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ABSTRACT

World Commodity Prices, Job Security and Health: Evidence from the Mining Industry*

A lack of job security is an increasingly prevalent characteristic of modern labour markets, and there is evidence that recent financial crises have exacerbated this issue. In this paper, we assess how exogenous changes in the macroeconomic environment affect workers' perceived job security, and the impact of job security on measures of mental and physical health. To identify these effects, we exploit variation in world commodity prices over the period 2001–15, and analyse 15 waves of individual-level panel data that includes unusually detailed classifications of mining workers. We find that commodity price movements drive changes in perceived job security, which in turn significantly and substantively affects the mental health of workers. In contrast, we find no effects on physical health. Our results imply that the estimated welfare costs of recessions are substantially larger when the effects of job insecurity on the health of workers is considered.

JEL Classification: J11, J21, I31

Keywords: job security, health, macroeconomic conditions, panel data

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1. Introduction

The extent to which poor macroeconomic conditions affect one's physical health is still open to debate (Ruhm, 2015). However, numerous studies in recent years leave less doubt that recessions have harmful effects on mental health. Deleterious effects have been detected for self-reported symptoms of poor mental health (McInerney et al., 2013), mental health-related hospitalisations (Engelberg and Parsons, 2013), prescriptions for anti-anxiety and anti-depressant medications (Bradford and Lastrapes, 2014), searches on the Internet for 'depression' and 'anxiety' (Tefft, 2011), and suicide rates (Ruhm, 2000; Phillips and Nugent, 2014; Breuer, 2015). It also has been found that recessions reduce life satisfaction (Di Tella et al., 2003; Luechinger et al., 2010). These findings are complementary to studies that have shown that at the individual-level, losing your job adversely affects mental health and other measures of wellbeing (see, for example, Winkelmann and Winkelmann, 1998; Eliason and Storrie, 2009; Kassenboehmer and Haisken-DeNew, 2009; Sullivan and Von Wachter, 2009; Browning, 2012; Black et al., 2015).

But whose mental health suffers most during economic downturns? Changes in the macroeconomic environment have larger effects on mental health than can be explained by increased distress of the newly unemployed, or the reduced labour market opportunities of the long-term unemployed. One argument proposed in the literature is that economic downturns breed greater job insecurity among the much larger numbers of employed, and that this wider insecurity is the main driving force of the observed aggregate worsening in mental health (for example, Di Tella et al., 2003; Luechinger et al., 2010; Green, 2011; Caroli and Godard, 2016). In other words, individuals may care about increases in the unemployment rate, even when they themselves are not unemployed (Luechinger et al., 2010). As Di Tella et al. (2003) explain, "... an increase in joblessness can affect well-being through at least two channels. One is the direct effect: some people become unhappy because they lose their jobs. The second is that, perhaps because of fear, a rise in the unemployment rate may reduce well-being even among those who are in work or looking after the home." (p.814) Within a theory of social comparisons, Clark et al. (2010) similarly note that, "The social norm of unemployment suggests that aggregate unemployment reduces the well-being of the employed, but has a far smaller effect on the unemployed." In fact, it has been argued more broadly that the anticipation of a stressful event represents an equally important, and perhaps even greater, source of anxiety than the occurrence of an actual event (Lazarus and Folkman, 1984; Burgard et al., 2009).[1]

These arguments and findings are important, because they imply that the welfare costs of economic downturns might be substantially larger if the effects of job insecurity on the health of workers are considered in addition to the impacts on the newly unemployed. However, while this is an appealing argument, to date there have been few studies that provide causal evidence on the extent to which job insecurity drives (rather than is correlated with) changes in mental and physical health. For a number of reasons, providing a causal estimate is difficult in this context (Reichert and Tauchmann, 2017). Firstly, individuals likely self-select into jobs that differ in their underlying security and long-term prospects. Researchers can readily control for observable characteristics that partly determine such selection. But characteristics and preferences, such as time discount rate and the level of risk aversion, and cognitive and non-cognitive skills, are only partly measured in surveys. Moreover, individuals are likely to select into jobs that differ in their security, based on their current (or expected) mental and physical health. Secondly, there is the potential for reverse causality: health shocks, which can reduce productivity, may also increase workers' fears that they will be fired or made redundant. Thirdly, there is the distinct possibility of measurement error in workers' reports of their job security, as well as in their self-reported health.

To overcome these identification challenges, one must find a source of exogenous variation in job security: in particular, an exogenous shock to job security that impacts certain workers and not others, or the same worker at different times. It is also important that workers not be able to foresee this shock, and thus adjust their economic decision-making in advance. Few studies have been able to overcome these identification challenges.[2] Recent attempts include Caroli and Godard (2016), who

[1] There is some evidence that job insecurity can impact the mental health of family members (Carlson, 2015; Bünnings et al., 2017). Increased job insecurity also has been found to cause households to increase savings (Carroll et al., 2003) and to reduce or defer consumption (Benito, 2006).

[2] We note that there is a substantive literature in psychology and public health that has focused on the link between job insecurity and health (see De Witte, 1999; Sverke et al., 2002; Virtanen et al., 2013; Fiori et al., 2016), and a number of studies have used panel data to better address this relationship (see De Witte et al., 2016). The results from these studies are mixed, but tend to find that there is a significant association between job insecurity and poorer health outcomes, with the strength of the relationship being greater for mental than physical health. While the use of longitudinal data improves temporal identification, this literature has not tended to use exogenous variation in job security to identify causal health effects. One of the most highly cited papers is Ferrie et al. (2002), who analysed prospective cohort data from the Whitehall II study. The study found that a loss of job security for white-collar workers in the British Civil Service was associated with worse self-reported health and increased psychiatric morbidity. Interestingly, these adverse effects did not fully disappear when the threat of job loss was removed.

fit a model of individual-level health outcomes using European data: perceived job security is instrumented by country-specific employment protection legislation interacted with industry-specific dismissal rates. Their surprising conclusions are that job insecurity significantly increases the probability of individuals suffering from skin problems and headaches or eyestrain, but does not affect depression or anxiety. Reichert and Tauchmann (2017) estimate the effects of company-level workforce reductions on private sector workers in Germany. Results from their individual-level fixed-effects models suggest that the fear of job loss, measured by workforce reductions, negatively affects employee psychological health and job security. Finally, Bratberg and Monstad (2015) exploit a natural experiment in which some Norwegian municipalities were affected by a financial shock. They find that the financial shock reduced municipality workers' sickness absence, which they argue is the consequence of reduced job security. A limitation of this study is that it did not have any direct measures of job security, nor does it analyse the effect of the financial shock on mental health.[3]

In this paper, we aim to shed additional light on why changes in the macroeconomic environment have a major impact on health, by identifying the causal effect of economic conditions on feelings of job insecurity, and in turn mental health. We also test whether physical health is equally affected by job security. To do this, we employ a unique identification approach: using unusually detailed Australian data for the period 2001-15, we focus on a sample of individuals working in specific mining subindustries (e.g. iron ore, gold, coal), and explore how their perceived job insecurity varies with world commodity prices. While the mining sector in Australia only accounts for around 2% of the workforce, it is of prime importance for the economy, currently accounting for 8.5% of GDP, and half of total export earnings (Garnett, 2015).

Our main regression specification includes commodity fixed-effects and month-year fixed-effects, which implies that identification is driven by differential variation in commodity prices across time. During our sample period, there was substantial variation in commodity prices because of strong demand growth from China, India and other industrialising economies and the collapse in global economic

[3] A related set of studies demonstrates that employment protection causally affects sickness absenteeism (see, for example, Ichino and Riphahn, 2005; Olsson, 2009), with this relationship argued to be mediated by job security.

growth associated with the Global Financial Crisis. This price variation differentially shocked the profitability of different mining subindustries, affecting perceived demand for labour.[4] Our study thus has tight internal validity. The most similar study we are aware of is Goldberg et al. (1999), who estimate the effect of industry-specific export and import real exchange rates on employment stability in the US, as represented by individual-level job-changes and industry-switches. More recently, Kaiser and Siegenthaler (2016) analyse a sample of Swiss manufacturing firms estimating the effects of industry-specific exchange rates on employment, while Berman et al. (2017) exploit exogenous variation in world commodity prices to identify the impact of mining on conflicts in Africa.

2. Data

2.1. HILDA Survey Data

Data come from the Household, Income and Labour Dynamics in Australia (HILDA) survey. HILDA is an ongoing longitudinal study that began in 2001 with a nationally representative sample of 7,682 Australian households. We use all currently available waves (1 to 15) of the unconfidentialised version of HILDA, which contains detailed industry codes (4-digit Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006) of the respondents. We use these codes to identify our sample of individuals who work in different types of mines (e.g. gold, iron ore, coal) within the mining industry. Columns (1) and (2) of Appendix Table A provide the full list of mining subindustries and related ANZSIC 2006 codes.[5]

The sample in our main analysis is individuals who were employed in the mining industry at the time of a HILDA survey. The sample contains 1,578 person-year observations on 524 individuals in eight different mining subindustries. Most of these individuals work in coal mining (49.3%), followed by iron ore mining (14.5%), oil and gas extraction (12.2%), and gold ore mining (8.6%), as shown in column (3) of Appendix Table A. Figure 1 is a map of currently operating mines of all commodities within Australia; it shows that these mines are spread across all

[4] Green and Leeves (2013) and Rohde et al. (2016) also use Australian panel data to study the relationship between insecurity and mental health. While both papers contribute to the literature by applying individual fixed effects models, neither use exogenous variation in job insecurity to allow for causal identification.

[5] Several industry codes cannot be matched to commodity price data because the codes are not specific enough or because price information is not available. These codes are: metal ore mining; mineral sand mining; other metal ore mining; non-metallic mineral mining; and quarrying, gravel and sand quarrying, and other construction material mining. However, this excludes only a small number of observations, given that few individuals work in these industries.

Australian states. Nevertheless, Appendix Table B (Columns 1 and 2) shows that, compared to national averages, the mining workers in our sample are more likely to reside in Queensland (33.1% versus 21.4%) and Western Australia or Northern Territory (28.6% versus 9.9%), and in regional and remote areas (67.1% versus 34.6%). Clearly mining is a male-dominated industry (87.3%) compared to the average for all employees in Australia (49.7%). Mining workers are only on average half a year older (38.19 versus 37.57) than all employees, but are more likely to be married or cohabiting (74.1% versus 62.9%), and to have more young children (72.6% versus 53.8%). Also, a lower proportion of workers in the mining sector were born in non-English-speaking countries (3.5%), compared with all workers (10.1%). Given the nature of the industry, mining workers also are more likely to have had a vocational education (48.9% versus 31.0%), and correspondingly are less likely to have a university-level education (15.9% versus 27.9%). We discuss the external validity of our results in Section 6.

2.2. Measuring Job Security and Health

Perceived job security is a key variable for the analysis. We construct this variable based on individuals' responses to seven questions about their satisfaction with job security and employment opportunities, their perceived likelihood of losing and leaving job, and future job security. The full text of the questions can be found in Appendix C. Some of these questions are asked in a personal interview (Personal Questionnaire) conducted face-to-face with the majority of respondents in HILDA. The remaining questions are asked in a confidential paper questionnaire (Self-Completion Questionnaire). Columns (1) and (2) of Table 1 show the mean values of these variables for all employees in HILDA, and for mining workers, respectively. Mining workers report lower satisfaction with their job security (7.44 versus 7.96), even though their satisfaction with employment opportunities is higher (7.73 versus 7.43). They also think that there is a higher percentage chance of them losing their job in the next 12 months (14.92 versus 10.27) than all workers, and thus are more worried about the future of their jobs (3.26 versus 2.89). However, although higher, job insecurity in the mining industry is not dramatically greater than for the wider workforce, most workers in the mining industry feel reasonably secure in their jobs.

We use factor analysis to reduce the number of job security variables, which we perform using all available HILDA observations for employed individuals, not just for those employed in mining. As a result, only one factor has an eigenvalue greater than 1, which loads on all seven questions. The scoring coefficients on the individual job security questions are shown in Column (3) of Table 1. Satisfaction with job security and perceived secure future in one's job have the highest scoring coefficients. The expected likelihood of leaving your current job has the lowest scoring coefficient. The negative mean of the job security factor (-0.164) confirms that our mining sample on average feels less secure than the general working population (0.164 standard deviations lower).

We measure worker health using the SF-36 multi-attribute health instrument, which has been widely used in the economics literature (see, for example, Brazier et al., 2002; and Cornaglia et al., 2014). It consists of a series of questions about mental and physical wellbeing and functioning in eight domains: Vitality, Social-Functioning, Role-Emotional, Mental Health, Physical Functioning, Role-Physical, Bodily Pain, and General Health. Within each domain, the answers are scored and summed to produce an index. We perform a factor analysis on these indices; as expected, it produces two factors (with eigenvalues greater than 1). One factor primarily loads on psychological domains (Mental Health, Vitality, Social-Functioning, and Role-Emotional) and the other on physical domains (Physical Functioning, Role-Physical, Bodily Pain, and General Health). We refer to the first factor as 'Mental Health' and the second factor as 'Physical Health'.

2.3. Commodity Prices

We link the HILDA data to monthly worldwide commodity prices obtained from the International Monetary Fund (IMF) Primary Commodity Prices database.[6] The price variable is constructed as follows: first, we select the relevant price series for each of the mining subindustries. Next, we convert the commodity prices to Australian dollars using historical USD/AUD exchange rate information from the Reserve Bank of Australia (RBA) to take into account exchange rate fluctuations.[7] Finally, we create subindustry-specific price indices using the average 2005 price as the base

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[6] Where possible price series come from IMF Primary Commodity Prices database: https://www.imf.org/external/np/res/commod/index.aspx.
Gold and silver prices were obtained from World Bank (WB) Global Economic Monitor Commodities database: http://databank.worldbank.org/data/reports.aspx?source=global-economic-monitor-%28gem%29-commodities#.

[7] See http://www.rba.gov.au/statistics/historical-data.html#exchange-rates.

price (so that the average 2005 price in AUD = 1).[8] For oil and gas extraction and silver-lead-zinc ore mining, there is more than one relevant price; for those subindustries, we calculate a weighted average price index, where the weights are relative industry shares used by the RBA in their calculation of the Index of Commodity Prices.[9] Appendix Table A lists the specific price series and weights used in the calculations. In most specifications, the price is measured in the month prior to the survey interview.

Figure 2 depicts the subindustry-specific price indices for the years covered by HILDA and included in our analysis. It also shows the correspondence of price movements with the timing of the annual sampling of HILDA (shaded in grey), where the majority of survey respondents are interviewed in the last quarter in each year. From 2001 to 2006, mining commodity prices were relatively stable. After 2006 the variation in prices increased substantially, with iron ore and coal being especially volatile. In fact, the price of iron ore almost doubled from 2009 to 2011 and varied substantially afterwards. During this period, commodity demand shocks were the primary cause of price increases. Exceptionally strong demand growth from the industrialising economies, particularly China and India, caused inventories of many commodities to fall to historically low levels, raising prices significantly (Devlin et al., 2011). The sharp collapse in global economic growth corresponding to the Global Financial Crisis explains much of the decline in prices during the end of the period.

Figure 3 highlights the level of correlation between aggregate world commodity prices and mining employment levels. Specifically, it presents the IMF metals price index from 2000 to 2015 (2005 = 100), along with Australian Bureau of Statistics (ABS) Labour Force Survey data on the number of full-time employed persons working in the metal ore mining industry.[10] We can see that prices and employment are strongly correlated, as expected. Also, changes in commodity prices tend to lead changes in mining employment. For example, employment changes lag by approximately two years the increase in price in 2003 and the decrease in price

[8] We normalize the commodity prices with respect to the 2005 average following the IMF. Using other year averages or an average price across all years (2001-15) produces comparable results. Comparable results are also generated when using commodity prices expressed in USD. For example, the estimated effects of commodity prices in USD and AUD on the job security factor equal 0.152 (with standard error 0.043) and 0.198 (with standard error 0.054), respectively.

[9] See http://www.rba.gov.au/statistics/frequency/weights-icp.html

[10] The metals price index is constructed from copper, aluminium, iron ore, tin, nickel, zinc, lead, and uranium price indices, and does not reflect any Australian Dollar exchange rate fluctuations across the sample period.

in 2011. Given this relationship, it is reasonable to think that mining workers would relate changes in commodity prices to job security.

3. Methods

To determine the relationship between perceived job security (js_{ijt}) and commodity prices (p_{ct}), we estimate the following linear regression model:

$$js_{ict} = \beta_1 p_{ct} + \boldsymbol{X}'_{ict}\boldsymbol{\beta_2} + m_t^1 + \mu_c^1 + u_{ict} \qquad (1)$$

where i indexes individuals, c indexes mining commodities, and t indexes time (month-year). Vector $\boldsymbol{X}'_{ict}$ includes demographic and socio-economic characteristics: gender, age, quadratic function in age, marital status, number of children, education, country of birth, state of residence, and remoteness of residence. These variables are included to account for the variation in workforce composition across mining commodities over time. The composition of the workforce may change due to the expansion or contraction of mining operations in response to rising or falling commodity prices. For example, an increase in world commodity prices may induce a mining business to expand operations, which in turn may alter the characteristics of the workforce.

Commodity fixed effects μ_c control for any time-invariant mean differences across mining subindustries, whether from observable or unobservable confounders. Multiple observations from different workers in each month allow for the estimation of month-by-year time fixed effects m_t. These time fixed effects control for aggregate monthly shocks across commodities, such as global macroeconomic shocks, and for any general Australian mining shocks or policy changes that may jointly impact upon world commodity prices and job security. They also control for seasonality.

The clear link between movements in world commodity prices and real employment outcomes shown in Figure 3 suggests that $\beta_1 > 0$. In essence, decreases in price eventually reduce company revenues and restrict labour demand in affected mining businesses. Therefore, sustained price decreases are expected to eventually lead to layoffs. Price decreases also may work through labour supply, influencing workers to voluntarily leave their job for another. Both of these labour supply and labour demand channels imply that, in the short-term, decreases (increases) in world commodity prices will decrease (increase) perceived job security.[11]

Our analysis is based on the premise that mining workers are aware of changes in the price of their mine's commodity, and that this affects their perceived job security. The results shown in Section 4.1 suggest that this is the case. We also test whether these job security perceptions are meaningful, in the sense that they predict actual changes in employment status. In Appendix Table D we present estimates from models that relate employment changes to one-year lagged perceived job security. The estimates provide strong evidence that job security significantly and substantively predicts future employment outcomes: a one standard deviation increase in job security increases future employment by 2.3 percentage points. The results also suggest that increased security increases employment in the mining industry (by 5.5 percentage points), employment in the same mining subindustry (by 5.8 percentage points), and decreases the likelihood of being fired (by 5.7 percentage points) and changing jobs (by 9.3 percentage points).

The speed with which price movements affect perceived job security is less certain, and will depend largely upon information flows within the general mining industry and within each specific mining company. We empirically investigated this issue by systematically constructing a series of weighted mean prices, using prices over the 12 months prior to the survey, essentially representing different lag structures. Then we estimated equation (1) using these different price variables and evaluated the goodness-of-fit of each. The weights come from the probability distribution function of the log normal distribution; we chose it for its ability to provide a sufficiently wide range of different weighting patterns (Appendix Figure D provides some examples). Our results suggest that goodness-of-fit is maximised when most weight is given to recent prices (this weighting scheme is represented by the red dashed line in Appendix Figure D). Throughout the rest of the paper we use price-last-month (i.e. all of the weight on price from last month), because the results using this more straightforward approach are very similar to those using the weighted price that maximises goodness-of-fit.

[11] Importantly, there is evidence that mining workers are cognisant of recent movements in commodity prices. For example, there are multiple periodicals produced specifically for mining workers (such as 'Australian Mining' and 'Mining Monthly') that regularly contain articles on commodity price movements and their likely impacts, such as on mine expansions or closures. As a specific example, a recent article titled 'Coal price soars, sees mines reopen', begins with "The current surge in coal prices has signalled positivity in the resources sector, leading to announcements of mines reopening both in Australia and overseas" (Masige, 2016).

We use a close variant of equation (1) to model the impact of commodity prices on health (h_{ict}):

$$h_{ict} = \alpha_1 p_{ct} + \boldsymbol{X}'_{\boldsymbol{ict}}\boldsymbol{\alpha_2} + m_t^2 + \mu_c^2 + \varepsilon_{ict} \quad (2)$$

This reduced-form model provides estimates of how industry-specific macroeconomic conditions (represented by commodity prices) affect health. Our premise is that decreases in world commodity prices will decrease mental (but not physical) health ($\alpha_1 > 0$), and that the pathway for this effect is only through changes to perceived job security. The results presented in Section 4.2 support this assertion, demonstrating that commodity prices are not significantly related to: job changes; promotions; satisfaction with pay, the work itself, hours worked, and job flexibility; and satisfaction with financial situation, amount of free time, home in which you live and neighbourhood.

In addition to the reduced-form Model (2), we estimate two-stage least squares (2SLS) model of health, using commodity prices as an instrumental variable for perceived job insecurity:

$$h_{ict} = \delta_1 \widehat{js}_{ict} + \boldsymbol{X}'_{\boldsymbol{ict}}\boldsymbol{\delta_2} + m_t^3 + \mu_c^3 + v_{ict} \quad (3)$$

The standard assumptions underlying this 2SLS model, and its likely validity, are discussed in Sections 4.2 and 5.3.

One further assumption underlying all three models is that world commodity prices are not determined by decisions of mining companies with regards to their Australian-based operations. Indeed, it would be problematic if a company's decision to lower production at an Australian mine, and consequently to reduce the mine's workforce, caused changes in world commodity prices. That example is plausible only for iron ore and coal, given that Australia's shares of world exports in those commodities are large. Importantly, our main results are robust to re-estimating the models with coal and iron ore omitted.[12]

[12] The estimated effects of commodity prices on job security, β_1 in equation (1), equals 0.209 when coal is omitted from the estimation sample, equals 0.163 when iron ore is omitted from the estimation sample, and equals 0.212 when both are omitted. Full results of this robustness exercise are available upon request.

To demonstrate robustness, we estimate two key variants of these models. First, we additionally include individual fixed effects α_i, which more fully account for changes in workforce composition across time. This conservative model is identified only from individuals who remain in the same mining subindustry in HILDA for at least two years (86% of the sample). In the second variant, we additionally include commodity-specific linear time trends. This separates the impact of changing commodity prices from other commodity-specific trends in job security, to the extent that these trends are roughly linear. This model will be overly restrictive if the commodity-specific time trends capture exogenous variation in commodity prices over time. The results of these robustness exercises are presented in Section 6.

We also explore the robustness of our results to different price functions. We test for asymmetric price effects, price volatility, and non-linear price effects. To investigate whether commodity prices affect certain mining workers differently, we interact the price variable with characteristics of the employer, job, and individual. Finally, we estimate quantile regression models that allow for the effect of commodity prices to vary across the distribution of the job security factor. To do so, we follow Firpo et al. (2009) and estimate unconditional quantile regressions that are based on the recentered influence function (RIF).

4. Perceived Job Security Results

4.1. Job Security Effects

Column (4) of Table 1 displays the estimated effects of world commodity prices on perceived job security – β_1 in equation (1). Row 1 presents the results for our main measure of job security, a standardised variable derived from our factor analysis on the seven listed job security measures available within the HILDA data (rows 2-8). The remaining rows present $\hat{\beta}_1$ for each job security measure separately.

These estimates indicate that price increases lead to a substantive improvement in workers' perceived job security. For instance, a doubling of 2005 prices, which is well within our observed price movements, is estimated to increase reported job security by 0.198 standard deviations (row 1). This increase is driven by mining workers who report that they are more satisfied with their job security (0.362, row 2) and employment opportunities (0.236, row 2), less likely to lose their job (-2.949, row 4), more likely to think that they have a secure future (0.208, row

7), and less worried about the future of their job (-0.326, row 8). Prices are estimated to have a smaller (not statistically significant) effect on workers' propensity to (voluntarily) leave their job (row 5), and to agree (significant at only the 10% level) that their employer will still be in business five years from now (0.169, row 6). Overall, the estimates presented in Table 1 suggest that mining workers are highly cognisant of world commodity prices and are concerned about the effect that they may have on the profitability of mining operations and in turn their employment prospects.

The additional coefficients from the regression model of the main composite job security variable can be found in column (3) of Appendix Table B. These estimates suggest that perceived job security decreases with age, up to around 40 years, and then increases with age thereafter. They also suggest that immigrants from non-English speaking countries feel more secure (compared to Australian-born workers), and that parents, university graduates and immigrants from English-speaking countries feel less secure.

Table 2 provides the results from several alternatively specified models, but still using our main composite measure of perceived job security. First, we test for asymmetries in the relationship between commodity prices and perceived job security by disaggregating the price variable into two components: price last month if prices are trending upwards, and price last month if prices are trending downwards. The results in panel 1 suggest that workers respond similarly to prices regardless of the short-term trend. Second, we test whether large price shocks drive the results. The finding in panel 2 suggests that perceived job security is unrelated to the variance of prices. Third, panel 3 indicates whether the linear specification we use in Table 1 is sufficient by allowing for a quadratic relationship. The coefficient on price squared is economically small and statistically insignificant, indicating that our linear approximation is sufficient.

For panels 4 and 5 we conduct placebo-type tests: we examine whether future prices are associated with current job security perceptions, and whether prices last month are associated with perceived job security among ex-mining workers. Assuming that equation (1) is correctly specified, the coefficient on prices next month should be near zero; that is what we find. Similarly, we find that former mining workers are unaffected by commodity prices. Panel 6 considers whether perceived job security of all non-mining workers is affected by changes in commodity prices; as expected, it is not.

Finally, we explore the potential for a heterogeneous relationship between commodity prices and job security by using the unconditional quantile regression approach. This approach developed by Firpo et al. (2009) allows us to estimate the effects of commodity prices across the entire distribution of job security. We find that the effect of commodity prices on job security is largest at lower quantiles. In particular, the estimated price effects at the 10th and 25th unconditional quantiles equal 0.390 (se = 0.121) and 0.398 (se = 0.099), respectively. These effects indicate that a doubling of 2005 prices increases job security by around 0.4 standard deviations for workers with low job security. The price effects at the 75th and 90th unconditional quantiles are statistically significant, but much smaller (0.163 and 0.079, respectively). Together, these estimates indicate that workers with low perceived job security are more affected by changes in mining profitability are than workers with high perceived job security.

4.2. Additional Effects

Before presenting the result of our models of mental and physical health, we investigate whether commodity prices affect known determinants of health status other than perceived job security. These results help us to interpret the reduced-form estimates, and they reveal the likely validity of using commodity prices as an instrumental variable for job security. Specifically, in Table 3 we test whether changes in commodity prices affect other job attributes (Panel A), and the non-work aspects of life (Panel B).

The results in Panel A indicate that the commodity price last month does not affect any of the listed job attributes. Price has a small and statistically insignificant impact upon: wages, hours worked in past week, satisfaction with total pay, the work itself (work content), hours worked, and flexibility to balance work and non-work commitments. In addition, price is unrelated to whether workers feel their job is stressful or complex, and whether they have freedom over what, how and when they work. Therefore, it appears that the only measured job-related attribute affected by changes in commodity prices – at least in the short run – is perceived job security.

Similarly, Panel B indicates that the commodity price is not a significant determinant of satisfaction with other aspects of workers' lives: satisfaction with the home in which you live, financial situation, feeling part of your local community, the neighbourhood in which you live, amount of free time, and your relationship (for those who are not single), are all unaffected by commodity prices. Furthermore, commodity prices do not affect workers' expectations that they will move from their home residence in the next 12 months.

Overall, the results so far indicate that increases in world commodity prices have: (a) a large positive effect on how secure workers feel in their job; and (b) statistically insignificant effects on other aspects of work and life. These findings support the conjecture that commodity prices only affect health through the impact on perceived job security.

5. Health Results

5.1. Reduced-Form Effects

Table 4 presents the estimated effects of world commodity prices on mental and physical health. These estimates show that prices are significantly related to our overall mental health measure: a doubling of 2005 prices is estimated to increase the mental health of mining workers by 0.108 standard deviations (significant at the 5% level). In contrast, commodity prices have only a small and statistically insignificant effect on overall physical health (-0.039).

To help us understand how mental health is affected by prices, Panel B presents the estimated effects on the four SF-36 dimensions that strongly correlate with the overall measure: mental health, vitality, role emotional, and social functioning.[13] These estimates suggest that a doubling of 2005 prices increases the mental health dimension by 0.106 standard deviations (significant at 5% level) and the vitality dimension by 0.122 standard deviations (significant at 10% level). The role emotional and social function dimensions, which reflect whether emotional problems limit day-to-day and social activities, are not affected by prices.

Similarly, Panel C presents the price effects for the separate dimensions of physical health. The small and statistically insignificant estimates are in line with expectations, because we would not expect changes in job security to worsen

[13] The mental health dimension reflects whether the individual has been feeling: nervous, so down in the dumps that nothing could cheer them up, calm and peaceful, down, and happy. The vitality dimension reflects whether the individual has been feeling: full of life, lot of energy, worn out, and tired. The role emotional dimension reflects whether emotional problems have meant the individual has: cut down amount of time spent on work or other activities, accomplished less, and did not do work or other activities carefully. The social functioning dimension reflects whether emotional problems have interfered with normal social activities.

physical functioning, increase bodily pain, or create physical health problems that prevent regular daily activities at least in the short run.

Of course, some workers may be more vulnerable to demand shocks (price movements) than others, and therefore there may be heterogeneity in the effect of commodity prices on health. Repeating the analysis from 4.1, we first explore this possibility by using the unconditional quantile regression approach. We find that the effects of commodity prices on mental health are similar across quantiles. For example, the estimated price effects at the 10th, 25th, 50th, 75th and 90th quantiles equal 0.110, 0.119, 0.102, 0.105 and 0.093, respectively. These estimates indicate that workers with poor mental health are no more affected by changes in mining profitability than are workers with good mental health.

We also explore heterogeneity by estimating the price effects separately for particular subgroups. We compare the effects for workers: (1) with and without a university degree level education; (2) employed in a managerial position or not; (3) employed with their firm for more or less than 4 years; (4) on a permanent employment contract or being on a casual (flexible) or fixed-term contract; and (5) working in a large (with more than 5,000 employees) or small (less than 5,000 employees) firm. Our expectation is that workers with less education, employed in a non-managerial position, having fewer years of tenure with the firm, being employed on a more casual basis, and working for smaller firms will be the most vulnerable to perceived changes in job security. The results in Table 4 are broadly in line with these hypotheses. However, the estimated effect of prices on mental health only differs significantly by education.

5.2. Robustness Models

Our main specification includes commodity fixed-effects and month-year fixed-effects, implying that identification is driven by differential variation in commodity prices across time. To further test for the robustness of this source of identification, Table 6 presents the results from two more-highly saturated models, which include: (a) individual-level fixed-effects; and (b) commodity-specific linear time trends. The model with individual-level fixed-effects should better capture changes in the composition of workforces that are driven by changes in commodity prices. The model with commodity-specific linear time trends should also capture commodity-specific linear changes in perceived job security and health some proportion of which may be unrelated to changes in price. One natural consequence of adding many additional covariates, especially considering our sample size, is that the precision of all of the estimated effects will be reduced. However, this robustness investigation provides us with an indication of whether our main findings can be broadly replicated.

The results in Column (1), for the individual-level fixed-effects model, indicate that increases in price improve perceived job security (0.106**) and mental health (0.090*), with the latter effect being driven by changes in vitality (0.146**) and the mental health dimension (0.093*). This set of results is largely in-line with those from our main model, the main differences being that the job security estimate is smaller. The estimated effects shown in Column (2), which are generated from the model with commodity-specific linear time trends, are generally less precise than those from our main specification. This is not unexpected, given that the linear trends will capture a proportion of the variation in prices. But importantly, the pattern of results is similar to the main estimates, with the point estimates for the mental health outcomes also comparable in magnitude.

5.3. Instrumental Variable Effects

Next we provide the corresponding 2SLS estimates of the effect of job security on mental and physical health. These estimates are valid under the explicit assumption that changes in world commodity prices affect health only through their impact on job security. The results presented in Table 3 support this assumption across a wide array of potential pathways. However, we cannot fully rule out other less obvious pathways that might exist. With this caveat in mind, the 2SLS results are presented in Table 7.[14]

The 2SLS estimate of the effect of job security on mental health is around 2.5 times larger than the corresponding OLS estimate, with a one standard deviation increase in job security estimated to increase overall mental health by 0.490 standard deviations (compared to a 0.191 standard deviation change with OLS).[15] Importantly, the fact that we are finding significant effects of job security on two dimensions of

[14] The F-Statistic from the first stage model of job security equals 16.52, suggesting that we do not have a weak instrument issue.

[15] It is interesting to compare the magnitude of the estimates effect of job security on mental health for workers with that of the effect of losing your job. In HILDA as part of a series of questions on major life events in the last 12 months, individuals are asked if they have been fired or made redundant. For individuals aged 18-64, we find that this event is associated with a significant 0.282 decline in our standardised mental health score, being higher for females (0.355) than males (0.234). The roughly comparable magnitude of our job security estimates supports the importance of considering the mental health effects of recessions on the larger wider workforce.

mental health (mental health and vitality), but not on role emotional or social functioning, as well as no effect on any dimension of physical health, supports the hypothesis that our IV strategy in not confounded by omitted pathways between commodity prices and health.

One explanation for the difference between OLS and 2SLS is that there is substantial measurement error in the job security measure. Another possibility is that the average treatment effect (OLS) is different from the local average treatment effect, which is the case if the instrument (commodity prices) has a heterogeneous impact on job security. The results from Section 4 suggest that workers with low job security are most affected by prices; these tend to be workers with lower education, with fewer years of tenure, and a casual contract.

Overall, the 2SLS findings, together with those shown in Tables 4, 5 and 6, provide consistent and robust evidence that increased job insecurity is strongly linked and adversely impacts the mental health of workers. In particular, feeling secure appears to decrease the propensity for workers to feel nervous, down in the dumps, worn out, and tired.

6. External Validity

One important strength of our study is the tight matching of exogenously driven economic conditions within sub-sectors of one industry (mining), implying strong internal validity. From the various model estimates, we are confident that we are capturing the true effect of commodity price movements by sub-sector of the mining industry on the perceived job security of workers. The underlying causal mechanism we have assumed is that mining workers are cognisant of price changes in their specific sector; our analyses clearly suggest that this is the case.

While mining is an industry where employment prospects are closely aligned to world commodity price movements, it is also the case that workers in many industries and occupations will not have such explicit and readily identifiable real-time information about their employment prospects. This means that finding corresponding exogenous variation for a variety of industries is very difficult. Thus, we recognise that the strength of our results comes at the potential cost of uncertain external validity: that is, the extent to which our results can be generalised to other workers and industries. The mining industry is male dominated, and many jobs are in rural areas. Moreover, the nature of some jobs in the mining industry, which entail working in relatively harsh and remote conditions but typically receiving higher wages than similarly skilled workers, might mean that mining workers differ in key economic preferences and characteristics. For example, they may differ by time and risk preferences. If, for example, mining workers are less risk averse, and they select into mining because they are willing to accept more employment uncertainty for higher wages, then our estimates of the effect of job security on health might be smaller than what would be found for other industries. Similarly, those selecting into the mining industry might have different levels of physical and mental health, which might mean that the effects of shocks to job security could have different impacts on health for workers in other industries.

To shed some light on this issue, we provide in the top panel of Appendix Table F descriptive information about health and proxies for time and risk preferences for mining workers, compared to other jobs that could reasonably be viewed as substitute work options. Thus, we compare mining workers to those in agriculture, construction and manufacturing, but also provide the statistics for all other workers. Given that mining is male-dominated, these statistics are provided for males only to avoid any gender differences in health or economic preferences.[16] Importantly, there is no significant difference in the level of mental health of mining, agricultural and construction workers, with only a slightly lower level for those in manufacturing and other industries. Only agricultural workers report significantly lower physical health than miners. In regards to our proxies for time and risk preferences, there is no significant difference between miners and all of the other industries in attitudes to risk, and only slight differences in planning horizon.

To further inform on the likely external validity of our results, the bottom panel in Appendix Table F provides estimates of the coefficient on the lag of perceived job security on employment for miners and each of the comparison industries (i.e. the equivalent model to the first row of Appendix Table D). Across all industries perceived job security is a significant and strong predictor of future employment, and importantly the magnitude of the relationship is very similar across all industries. The final row provides OLS estimates of the relationship between job security and mental health by industry (i.e. the equivalent model to the first row of Table 7). Again, the magnitude of the estimates is similar for miners and construction

[16] The average standard mental and physical health measures are above zero because these statistics are for males only, whereas the standardised is based on males and females.

and manufacturing workers, and only around 10% and 20% smaller than for agricultural and all industries, respectively. Overall, although only indicative, these results suggest that the main conclusions regarding the strong link between job security and mental health that we have found for mining workers is likely to be relevant for other industries.

7. Conclusion

Recent economic recessions, increasing global competition, the outsourcing and offshoring of jobs, rapid advancements in technology and automation, and labour market deregulation, are all factors that have led to greater job insecurity for workers (Ferrie, 2001; Sverke and Hellgren, 2002; Blinder, 2009; Burgard et al., 2009; Kalleberg, 2009; Virtanen et al., 2013; ILO, 2014; Caroli and Godard, 2016). Changes in the nature of employment mean that there are fewer "jobs for life", and there has been a growing reliance by private-sector firms on temporary, casual, and zero-hour contracts (Lewchuk, 2017). In addition, recent austerity measures in the wake of the Global Financial Crisis have been aimed at cutting the size of the public-sector workforce (Hodges and Lapsley, 2016), which has meant that many traditionally secure jobs can no longer be relied upon for long-term financial stability. Consequently, job insecurity is now a salient feature of both the private and public sectors.[17]

In this paper, we provide some new evidence on the impact of changes in job security on physical and mental health, using a novel identification strategy in the literature – exogenous movements in world commodity prices. Here we build on papers that have used a similar strategy in other contexts (Kaiser and Siegenthaler, 2016; Berman et al., 2017). In particular, we study how the perceived job security of workers in the mining industry in Australia is affected by changes in subindustry world prices for commodities, and we use this as a source of exogenous variation in the expected labour demand in the industry. It is clear that employment in the mining industry is closely aligned to changes in commodity prices, and our results suggest that mining workers are highly cognisant of price changes.

Our findings also shed light on the wider costs of recessions and economic slowdowns on health. Many studies have documented a sizeable aggregate decline

[17] Moreover, job insecurity is likely to increase further, with Frey and Osborne (2013), for example, calculating that around 47% of total US employment is at risk of being automated over the next two decades.

in mental health in times of high unemployment in many countries. When thinking about those most affected by recessions, it is natural to first consider the costs incurred by those who are made unemployed. However, a wide body of literature has found that job insecurity is strongly associated with worse health for workers. Therefore, the extent to which recessions increase perceived job insecurity, and in turn how this affects health, is an important issue to study further. Even at the highest point of unemployment following the Global Financial Crisis, the numbers of unemployed are many times lower than the number of employed. Therefore, even a relatively small decline in worker health due to greater job insecurity can dominate aggregate health costs.

We estimate a number of different models to test the robustness and consistency of our main results. In response to an increase in world commodity prices, the perceived job security of workers increases substantially: a doubling of 2005-level prices is estimated to increase perceived job security by around one-fifth of a standard deviation. The effects are even larger for the most vulnerable. Importantly, using reduced-form models we find that higher commodity prices increase mental health: a doubling of 2005-level prices is estimated to increase our index by around one-tenth of a standard deviation. In contrast, there is no such effect for physical health. Using commodity prices as an instrument for job security on models of mental and physical health confirms these results. While our study has strong internal validity, we also have provided some evidence that this strong link between perceived job security and mental health is likely to apply to workers' in other industries.

Overall, we find robust evidence that: (1) exogenous changes in macroeconomic conditions affect the perceived job security of workers; and (2) that shocks to perceived job security substantively affects workers' mental health, but not their physical health. In line with the hypothesis of Di Tella et al. (2003), our results suggest that the fear of losing a job generates a significant drop in the wellbeing of those who work, and that this is likely to be the key driver in the observed worsening in mental health and wellbeing found in times of recession.

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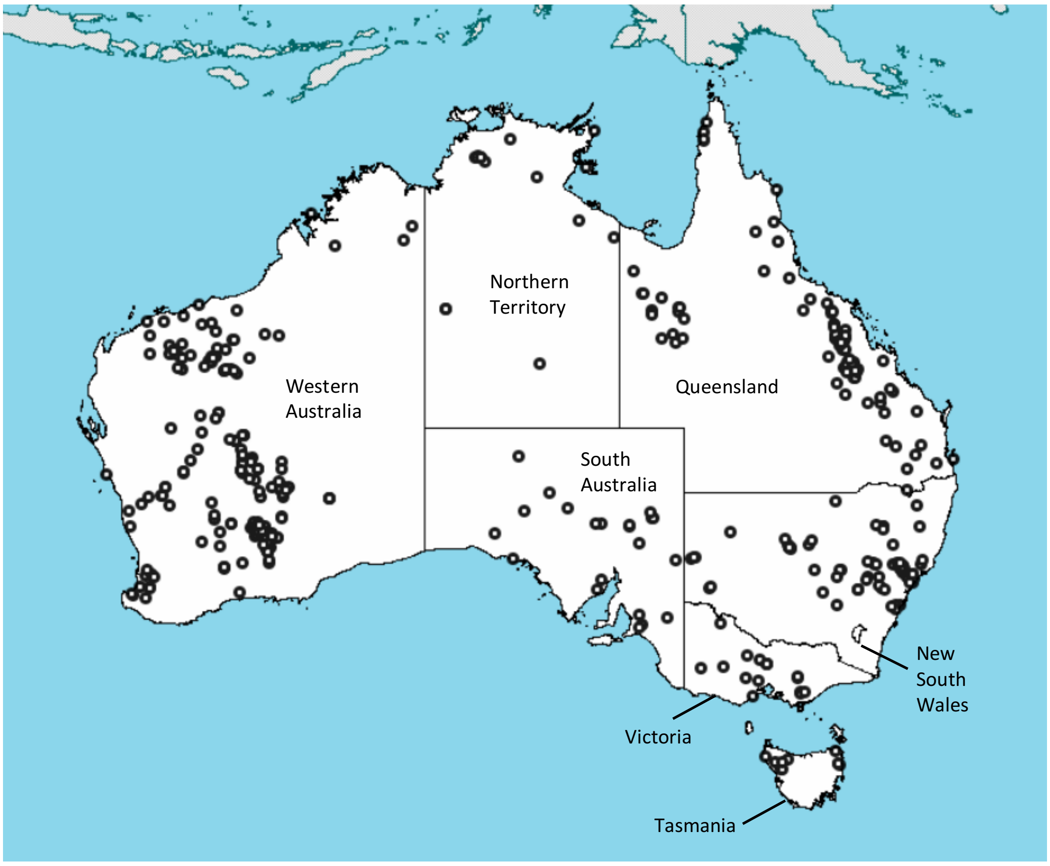
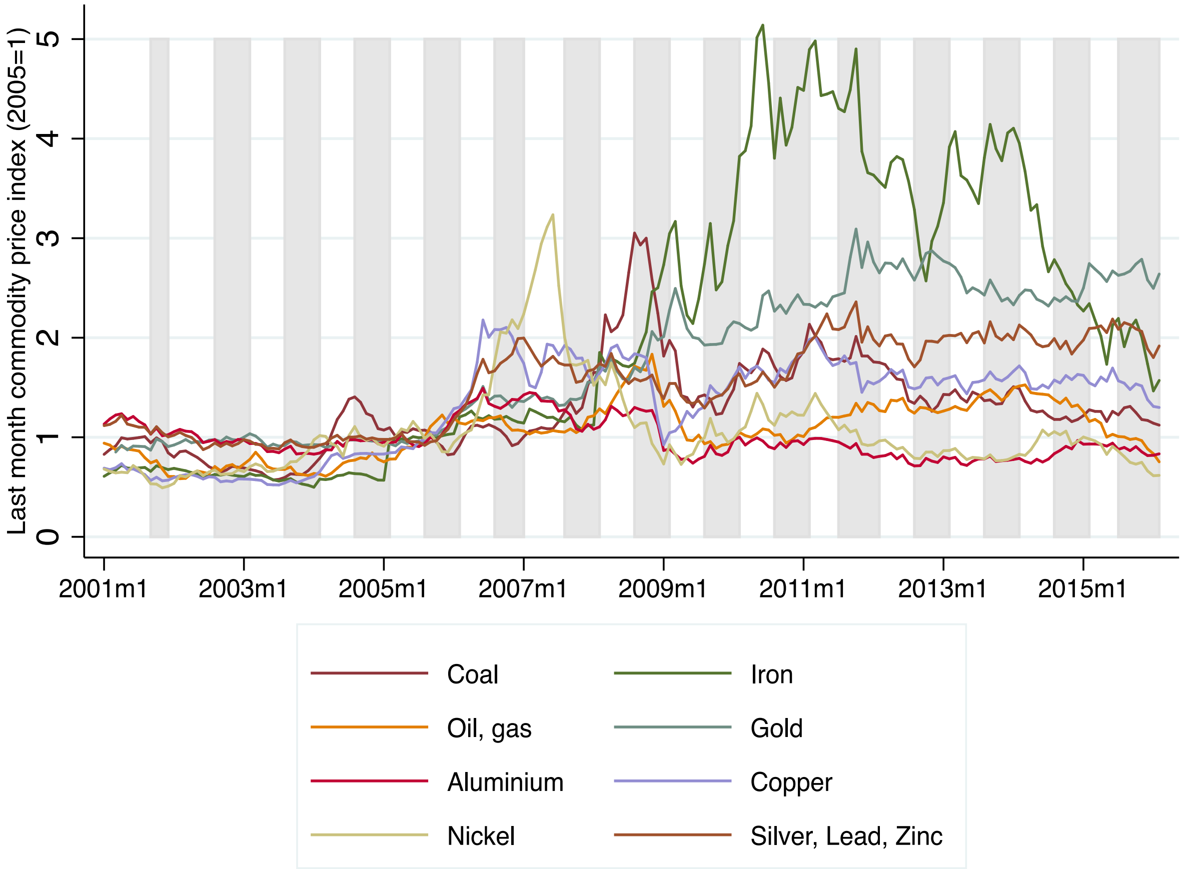
Figure 1: Map of Operating Australian Mines of all Commodities



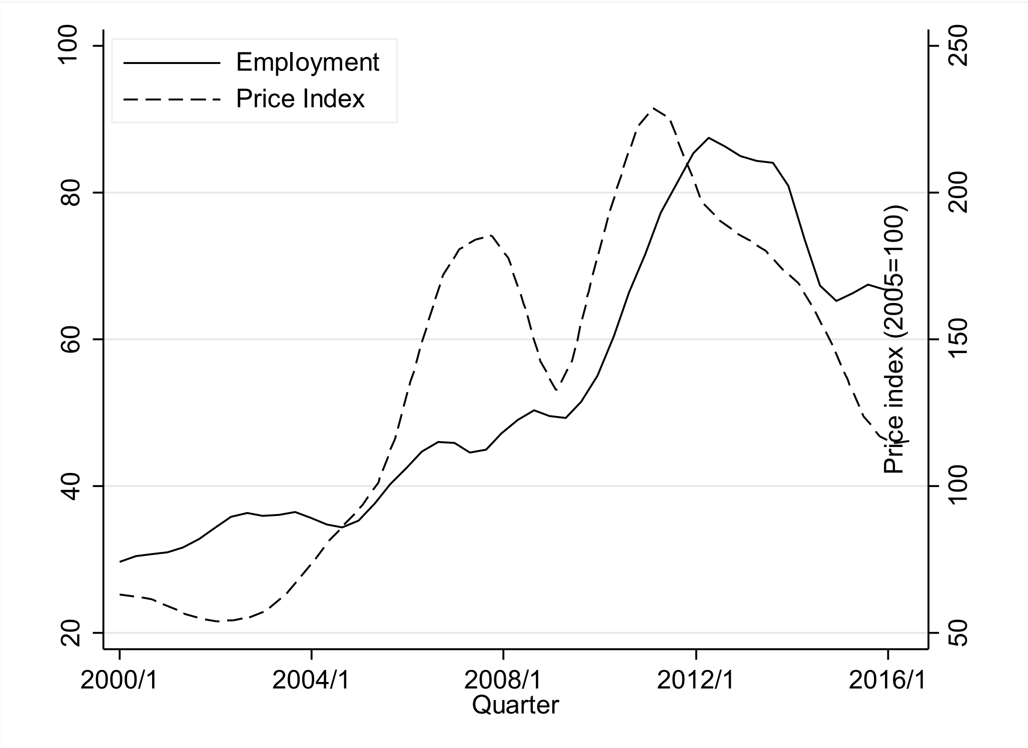
Source: Geoscience Australia's Australian Mines Atlas: http://www.australianminesatlas.gov.au/

Figure 2. Commodity Prices, and HILDA Sampling (in grey shade)



Sources: IMF and WB.

Figure 3. Employment Levels in the Metal Ore Mining Industry and Metal Price Index over time



Sources: IMF and ABS.

Table 1: Descriptive Statistics of Job Security, and Estimated Effects of Commodity Prices on Perceived Job Security Measures

		(1) All Mean	(2) Sample Mean	(3) Scoring Coefficient	(4) Price Coefficient	
1.	Job security factor (standardised)	-0.007	-0.164	-	0.198***	(0.052)
2.	Satisfaction with job security (0-10)	7.961	7.442	0.276	0.362***	(0.119)
3.	Satisfaction with employment opportunities (0-10)	7.439	7.733	0.199	0.236**	(0.092)
4.	Percentage chance of lose job (0-100)	10.272	14.924	-0.228	-2.949**	(1.199)
5.	Percentage chance of leave job (0-100)	23.588	18.719	-0.100	-1.417	(2.307)
6.	Agree that company still in business in 5 years (1-7)	5.933	5.762	0.181	0.169*	(0.098)
7.	Agree that I have a secure future in my job (1-7)	4.998	4.868	0.272	0.208**	(0.097)
8.	Agree that I worry about future of my job (1-7)	2.889	3.259	-0.217	-0.326***	(0.084)

Notes: Sample size equals 1,578. First column presents the means for all employees in HILDA (n=107,701). Commodity price variable is an index of last month subindustry-specific price (2005 = 1.00). Standard errors clustered at the individual level are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Table 2: Estimated Effects of Commodity Prices on Job Security from Alternative Model Specifications

	Price coefficient	
1. Asymmetry		
Price last month if higher	0.191***	(0.052)
Price last month if lower	0.214***	(0.060)
2. Mean and variance		
Price last month	0.218***	(0.063)
Variance last 12 months	-0.002	(0.003)
3. Non-linearity		
Price last month	0.408**	(0.175)
Price last month squared	-0.042	(0.030)
4. Future price		
Last month	0.471**	(0.194)
Next month	0.006	(0.193)
5. Ex-mining workers		
Price last month	0.054	(0.041)
6. All non-mining workers		
Average price last month	0.069	(0.073)

Notes: In panels 1-4, sample size is 1,578 person-year observations. In panels 5 and 6, sample sizes are 3,018 and 119,650. In panels 1-5, commodity price variable is an index of subindustry-specific commodity price (2005 = 1.00). In panel 6, commodity price variable is an average of all commodity prices. Standard errors clustered at individual are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, and commodity fixed-effects. Regressions in panels 1 – 5 additionally control for month-year effects and regression in panel 6 additionally controls for month and year effects *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Table 3: Estimated Effects of Commodity Prices on other Job and Life Outcomes

	Sample Mean	Price coefficient	
A. Job Attributes			
Log real weekly wages & salary	7.303	-0.011	(0.103)
Hours work per week	50.162	0.805	(0.851)
Satisfaction with total pay (0-10)	7.876	-0.102	(0.093)
Satisfaction with the work itself (0-10)	7.587	-0.038	(0.107)
Satisfaction with hours you work (0-10)	7.190	-0.018	(0.119)
Satisfaction with flexibility (0-10)	6.822	-0.120	(0.171)
Job quality factor: high stress and low pay (std)	-0.209	-0.050	(0.052)
Job quality factor: high control/autonomy (std)	-0.261	-0.016	(0.061)
Job quality factor: high complexity (std)	0.279	0.046	(0.051)
B. Other aspects of life			
Satisfaction with financial situation (0-10)	7.155	0.141	(0.111)
Satisfaction with amount of free time (0-10)	6.392	-0.018	(0.125)
Satisfaction with home in which you live (0-10)	7.761	-0.016	(0.130)
Satisfaction with neighbourhood (0-10)	7.762	0.138	(0.100)
Satisfaction with feeling part of community (0-10)	6.607	0.064	(0.123)
Satisfaction with relationship with partner (0-10)	8.376	0.224	(0.144)
Likely to move residence in next 12 months (0/1)	0.202	0.007	(0.021)

Notes: In panels A and B, presented figures are coefficients on an index of subindustry-specific last month commodity price (2005 = 1.00). The estimates in each row come from separate models. Standard errors (in brackets) clustered at the individual level are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Table 4: Reduced-Form Effects of Commodity Prices on Mental and Physical Health

	Sample size	Price Coefficient	
A. Summary Measures			
i. Mental health	1340	0.108**	(0.047)
ii. Physical health	1340	-0.039	(0.043)
B. Mental Health Dimensions			
i. Mental health	1358	0.106**	(0.051)
ii. Vitality	1358	0.122*	(0.064)
iii. Role emotional	1354	0.013	(0.042)
iv. Social functioning	1364	0.001	(0.046)
C. Physical Health Dimensions			
i. Physical health	1351	-0.018	(0.038)
ii. Bodily pain	1359	0.020	(0.053)
iii. Role physical	1355	-0.020	(0.047)
iv. General health	1355	0.072	(0.057)

Notes: Commodity price variable is an index of last month subindustry-specific last month commodity price (2005 = 1.00). Standard errors are presented in parentheses. Standard errors clustered at the individual level are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Table 5: Heterogeneity in the Estimated Effects of Commodity Prices on Mental Health

		Sample size	Price Coefficient		Difference	*t*-statistic
i.	University degree	226	-0.094	(0.097)		
	No university degree	1114	0.124***	(0.048)	-0.219**	-2.253
ii.	Manager	632	0.099	(0.064)		
	Not a manager	708	0.114**	(0.053)	-0.015	-0.222
iii.	Tenure ≥ 4 years	606	0.055	(0.064)		
	Tenure < 4 years	734	0.143***	(0.053)	-0.088	-1.319
iv.	Permanent employment contract	1031	0.117**	(0.050)		
	Casual or fixed-term contract	277	0.104	(0.073)	0.013	0.184
v.	Firm size ≥ 5000 employees	581	0.126**	(0.059)		
	Firm size < 5000 employees	519	0.184**	(0.074)	-0.057	-0.807

Notes: Presented figures are coefficients on an index of subindustry-specific last month commodity price (2005 = 1.00). The estimates in each panel come from separate models. Standard errors clustered at the individual level are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Table 6: Estimated Effects of Commodity Prices from Extended Models

	(1) Industry FE + Individual FE		(2) Industry FE + Industry Time Trends	
A. Job Security	0.106**	(0.049)	0.085*	(0.051)
B. Health and Wellbeing				
i. Mental health	0.090*	(0.050)	0.093*	(0.056)
ii. Physical health	-0.019	(0.054)	-0.063	(0.044)
C. Mental Health Dimensions				
i. Mental health	0.093*	(0.052)	0.107*	(0.058)
ii. Vitality	0.146**	(0.065)	0.076	(0.066)
iii. Role emotional	-0.025	(0.043)	-0.001	(0.045)
iv. Social functioning	-0.007	(0.051)	0.003	(0.054)

Notes: Presented figures are coefficients on an index of subindustry-specific last month commodity price (2005 = 1.00). Standard errors clustered at individual level are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Table 7: Estimated Effects of Job Security on Health

		Sample size	OLS		2SLS	
A. Summary Measures						
i.	Mental health	1340	0.191***	(0.027)	0.490**	(0.211)
ii.	Physical health	1340	0.012	(0.021)	-0.175	(0.197)
B. Mental Health Dimensions						
i.	Mental health	1358	0.211***	(0.030)	0.496**	(0.232)
ii.	Vitality	1358	0.196***	(0.034)	0.572**	(0.279)
iii.	Role emotional	1354	0.100***	(0.024)	0.060	(0.191)
iv.	Social functioning	1364	0.094***	(0.027)	0.004	(0.208)
C. Physical Health Dimensions						
i.	Physical health	1351	0.026	(0.025)	-0.079	(0.167)
ii.	Bodily pain	1359	0.096***	(0.031)	0.093	(0.235)
iii.	Role physical	1355	0.052*	(0.029)	-0.093	(0.213)
iv.	General health	1355	0.201***	(0.037)	0.339	(0.247)

Notes: Standard errors clustered at individual level are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Appendix Table A. Mining related ANZSIC 2006 codes and prices series

(1) Industry	(2) ANZSIC 2006 code	(3) Sample mean	(4) Price series	(5) Weight
Coal Mining	600	0.493	Coal, Australian thermal coal, 12,000- btu/pound, less than 1% sulfur, 14% ash, FOB Newcastle/Port Kembla, US$ per metric ton	n/a
Oil and Gas Extraction	700	0.122	Crude Oil (petroleum), simple average of three spot prices: Dated Brent, West Texas Intermediate, and the Dubai Fateh;	0.4
			Natural Gas, simple average of three prices: Russian Natural Gas border price in Germany, Indonesian Liquefied Natural Gas in Japan, and Natural Gas spot price at the Henry Hub terminal in Louisiana	0.6
Iron Ore Mining	801	0.145	China import Iron Ore Fines 62% FE spot (CFR Tianjin port), US dollars per metric ton	n/a
Bauxite Mining	802	0.062	Aluminium, 99.5% minimum purity, LME spot price, CIF UK ports, US$ per metric ton	n/a
Copper Ore Mining	803	0.037	Copper, grade A cathode, LME spot price, CIF European ports, US$ per metric ton	n/a
Gold Ore Mining	804	0.086	Gold (UK), 99.5% fine, London afternoon fixing, average of daily rates	n/a
Nickel Ore Mining	806	0.029	Nickel, melting grade, LME spot price, CIF European ports, US$ per metric ton	n/a
Silver-Lead-Zinc Ore Mining	807	0.027	Silver (Handy & Harman), 99.9% grade refined, New York	0.33
			Lead, 99.97% pure, LME spot price, CIF European Ports, US$ per metric ton	0.33
			Zinc, high grade 98% pure, US$ per metric ton	0.33

Appendix Table B: Estimated Coefficients of Individual-Level Covariates on Job Security

	(1) All Mean	(2) Sample Mean	(3) Estimated coefficient	
Price last month	-	1.524	0.198***	(0.052)
Male	0.497	0.873	0.156	(0.100)
Age	37.57	38.19	-0.038*	(0.023)
Age-squared/100	-	-	0.045	(0.028)
Married/Cohabitating	0.629	0.741	0.098	(0.086)
Number of children under 15 years	0.538	0.726	-0.111***	(0.037)
High School	0.181	0.127	-0.028	(0.123)
Vocational education	0.310	0.489	-0.154	(0.108)
University degree	0.279	0.159	-0.346***	(0.133)
Born in foreign ES country	0.086	0.100	-0.316**	(0.136)
Born in foreign NES country	0.101	0.035	0.445**	(0.195)
VIC/SA/TAS	0.395	0.108	-0.136	(0.184)
QLD	0.214	0.331	-0.155	(0.126)
WA/NT	0.099	0.286	0.148	(0.164)
Inner Regional Australia	0.229	0.327	0.133	(0.101)
Outer Regional Australia	0.099	0.243	0.101	(0.119)
Remote/Very remote Australia	0.018	0.101	0.206	(0.136)

Notes: Sample size equals 1,578. Means for all employees in HILDA (n=109,101) are presented in the first column. Commodity price variable is an index of subindustry-specific last month commodity price (2005 = 1.00). Standard errors clustered at individual level are presented in parentheses. Omitted categories for education, country of birth, state, and remoteness are Less than high school, Born in Australia, New South Wales (NSW), and Major cities of Australia. VIC stands for Victoria, SA for South Australia, TAS for Tasmania, QLD for Queensland, WA for Western Australia, and NT for Northern Territory. Regression controls for commodity fixed-effects and month-year effects. *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Appendix C: Job Security Questions in HILDA

Personal Questionnaire:

1. Looking at [showcard], please pick a number between 0 and 10 to indicate how satisfied or dissatisfied you are with the following aspects of your job. Your job security?
2. I am going to read out a list of different aspects of life and, using the scale [showcard], I want you to pick a number between 0 and 10 that indicates your level of satisfaction with each. Your employment opportunities?
3. What do you think is the per cent chance that you will lose your job during the next 12 months? (That is, get retrenched or fired or not have your contract renewed.)
4. What do you think is the per cent chance that you will leave your job voluntarily (that is, quit or retire) during the next 12 months?

Self-Completion Questionnaire:

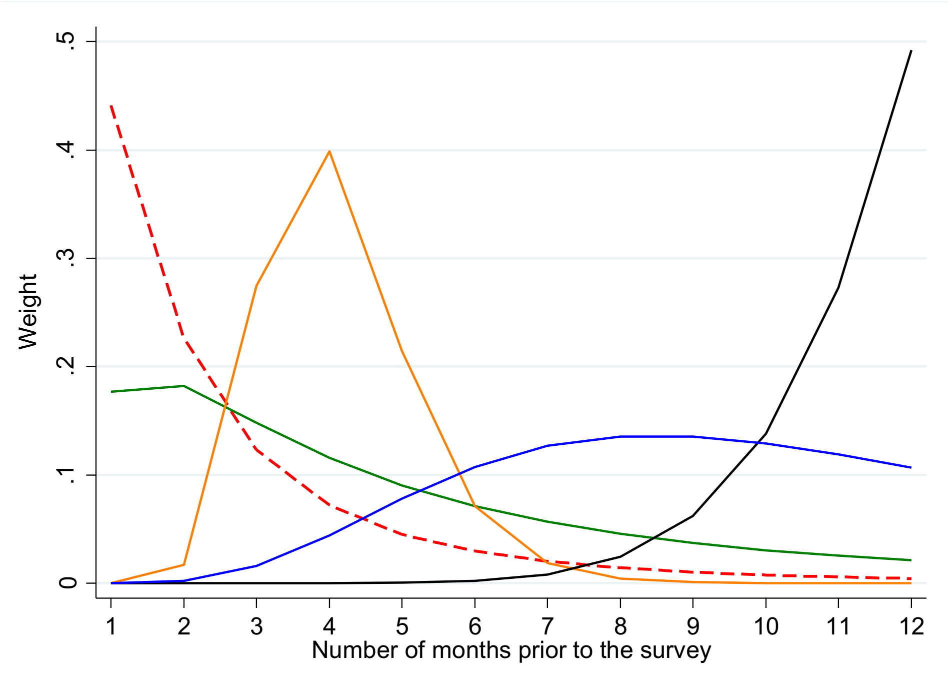
5. The following statements are about your current (main) job. Please indicate, by crossing one box on each line, how strongly you agree or disagree with each. The more you agree, the higher the number of the box you should cross. The more you disagree, the lower the number of the box you should cross. (on 7-point scale):
    a. The company I work for will still be in business 5 years from now.
    b. I have a secure future in my job.
    c. I worry about the future of my job.

Appendix Table D: Effects of Job Security on Future Employment Outcomes

	Sample size	Lagged Job Security Coefficient	
Employed	1306	0.023**	(0.009)
Employed in mining industry	1306	0.055***	(0.014)
Employed in same mining subindustry	1360	0.058***	(0.015)
Fired in last 12 months	1123	-0.057***	(0.011)
Changed jobs in last 12 months	1122	-0.093***	(0.015)

Notes: Sample consists of individuals employed in mining in the past year. Presented figures are coefficients on the job security factor in the past year. The estimates in each row come from separate OLS models. Standard errors clustered at individual are presented in parentheses. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, commodity fixed-effects, and month-year effects (time varying variables are measured in the past year). *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 level, respectively.

Appendix Figure E: Examples of Weighting Schemes used to Construct Alternative Price Series



Appendix Table F: Summary Statistics by Industry Classification

	Mining	Agriculture	Construction	Manufacturing	All Others
Mental health	0.18	0.16	0.15	0.04***	0.06***
	[0.85]	[0.92]	[0.91]	[0.95]	[0.97]
Physical health	0.06	-0.32***	0.00	0.00	0.05
	[0.88]	[1.19]	[0.96]	[0.95]	[0.94]
Short planning horizon	0.21	0.22	0.26***	0.28***	0.24***
	[0.41]	[0.41]	[0.44]	[0.45]	[0.43]
Takes financial risks	0.09	0.10	0.08	0.07	0.10
above average	[0.28]	[0.30]	[0.27]	[0.26]	[0.30]
Lag job security on employment	0.026***	0.030***	0.023***	0.025***	0.022***
	(0.009)	(0.008)	(0.003)	(0.003)	(0.001)
Job security on mental health	0.190***	0.227***	0.207***	0.204***	0.255***
	(0.030)	(0.028)	(0.014)	(0.015)	(0.008)

Note: The sample consists of males only. In the top panel, standard deviations are presented in brackets; other figures are sample means. *** denotes that the industry sample mean is significantly different from the sample mean in mining, at the 1% level. The variable short planning horizon indicates that the most important time period for planning saving and spending is either in the next week or next few months (rather than in the next year, next 2-4 years, next 5-10 years, >10 years ahead). The takes above average financial risks variable indicates that the willingness to take either substantial financial risks or above average financial risks (rather than average financial risks or no financial risks). In the bottom panel, standard errors are presented in parentheses; other figures are coefficient estimates. All regressions control for gender, quadratic function in age, marital status, number of dependent children, education, country of birth, state, remoteness, and month-year effects.