it}^* to vary via the polynomial in x. While this is a fully parametric estimator, it mimics semiparametric methods in that the marginal effect can take on a wide variety of forms including increasing, decreasing, concave, convex, and non-monotonic with up to $k - 1$ turning points. Such a flexible approach is required to detect any sharp changes in sensitivities to risk that may occur at a given income level. The choice of polynomial order k is critical to the performance of the model. If $k = 0$ then a constant effect size of γ_0 is implied whereas if $k = 1$ then the marginal effect varies linearly with x. Greater values give additional flexibility, which must be offset against the possibility of overfitting. 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, we err on the side of caution by using a fairly large value of $k = 3$ throughout. This provides surplus parameters for most but not all models. Nonetheless given that each $\gamma_j \times x_{it}^j$ term 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 bootstrap confidence intervals to establish significance.

Estimations

The model specified in Eq (2) is estimated using both mental and physical outcomes as the dependent variable and each risk measure on the RHS. Parameters are obtained using OLS with cluster/heteroskedasticity robust standard errors.[2] Our general specifications employ a full set of covariates, however as a test for robustness we also estimate a second set of models excluding the life event dummies, and note a general similarity between the findings. Full results are omitted for the sake of brevity although they are available from the

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[2]Clusters are defined by individual and hence account for correlation between ε_{it} and ε_{it-1}.

authors upon request. In each case some informal diagnostics were performed by examining the signs and significance of the estimated coefficients. In general these conform to expectations across all models and thus no immediate signs of misspecification were present.

The influence of each risk measure upon health is examined using the marginal effect (denoted $\phi(x)$), which is obtained by differentiating Eq (2) with respect to R^*_{it}

$$\phi(x) = \sum_{j=0}^{k} \gamma_j \times x_{it}^j \qquad j = 0, ..., k \qquad (3)$$

The estimated functions $\hat{\phi}(x)$ are plotted in Figures 1 and 2 for each measure below based on coefficients $\hat{\gamma}_0, ..., \hat{\gamma}_k$. To conduct inference we use clustered bootstrap standard errors which are determined as follows:

1. Resampling with replacement is undertaken from clusters $i \in [1, ..., n]$. This retains the covariance between X_i, x_i and R^*_i without needing it to be explicitly imposed. These bootstrap samples are labeled $b = 1, 2, \ldots, B$.

2. Parameters β^* and γ^* are estimated for pseudo-samples $b = 1, 2, \ldots, B$.

3. The marginal effects $\hat{\phi}^*(x; \hat{\gamma}^*)$ are calculated from (2) over a grid of values for x.

4. The confidence interval is then $\hat{\phi}(x; \hat{\gamma}) \pm 2 \times \sigma_{\phi^*}$.

The solid lines in Figure 1 show the estimated relationships for mental health while the dashed lines give the confidence intervals. Income is on the horizontal axes up to a value of \$100,000 per year, a figure which covers approximately 98% of the sample. Values below a poverty line of \$18,358 – set equal to half the median real income for the pooled sample are shown in grey. For interpretation it is emphasized that the average income over all individuals throughout the period is \$40,726.

Figure 1: Impacts of Economic Risk Measures on Mental Health over Income
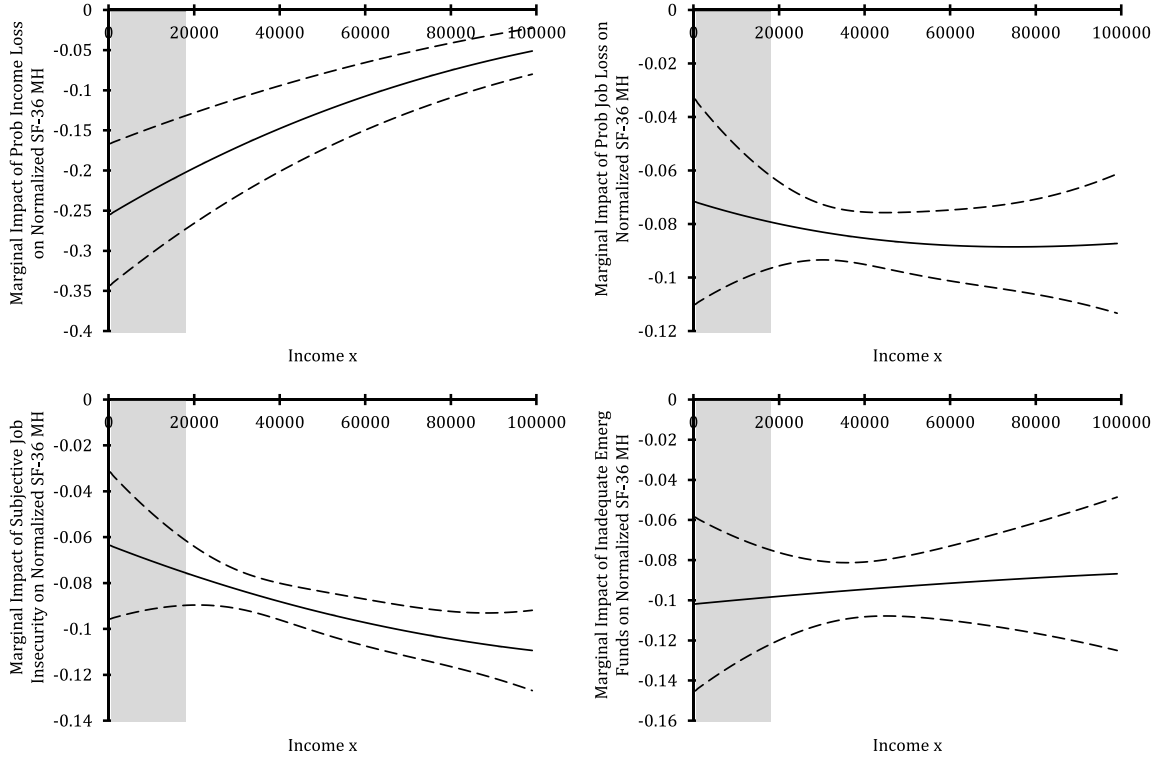
Note: The vertical axes show the impact of the risk measure on mental health and the horizontal axes show the change in effect size over income. In each plot the poverty lines are highlighted in grey. The top left panel gives the effect of the probability of a 50% loss in income, the top right panel the effect of the latent probability of job loss, the bottom left shows self assessed job insecurity and the bottom right the subjective ability to raise emergency funds. Confidence intervals based on ±2 standard errors are depicted with dashed lines and are obtained with cluster bootstraps.

The top left panel presents the impact of the normalized index gauging the probability of a 50% income loss in the coming year. Subject to our assumptions of exogeneity, a standard deviation increase in this measure lowers an individual's mental health score by around 0.2 standard deviations if they are currently at the poverty line, and by around 0.15 if they are at the sample mean. Higher income individuals have lower sensitivities again, although the effect is significant at all income levels. This declining sensitivity is expected if losses at the low end of the income distribution result in absolute deprivation, and therefore the result favors the idea that vulnerability is more relevant than economic insecurity. Nonetheless as all individuals have some sensitivity, and as even large losses for persons with incomes of $100,000 per year are unlikely to translate directly into poverty, it appears as if there are limits to the the degree to which income may serve as a buffer in providing protection against this particular risk.

Furthermore the notion that the mental health effects of risk exposure are buffered by a high income incomes does not persist when other hazards are considered. The top right panel shows sensitivities to the probability of job loss index one year into the future. While individuals are much less sensitive to this risk there are still significant mental health impacts over the entire depicted income range. Indeed there is no sign of this marginal effect tapering off as incomes rise, and the standard error bars are wide enough to imply that sampling errors can account for the small trend that is present. Similarly the two subjective indices also show no evidence of a buffering effect. For perceived job insecurity there is a comparable trend to the objective measure with the point estimates implying that high income individuals may be fractionally more sensitive, however the confidence intervals again suggest that the degree of change is unlikely to be significant. Lastly the bottom right panel shows that a perceived lack of emergency funds also harms mental health in a

significant and uniform manner. A standard deviation shock to this variable lowers mental health by about 0.09 standard deviations at all income levels, and therefore higher incomes again provide no extra protection.

In order to draw stylized conclusions on the relationship between economic risk and health we look for a consensus between the results presented in Figure 1. Considering all four plots simultaneously, we observe unambiguous evidence that economic risks are harmful for mental health, but see little to suggest the marginal health effects vary substantially with income. Based upon these findings we conclude that mental health is sensitive to economic threats at all income levels, and there is no indication of rapid structural change (implying threshold effects) anywhere around the poverty line. Since increasing incomes fail to mitigate the effects of three out of four of our economic risks, and provide an imperfect insulating effect for the other, we conclude that all individuals are potentially affected and therefore economic insecurity is the more appropriate welfare concept for mental health in Australia.

Analogous results for transformed SF-36 physical functioning scores are given in Figure 2. Again, point estimates of the influence of income risk in the top left panel show a negative and significant marginal effect for all individuals which declines monotonically as incomes increase. A similar pattern can also be seen for the objective and subjective measures of job insecurity, which have significant impacts upon physical health only for individuals with annual incomes less than around $50,000, and converge to zero as incomes approach $100,000. Finally the same is true for the subjectively inadequate emergency funds index, which also declines in magnitude (at least at low levels) and only impacts significantly for incomes below around $40,000. Given that our risks tend to only have significant effects for lower and middle income Australians this result suggests that high incomes provide a great deal of protection for physical health. However there is some uncertainty about this claim as the results are not entirely due to changes in the estimated effect sizes, but are also attributable to the broad confidence intervals that surround each estimate. Thus while there does appear to be a decreasing sensitivity to risk for all four measures, they are (at least in isolation) also consistent with constant effect sizes, which would appear as horizontal lines accommodated between the error bars. Since there is some ambiguity about which interpretation is correct we suggest that a compromise position is the most likely, that income does provide some protection for physical health but the magnitude is small enough to be difficult to identify precisely with econometric models.

Figure 2: Impacts of Economic Risk Measures on Physical Health over Income
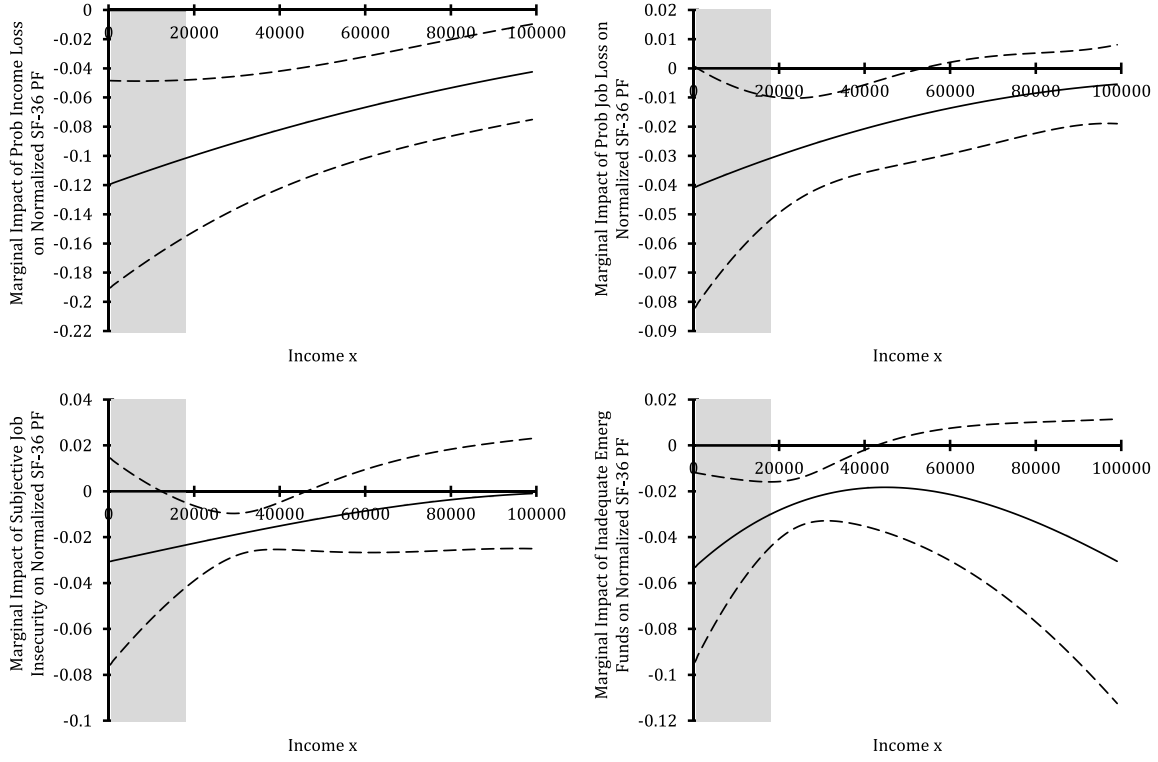
Note: The vertical axes show the impact of the risk measure on physical health and the horizontal axes show the change in effect size over income. In each plot the poverty lines are highlighted in grey. The top left panel gives the effect of the probability of a 50% loss in income, the top right panel the effect of the latent probability of job loss, the bottom left shows self assessed job insecurity and the bottom right the subjective ability to raise emergency funds. Confidence intervals based on ±2 standard errors are depicted with dashed lines and are obtained with cluster bootstraps.

Given that the results from Figure 1 indicate that higher incomes offer no protection for mental health outcomes, but Figure 2 gives qualified support for a buffering effect for physical health, it is desirable to examine why these results differ. Although there are a number of potential explanations, there is a substantial body of evidence that suggests that the transmission mechanism between mental and physical outcomes is at the core of this effect. In particular it is well-known that lower and higher income individuals have differing methods of diffusing stress which will produce varying effects on physical wellbeing. Poorer individuals are more disposed to over eating (McLaren, 2007), smoking (Haustein, 2006) and are more likely to abuse alcohol (Mossakowski, 2008). Therefore if high levels of anxiety prompts such behavioral responses the physical ill-effects will be disproportionately greater for lower income persons. Alternatively a second potential explanation stems from the fact that higher incomes typically allow a greater level of access to healthcare. As most healthcare spending in Australia focuses on physical problems (Australian Institute of Health and Welfare, 2013) and mental disorders often go untreated (Kohn et al., 2004), higher incomes (and correspondingly better medical care) can be expected to impact more strongly upon physical rather than mental health.

4 The Health Consequences of Poverty and Vulnerability Relative to Economic Safety

The results presented in Figures 1 and 2 show the sensitivities of health to various forms of economic risks, however they constitute only half the story when aggregate health burdens are to be modeled. As individuals face these risks to differing degrees, it is important to account for the rates of exposure, as well as the sensitivities when appraising their overall impacts. To illustrate the changing nature of economic risk over the income distribution, Figure 3 presents kernel regressions of each standardized measure against income. In general the results conform to findings reported in other works (e.g. Hacker et al., 2011; Rohde et al., 2014, Western et al., 2012) where lower income individuals face higher burdens, although this does not hold in all cases as our income loss measure is disproportionately concentrated amongst richer individuals.[3]

Figure 3: Risk Exposure Over The Income Distribution
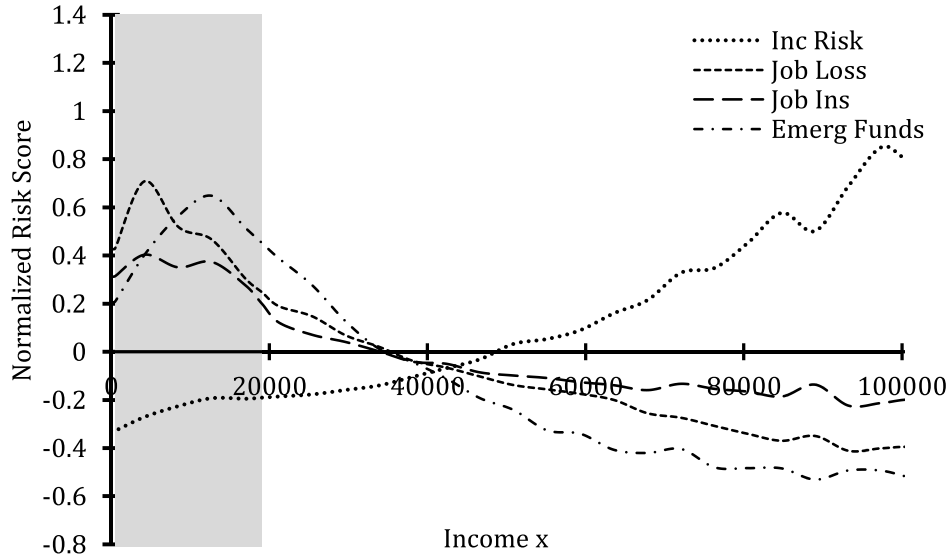
Note: The vertical axis gives the risk measure in standard deviations from the sample mean. The horizontal axis depicts income, while the grey section signifies incomes below the poverty line. All regression lines are obtained using fixed bandwidth Gaussian kernels.

In order to model the total health consequences of each measure it would be possible to multiply the marginal effects shown in Figures 1 and 2 with the rates of exposure in Figure 3. This is the approach pursued here, however we employ some discrete averages rather than the continuous method depicted due to some desirable decomposition properties of the latter. To begin individuals are divided into three mutually exclusive and collectively exhaustive subgroups: poor (incomes below $18,358 - 8.6% of the population), vulnerable (from $18,358 to $31,893 - 38% of the population) and (at least temporarily) safe from poverty (above $31,893 - 53.4% of the population). The value of $31,893 is calculated as the poverty line plus a standard deviation shock (based upon longitudinal variation) where it is assumed that persons beyond this point have negligible risk of absolute material deprivation in the immediate future. Once the discrete groups are established we estimate the same models presented in Tables 1 and 2 using dummy variables to estimate a health impact for each measure over each group. The coefficient estimates are presented in Table 1 alongside the subgroup averages of the risk scores.

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[3]Such as a result is expected for income as Australia has a Bismark style social welfare system that insures against losses only at the low end of the income distribution, leaving high income individuals more susceptible to this risk.

Table 1: Health Sensitivities to Economic Risk – Income Groups

	Group	Mental Health				Physical Health			
		Inc Loss	Job Loss	Job Insec	Em Funds	Inc Loss	Job Loss	Job Insec	Em Funds
Sensitivities	Poor	-0.146***	-0.087	-0.066*	-0.097	0.003	-0.030	-0.021	-0.036
	Vuln	-0.052**	-0.080	-0.083	-0.098	0.004	-0.026	-0.020	-0.015
	Safe	-0.012*	-0.078***	-0.092***	-0.094***	0.015	-0.019**	-0.014**	-0.028**
Exposures	Poor	-0.022	0.041	0.029	0.046	-0.022	0.041	0.029	0.046
	Vuln	-0.062	0.042	0.022	0.076	-0.062	0.042	0.022	0.076
	Safe	0.085	-0.084	-0.051	-0.123	0.085	-0.084	-0.051	-0.123

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 in the third row indicate significant differences from zero while tests in the first two rows indicate differences relative to this baseline. The final three rows give the averaged risk scores for the same three groups.

Results in Table 1 broadly reflect the marginal effects shown in Figures 1 and 2. There are negative and significant marginal effects associated with most risk measures and little evidence of structural change over the income subgroups, while the average exposure levels are in line with those depicted in Figure 3. Multiplying the averaged risk exposures for each group with the estimated coefficients give the aggregate health differences relative to the population as a whole. These differences are then separated using an Oaxaca-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). If r and c denote reference and comparison groups (such as the poor and vulnerable) the below expression is used

$$\hat{\beta}^c \bar{R}^c - \hat{\beta}^r \bar{R}^r = \left(\hat{\beta}^c - \hat{\beta}^r \right) \bar{R}^r + \left(\bar{R}^c - \bar{R}^r \right) \hat{\beta}^r + \left(\hat{\beta}^c - \hat{\beta}^r \right) \times \left(\bar{R}^c - \bar{R}^r \right) \tag{4}$$

where $\hat{\beta}^r$ and $\hat{\beta}^c$ are the estimated slope coefficients on the risk measures for the two subgroups and $\bar{R}^r$ and $\bar{R}^c$ 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 P indicates poverty, V is vulnerability and S denotes the safe group) with the poorer subgroup used as the baseline in each instance. Results are reported in Table 2.

Table 2: Oaxaca-Blinder Decompositions of Health Shortfalls

	Subgroups	Mental Health				Physical Health			
		Inc Loss	Job Loss	Job Insec	Em Funds	Inc Loss	Job Loss	Job Insec	Em Funds
V-P	Parameters	-2.1E-03	-8.7E-05	-5.0E-04	-4.5E-05	2.3E-04	1.5E-04	5.0E-05	9.5E-04
	Endowments	5.8E-03	-7.8E-05	4.6E-04	-2.9E-03	-5.9E-04	-3.0E-05	-2.1E-05	-1.1E-03
	Interactions	-3.8E-03	-2.1E-06	1.2E-04	-3.0E-05	4.1E-04	3.7E-06	1.2E-06	6.2E-04
	Total	1.2E-05	-1.7E-04	8.2E-05	-3.0E-03	4.8E-05	1.3E-04	3.0E-05	4.9E-04
S-P	Parameters	-3.0E-03	-3.5E-04	-7.5E-04	1.5E-04	2.6E-04	4.6E-04	3.0E-04	3.7E-04
	Endowments	-1.6E-02	9.8E-03	5.3E-03	1.6E-02	1.6E-03	3.8E-03	2.6E-03	6.1E-03
	Interactions	1.4E-02	1.1E-03	2.1E-03	-5.5E-04	-1.3E-03	-1.4E-03	-9.1E-04	-1.4E-03
	Total	-4.2E-03	1.1E-02	6.6E-03	1.6E-02	5.8E-04	2.8E-03	2.0E-03	5.1E-03
S-V	Parameters	-2.5E-03	-2.7E-04	-1.9E-04	3.2E-04	9.4E-05	3.1E-04	2.6E-04	-9.7E-04
	Endowments	-7.7E-03	1.0E-02	6.1E-03	2.0E-02	6.6E-04	3.3E-03	2.5E-03	3.1E-03
	Interactions	6.0E-03	8.0E-04	6.3E-04	-8.4E-04	-2.2E-04	-9.3E-04	-7.7E-04	2.5E-03
	Total	-4.2E-03	1.1E-02	6.5E-03	1.9E-02	5.3E-04	2.7E-03	2.0E-03	4.6E-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 of Table 2 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 from 0% to 0.3% of a standard deviation, depending upon the measure chosen. Assessing the relative impacts we see that in each case the contribution of the parameters is very close to zero, implying that virtually the entire shortfall in health outcomes is explained by either differentials in exposure or interaction effects. 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 when comparing the poor and safe groups and ranges between -0.04% (for the income loss index) and 0.06-1.6% for the other measures, while the shortfall occurring between the vulnerable and safe groups ranges from -0.4 to 1.9%. Again the endowments account for almost the entire health gap across each of measures. For physical health the health gaps are smaller (normally from 0 to 0.3% of a standard deviation for each comparison) and there is a certain amount of volatility across the indices. Nonetheless there is evidence of the parameters playing a meaningful role in explaining these differences, typically accounting for around 10-15% of the combined effect. Consequently it appears that an increasing income lowers an individual's sensitivity to risk as well as their level of exposure, although the reduction in exposure still explains the majority of the health shortfalls.

5   How Do Economic Risks Affect the Income-Health Gradient?

Given that our basket of economic risks have varying impacts upon health over the income distribution, it is of interest to model their aggregate effects on income-related health inequality. Since most risks are more prevalent for low income individuals we would expect they would act to increase differentials in health between the rich and poor. In this section we investigate this phenomena using the income gradient, which is simply the (typically positive) empirical relationship between a health measure and income over a cross section of the population. Our approach contrasts the observed gradient in health scores with counterfactual gradients obtained by removing the impacts of each economic risk. Thus we will compare the normalized SF-36 outcome H_{it}^* and the simulated score $\tilde{H}_{it}^* = X_{it}^{'}\beta + \alpha_i + \varepsilon_{it}$ where the latter is the predicted outcome for individual i in time t assuming $R_{it}^* = 0$, plus the error terms $\alpha_i + \varepsilon_{it}$.[4] Models $H_{it}^* = \phi_0^* + \phi_1^* x + \varepsilon$ and $\tilde{H}_{it}^* = \tilde{\phi}_0 + \tilde{\phi}_1 x + \varepsilon$ are then estimated using OLS based upon the pooled sample, where parameters ϕ_1^* and $\tilde{\phi}_1$ refer to the observed and simulated gradients.

Table 3: The Effect of Economic Risk Upon Health Gradients

	Mental Health				Physical Health			
	Inc Loss	Job Loss	Job Insec	Em Funds	Inc Loss	Job Loss	Job Insec	Em Funds
ϕ_1^*	3.31E-06	3.31E-06	3.31E-06	3.31E-06	2.35E-06	2.35E-06	2.35E-06	2.35E-06
$\tilde{\phi}_1$	4.12E-06	2.77E-06	3.00E-06	2.51E-06	2.49E-06	1.77E-06	1.96E-06	1.82E-06
$\phi_1^* - \tilde{\phi}_1$	-8.10E-07	5.40E-07	3.10E-07	8.00E-07	-1.40E-07	5.80E-07	3.90E-07	5.30E-07
$1 - \tilde{\phi}_1/\phi_1^*$	-0.24%	0.16%	0.09%	0.24%	-0.06%	0.25%	0.17%	0.23%

Note: The first row gives the true gradients in health outcomes for mental and physical health. The second row shows the gradients after normalizing out the economic risk measures and the third row provides the change that this normalization precipitates. The last row shows the percentage change and is interpreted as the proportion of income related health inequality that is offset by removing each risk.

Results from Table 3 show the income gradients for the real and simulated health measures. These are positive in all cases (implying that richer people enjoy better health outcomes) with stronger associations with income evident for mental health. By comparing the empirical and simulated parameters we can assess the differing impacts of economic risk on health over the income distribution. The leftmost columns for both health variables show that when income risk is removed from the equation, the gradients become steeper. This reinforces the point that when both sensitivities and risk exposures are considered, the overall health burden of the threat of income losses is disproportionately concentrated amongst richer individuals. Nonetheless

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[4]This approach employs the fixed effect α_i which requires a long panel for consistent estimation. At 11 waves it is assumed that our panel is sufficiently long to avoid biases in the estimation of this parameter.

the other risks can be seen to reverse this trend for both mental and physical health. In all other cases the gradients of the simulated outcomes are flatter than their observed counterparts, showing that these risks exacerbate income differentials in health. In order to obtain stylized facts about the overall effects of risk we again search for consistency across the measures. Since estimates that flatten the curve appear to dominate with an average reduction in the gradient of about 10% we use this value as a summary, suggesting that on average differentials in economic risk account for about this amount of income related health inequality. Although the result is dependent upon the way that risk is measured, such a stylized finding is useful in that as a general phenomena, economic risks do appear to be more damaging for poorer individuals and explain a meaningful proportion of health discrepancies. However the substantial degree of variation across measures indicates that there is a need to account for each risk separately when considering policy responses.

6 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 risk, we find that an individual's mental health score is affected by exposure to economic hazards at all levels of the income distribution. Indeed in most cases there is little evidence that the effect size changes at all, and hence we conclude that there is nothing particularly special about poverty or vulnerability in this context. Conversely, income does appear to offer some protection against adverse physical consequences although the magnitude is likely to be small and is difficult to discern from sampling variation.

As economic risks have negative implications for the health of all individuals, our results provide qualified support for the hypothesis that it is the prospect of loss, rather than deprivation that matters for health. Hence for a developed country such as Australia we conclude that economic insecurity rather than vulnerability is the more relevant welfare concept. Nonetheless this finding is nuanced, as (i) the results are dependent upon the type of risk considered, and (ii) it is not only the relative sensitivities to risk that are important but also the rates of exposure. As most economic risks are more prevalent at low income levels there are larger aggregate health shortfalls at this end of the distribution. These shortfalls are large enough to be meaningful and typically account for around 10% of the health differentials associated with income. As there is a greater need to protect poorer individuals from economic hazards, our results suggests Beveridgean social insurance systems that explicitly focus on preventing destitution in lower income individuals could still be an appropriate policy response. However due to substantial differences between the ways that risks are distributed with income it may be desirable to tailor the form of protection to the type of pitfall under consideration. Thus a policy mix that targets different hazards in different ways seems to be the best approach for combating the mental and physical health impacts of economic risks.

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