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# The distributional effects of natural disasters on the Big Five personality traits

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In the context of climate change and the well-established links between personality traits and life outcomes, this paper presents a novel investigation into the causal effects of natural disaster-induced housing damage on the Big Five personality traits. Using a time-varying, plausibly exogenous measure of local cyclone exposure as an instrument within an individual fixed effects instrumental variable framework, we find that weather-related home damage significantly reduces Conscientiousness and Emotional Stability, while increasing Openness to Experience. These effects are highly heterogeneous: significant impacts emerge only in quantile regression models, with individuals at the lower end of the Conscientiousness and Emotional Stability distributions more adversely affected, and those at the upper end of the Openness distribution exhibiting greater increases. Furthermore, our findings suggest that weather-related home damage may indirectly reduce earnings by altering personality traits in ways associated with lower income—effects that are not only statistically significant but also substantial in magnitude and economically meaningful. These personality changes may correspond to income losses of up to 5%, with socioeconomically disadvantaged individuals being most severely affected.

**Keywords:** Natural Disasters; Personality Trait; Big Five; Quantile Regression; Housing

**JEL classifications:** C18; I31; J3; R20; Q54

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## 1. Introduction

While the impacts of natural disasters have been widely documented, their effects on the Big Five personality traits have not yet been explored (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019). The Big Five personality traits—also known as the Five-Factor Model—refer to five broad dimensions of personality: Agreeableness, Conscientiousness, Emotional Stability, Extraversion, and Openness to Experience (Goldberg 1981; John & Srivastava 1999). These traits are widely used in psychology and are increasingly applied in other disciplines as well. This gap in the literature is significant, given the growing concern over the consequences of climate change-related disasters and the well-established relationship between the Big Five personality traits and various life outcomes (Borghans *et al.* 2008; Almlund *et al.* 2011; Heckman *et al.* 2021). This study addresses this gap by presenting a novel investigation into the causal effects of natural disaster-induced home damage on the Big Five personality traits.

By examining how such home damage influences personality traits, this study contributes to two broad strands of literature. The first is an extensive body of research on the impacts of natural disasters on life outcomes (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019). Within this literature, the present study is closely related to work examining the effects of weather-related home damage on outcomes such as health (Baryshnikova & Pham 2019; Mitchell *et al.* 2024; Li & Leppold 2025), financial status (Johar *et al.* 2022), life satisfaction (Gunby & Coupé 2023; Nguyen & Mitrou 2024a), residential mobility (Nguyen & Mitrou 2024b), and locus of control (Nguyen & Mitrou 2025a). However, none of these studies has investigated the effects of such events on the Big Five personality traits, as this study does.

Second, this study contributes to the rich literature examining the relationship between the Big Five personality traits and life outcomes (Borghans *et al.* 2008; Almlund *et al.* 2011; Heckman

*et al.* 2021)).<sup>1</sup> This literature has shown that these traits are associated with a wide range of outcomes, including educational choices (Lundberg 2013; Coenen *et al.* 2021), labour market outcomes (Heineck & Anger 2010; Uysal & Pohlmeier 2011; Fletcher 2013; Alderotti *et al.* 2023; Flinn *et al.* 2025), entrepreneurship (Hamilton *et al.* 2019), financial status (Brown & Taylor 2014; Gerhard *et al.* 2018), and investment decisions (Hammond & Morrill 2016; Bucciol & Zarri 2017; Basic-Sontic *et al.* 2017; Jiang *et al.* 2024).

Some studies also explore how specific Big Five personality traits help individuals cope with negative shocks (Kesavayuth *et al.* 2015; Chen & Wang 2024). For instance, Kesavayuth *et al.* (2015) find that women with high agreeableness or low conscientiousness are less adversely affected by mental illness than the average woman. Similarly, Chen and Wang (2024) show that conscientiousness mitigates income losses among Chinese college graduates entering the labour market during recessions.

Further, this literature has examined both the stability of the Big Five personality traits across the life cycle (Haehner *et al.* 2024) and the effects of major life events on personality change. Early studies often found minimal impacts (Cobb-Clark & Schurer 2012; Elkins *et al.* 2017), although more recent research suggests that events such as unemployment (Boyce *et al.* 2015) and involuntary job loss (Anger *et al.* 2017) can alter certain traits. This study contributes to this evolving literature by providing the first causal evidence linking weather-related home damage to changes in the Big Five personality traits. This contribution is particularly important in light of mounting concerns over the psychological and behavioural consequences of extreme weather events and the prevailing assumption in prior research that the Big Five personality traits are largely stable, with limited responsiveness to major life events.

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<sup>1</sup> This study also relates to research on other personality traits closely associated with the Big Five, including locus of control (see reviews by Borghans *et al.* (2008); Almlund *et al.* (2011); Heckman *et al.* (2021); Nguyen *et al.* (2024)). The specific relationship between each of the Big Five personality traits and documented outcomes varies depending on the trait in question, the life outcomes examined, and empirical methods employed.

To examine the causal effects of natural disaster-induced home damage on individuals' Big Five personality traits, this study leverages longitudinal data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, which includes individual-level self-reported measures of both natural disaster-related home damage and Big Five personality traits. To address the potential endogeneity of self-reported home damage, we employ an individual fixed effects instrumental variables (FE-IV) approach. This method builds on a substantial body of literature that successfully uses climatic factors as instruments to identify causal effects (Brückner & Ciccone 2011; Dustmann *et al.* 2017; Baryshnikova & Pham 2019; Imbert *et al.* 2022; Nguyen & Mitrou 2025a). Specifically, we use a time-varying measure of plausibly exogenous exposure to local cyclones as an instrument within the FE-IV framework. This model is used to estimate the causal impact of disaster-related home damage on each of the Big Five personality traits, both at the mean and across their distributions.

This study presents three main findings. First, we find that weather-related home damage significantly reduces Conscientiousness and Emotional Stability while increasing Openness to Experience. The results also reveal pronounced heterogeneity: significant effects are observed only in the quantile regression models, with individuals at the lower end of the Conscientiousness and Emotional Stability distributions being more adversely affected, and those at the higher end of the Openness distribution experiencing greater increases. The estimated effects are substantial—weather-related home damage can reduce Conscientiousness by up to 0.32 standard deviations (SD), lower Emotional Stability by 0.39 SD, and increase Openness to Experience by up to 0.29 SD.

Second, the estimated effects underscore the potential economic relevance of personality shifts induced by extreme weather events. Weather-related home damage may indirectly suppress earnings by altering personality traits in ways associated with lower income. These effects are

economically meaningful, corresponding to estimated earnings losses of up to 5%, with socioeconomically disadvantaged individuals most severely affected.

Third, while our heterogeneity analysis suggests no consistent pattern of differential impacts by gender, it reveals notable age-related differences. Specifically, the effects of home damage on Emotional Stability are more pronounced among younger individuals, while the effects on Conscientiousness and Openness to Experience are stronger among older individuals. Additionally, the impacts on Agreeableness and Extraversion are positive for older individuals and negative for younger individuals.

The remainder of this study is structured as follows. Section 2 describes the main data sources and the sample used in the analysis. Section 3 outlines the empirical model. Section 4 presents the main regression results and discusses the economic implications of the estimated impacts of weather-related home damage. Section 5 reports the results of heterogeneous effects by gender and age group. Finally, Section 6 concludes the paper.

## **2. Data and sample**

### **2.1. Data**

The primary data source for this study is the Household, Income and Labour Dynamics in Australia (HILDA) Survey—a nationally representative, longitudinal study that has tracked individuals from private households annually since 2001 (Summerfield *et al.* 2024). A key strength of HILDA is its ability to follow respondents over time, even after residential relocation, thereby preserving the sample’s representativeness and enabling the use of individual fixed effects models. This feature supports robust analysis of the relationship between natural disaster exposure and the Big Five personality traits. The analysis is based on Release 23 of the HILDA Survey, covering the period from 2001 to 2023.

### **2.2. Natural disaster exposure measure**

This study defines an individual as directly impacted by a natural disaster if they report that their residence was damaged or destroyed by a weather-related event—such as a flood, bushfire, or cyclone—within the past 12 months. This identification is based on responses to the survey question: “Did any of these events occur to you in the past 12 months?”, specifically the item prompting: “A weather-related disaster (e.g., flood, bushfire, cyclone) damaged or destroyed your home”. This measure is available from Wave 9 onward (Summerfield *et al.* 2024). Appendix Table A1 provides brief descriptions and summary statistics of the main variables used in this study.

As documented above, this individual-level self-reported indicator has been widely used in Australian research as a proxy for direct exposure to natural disasters in studies examining various life outcomes (Baryshnikova & Pham 2019; Nguyen & Mitrou 2025a). Consistent with this literature, the present study employs self-reported home damage as the primary measure of direct natural disaster exposure to examine its effects on the Big Five personality traits.

### **2.3. *Big Five personality traits***

Respondents in the HILDA Survey were assessed on their personality traits using a 36-item inventory originally proposed by Goldberg (1992) and subsequently refined by Saucier (1994). Specifically, respondents were asked 36 questions framed as follows: “How well do the following words describe you?” For each item, respondents indicated their level of agreement on a 7-point Likert scale ranging from 1 (“Does not describe me at all”) to 7 (“Describes me very well”). Consistent with prior studies using HILDA’s personality data (Cobb-Clark & Schurer 2012; Elkins *et al.* 2017), this study employs the Big Five personality traits constructed from a subset of 28 items (Summerfield *et al.* 2024). Validation work by Losoncz (2009) has demonstrated that using 28 items yields equivalent conclusions to those based on the full 36-item inventory.

Specifically, Agreeableness is derived from four items: sympathetic, kind, cooperative, and warm. Conscientiousness is based on six items: orderly, systematic, inefficient (reversed), sloppy (reversed), disorganised (reversed), and efficient. Emotional Stability is constructed from six reversed-scored items: envious, moody, touchy, jealous, temperamental, and fretful. Extraversion is derived from six items: talkative, bashful (reversed), quiet (reversed), lively, and extroverted. Finally, Openness to Experience is based on six items: deep, philosophical, creative, intellectual, complex, and imaginative.

Each Big Five personality trait is calculated by averaging responses to the relevant items, with reversed items recoded as necessary to ensure consistent directionality. Raw scores range from 1 to 7, with higher values indicating a stronger presence of the respective trait (Summerfield *et al.* 2024). For ease of interpretation, all trait scores are standardized to have a mean of zero and a standard deviation of one, with higher standardized values indicating a greater tendency toward the corresponding trait.<sup>2</sup> In the current release (Release 23) of the HILDA Survey, Big Five personality data are available only in Waves 5, 9, 13, 17, and 21.

Appendix Table A2 presents the correlations among the five personality traits, revealing positive and highly statistically significant relationships (at the 1% level) among most of them. An exception is the negative and highly statistically significant correlation (at the 1% level) between Emotional Stability and Openness to Experience. However, the absolute magnitudes of the correlations are modest, with the strongest correlation being 0.33, observed between Emotional Stability and Conscientiousness.

## **2.4. Sample**

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<sup>2</sup> Since different samples are used throughout this study, all personality trait scores are standardized using all valid observations from Release 23 to ensure comparability. As a result, standardized scores for specific subsamples—such as the main analytic sample—may deviate slightly from a mean of zero or a standard deviation of one.



The unit of analysis in this study is the individual, as both the Big Five personality trait measures and natural disaster exposure variables are recorded at the individual level. The sample is restricted to waves of the HILDA Survey that include both sets of measures—Waves 9, 13, 17, and 21—corresponding to the survey years 2009, 2013, 2017, and 2021, respectively. To facilitate the use of individual fixed effects in the empirical analysis, we further restrict the sample to individuals who are observed at least twice during the study period. These criteria yield a final sample of over 50,000 individual-year observations from more than 16,000 unique individuals, each observed up to four times over a 12-year period.

### 3. Empirical model

To examine the impact of weather-related home damage on each of the Big Five personality traits  $Y_{it}$  of individual  $i$  at time  $t$ , we adopt an individual fixed effects regression model, following previous studies (Johar *et al.* 2022; Gunby & Coupé 2023; Nguyen & Mitrou 2025a):

$$Y_{it} = \alpha_1 + \beta_1 D_{i(t-1)} + X_{it}\gamma_1 + \pi_i + \mu_{1it} \quad (1)$$

In Equation (1),  $D_{i(t-1)}$  is a binary variable indicating whether the individual reported that their home was damaged or destroyed by a weather-related event in the 12 months preceding the survey, as detailed in Subsection 2.2.  $X_{it}$  is a vector of time-varying control variables recorded at the time of the survey or during the survey year (see Appendix Table A1 for detailed variable descriptions).  $\pi_i$  captures unobserved individual-specific time-invariant characteristics, and  $\mu_{1it}$  is the idiosyncratic error term.  $\alpha_1$ ,  $\beta_1$  and  $\gamma_1$  are parameters to be estimated, with  $\beta_1$  being the coefficient of primary interest, reflecting the effect of home damage on the individual's Big Five personality traits.

While Equation (1) accounts for time-invariant unobserved heterogeneity across individuals, it does not fully address potential endogeneity concerns related to reverse causality or unobserved time-varying confounders in the self-reporting of weather-related home damage. Specifically,

it remains unclear whether reported home damage influences personality traits, or whether individuals with certain personality traits are more likely to report such damage. Nguyen and Mitrou (2025b), using the same dataset, document substantial inconsistencies in self-reported home damage among co-residing household members. Their findings suggest that factors such as individual health, life satisfaction, and local socio-economic conditions are systematically associated with both the likelihood of reporting damage and inconsistencies within households. These observations imply that self-reported home damage may be endogenous in Equation (1). Furthermore, unobserved time-varying individual-level factors that correlate with both personality traits and the likelihood of home damage reporting could bias the fixed effects estimates. Such endogeneity—whether arising from reverse causality or unobserved time-varying confounders—may lead to biased estimation of  $\beta_1$  (Wooldridge 2010).

To address concerns regarding endogeneity, we follow the empirical strategy employed in prior studies (Baryshnikova & Pham 2019; Nguyen & Mitrou 2025a), modelling the self-reported home damage indicator as a function of an instrumental variable, as specified in the following equation:

$$D_{i(t-1)} = \alpha_2 + \beta_2 Z_{i(t-1)} + X_{it} \gamma_2 + \pi_i + \mu_{2it} \quad (2)$$

In Equation (2),  $Z_{i(t-1)}$  denotes an instrumental variable,  $\mu_{2it}$  is the error term, and  $\alpha_2$ ,  $\beta_2$  and  $\gamma_2$  are vectors of parameters to be estimated. The definitions of  $X_{it}$  and  $\pi_i$  are consistent with those in Equation (1).

Motivated by a large international literature<sup>3</sup> and building on Australian studies that have successfully employed exposure to local natural disasters to identify the causal impact of

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<sup>3</sup> Climatic factors and extreme weather events have been widely used in the instrumental variable literature to identify the causal effects of various potentially endogenous variables. For example, they have been used as instruments for economic growth (Edward Miguel *et al.* 2004), income (Brückner & Ciccone 2011; Imbert *et al.* 2022), school displacement (Imberman *et al.* 2012), livestock prices (Maystadt & Ecker 2014), migration (Dustmann *et al.* 2017), demand for water (Unfried *et al.* 2022), time allocated to physical activity (Nguyen *et al.*

weather-related home damage on outcomes such as mental health (Baryshnikova & Pham 2019) and locus of control (Nguyen & Mitrou 2025b), this study uses a time-varying variable capturing individual exposure to a local cyclone as an instrument in the home damage equation (2). Specifically, our instrument—closely aligned with that used by Nguyen and Mitrou (2025b) and representing an improvement over the instrument employed by Baryshnikova and Pham (2019)—takes the value of one if the individual resided in a postcode whose centroid was located within 100 kilometres of a cyclone’s eye in the year preceding the survey, and zero otherwise.<sup>4</sup>

As documented by Nguyen and Mitrou (2025b), this variable is likely to serve as a valid instrument for five main reasons. First, the cyclone-exposure-based instrument is theoretically justified, as cyclones are explicitly listed in the survey as one of the natural disasters that can cause home damage. Second, the instrument is empirically supported by prior Australian research by Nguyen and Mitrou (2024b), which finds that cyclone exposure significantly increases the likelihood of self-reported weather-related home damage. Third, plausibly exogenous cyclone exposure is likely to cause home damage directly and precede any effects on an individual’s Big Five personality traits. This temporal ordering supports the exclusion restriction assumption, which requires that the instrument affects personality traits only through its impact on home damage (Wooldridge 2010).

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2022), crop loss (Quiñones *et al.* 2023), local demand shocks (Bernile *et al.* 2023), and church attendance (Moreno-Medina 2023).

<sup>4</sup> Following the methodology outlined by Nguyen and Mitrou (2024b, 2025c, 2025b), this study links the HILDA data to the historical cyclone database maintained by the Australian Bureau of Meteorology. The linkage is achieved by matching cyclone paths and dates from the historical database with the centroid of each respondent’s residential postcode and their interview date in the HILDA survey. We use the restricted-access version of the HILDA dataset, which requires a formal application process and provides postcode-level geographic information—offering the highest level of spatial granularity available (Summerfield *et al.* 2024). We employ this cyclone exposure measure to ensure a sufficient number of affected individuals for robust analysis. Specifically, Appendix Table A1 shows that over 4,000 individuals—approximately 8.3% of the sample—were exposed to a cyclone within 100 km of their residential postcode centroid. This level of exposure provides adequate variation to identify the impact of cyclones on weather-related home damage (Wooldridge 2010). Compared to the state-level disaster exposure instrument used by Baryshnikova and Pham (2019), our instrument is more objective—being derived independently of human behaviour—and more granular, as it is based on postcode-level exposure to cyclones.

Fourth, the structure of the HILDA survey enhances the validity of the instrument: while home damage is measured with reference to the 12 months preceding the survey date ( $D_{i(t-1)}$ ), personality traits are recorded at the time of the survey ( $Y_{it}$ ). This lag allows sufficient time for the effects of home damage to manifest and aligns with the measurement period of the instrument ( $Z_{i(t-1)}$ ), thereby reinforcing the exclusion restriction. Fifth, the instrument varies over time for the same individuals, enabling its application in individual fixed effects models that account for both time-invariant and time-varying unobserved characteristics. The ability to control for individual fixed effects, including residential preferences, is especially important given empirical evidence that areas prone to natural disasters tend to exhibit higher levels of socioeconomic disadvantage (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019).

Following previous studies on factors influencing individual personality traits (Cobb-Clark & Schurer 2012; Elkins *et al.* 2017; Nguyen *et al.* 2024) and to address concerns about potential endogeneity of the included variables, we include a parsimonious set of time-varying covariates at the individual, household, and local area levels in  $X_{it}$ . These covariates include the individual's age (and its square), educational attainment, household size, and an indicator for residing in a major city. To address temporal heterogeneity in outcomes, we include survey year and quarter dummies. In addition, we control for geographic variation by incorporating state and territory fixed effects in both equations. We further account for local socio-economic conditions that may influence individual behaviours by including regional unemployment rates and the Socio-Economic Indexes for Areas (SEIFA) scores.

We model the effect of home damage on each of the Big Five personality traits at the individual level because both the treatment and outcome variables are measured at the individual level. We estimate the individual fixed-effects model in Equation (1) using Ordinary Least Squares (OLS), and apply Two-Stage Least Squares (2SLS) to estimate the fixed-effects instrumental

variable (FE-IV) model. Robust standard errors are clustered at the individual level to account for potential serial correlation (Cameron & Miller 2015).

The estimated coefficient  $\beta_1$  from these models captures the average treatment effect of weather-related home damage on each of the Big Five personality traits. To examine potential heterogeneity in these effects across the distribution of each trait—and thereby inform the design of more targeted and effective policy interventions—we also estimate quantile treatment effects using appropriate quantile regression methods (Koenker & Bassett 1978; Firpo 2007; Firpo *et al.* 2009).

Specifically, to estimate Equation (1) at different points of the outcome distribution, we employ the unconditional quantile regression (UQR) method proposed by Firpo *et al.* (2009). Unlike the conditional quantile regression method developed by Koenker and Bassett (1978), the UQR approach enables the estimation of marginal effects of explanatory variables, including weather-related home damage, on the unconditional quantiles of  $Y_{it}$ , without requiring the rank-preserving assumption (Firpo 2007; Firpo *et al.* 2009). Furthermore, to estimate the quantile IV regression equations (1) and (2), we apply a quantile regression for panel data (QRPD) method by Powell (2020, 2022), which accommodates both individual fixed effects and instrumental variable methods within a quantile FE-IV framework. A similar strategy has been employed by two prior Australian studies to explore the heterogenous impacts of weather-related home damage on mental health (Baryshnikova & Pham 2019) and locus of control (Nguyen & Mitrou 2025b).

## **4. Main results**

### **4.1. Descriptive results**

Table 1 presents notable differences in key characteristics between individuals who reported weather-related home damage and those who did not. Specifically, 672 individuals—

representing 1.32% of the main analytic sample—reported experiencing weather-related home damage. This sample size, combined with the substantial within-individual variation in both home damage and personality traits (as demonstrated in Appendix Table A1), is sufficient to investigate the potential impact of home damage on the Big Five personality traits and supports the robust application of an individual fixed effects model (Wooldridge 2010).

Compared to those who did not report such damage, individuals who did are more likely to have been born overseas—particularly in non-English-speaking countries—and are less likely to hold a bachelor’s degree or higher, indicating lower levels of educational attainment.<sup>5</sup> They also tend to experience greater socio-economic disadvantage, residing in regions with lower socio-economic status or in non-metropolitan areas; however, these regions typically exhibit lower unemployment rates. Notably, individuals who reported home damage are significantly more likely to have been located within 100 km of a cyclone’s eye. This pattern is consistent with global evidence that disadvantaged populations are more likely to be exposed to elevated natural disaster risks, underscoring the importance of accounting for individual fixed effects when analysing the impacts of extreme weather events (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019).

Table 1 also reveals significant differences in three of the five aggregated personality traits between the two groups. Specifically, individuals who reported experiencing home damage score significantly lower in Conscientiousness and Emotional Stability, but higher in Openness to Experience, compared to their unaffected counterparts. This disparity is further illustrated in Appendix Figure A1, which presents the distribution of Big Five personality trait levels. Individuals who reported any weather-related home damage are overrepresented at the lower

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<sup>5</sup> For completeness and clarity of presentation, this section reports summary statistics for selected time-invariant individual characteristics, such as gender and migration status. Although these variables are excluded from regressions that include individual fixed effects, they are included in models without such controls.

end of the distribution for Conscientiousness and Emotional Stability, and underrepresented at the lower end of the distribution for Openness to Experience.

Furthermore, Figure 1, which presents changes in individuals' Big Five personality traits relative to the previous wave by change in home damage status, indicates that those who did not report home damage in the previous wave but did in the current wave (denoted as "Damage Onset") may exhibit increases in Agreeableness, Extraversion, or Openness to Experience, relative to individuals who experienced home damage in the previous wave but not in the current wave (denoted as "Damage Offset").<sup>6</sup> This pattern is evidenced by their underrepresentation at the negative end of the change distribution for these traits. In contrast, individuals in the "Damage Onset" group tend to exhibit decreases in Emotional Stability, as they are overrepresented at the negative end of that trait's change distribution.

#### **4.2. Main regression results**

Table 2 presents estimates of weather-related home damage on the Big Five personality traits using various estimators. The results from the pooled regression, which does not control for individual fixed effects and is reported in Column 1, indicate that weather-related home damage is statistically significantly (at the 5% level or better) and negatively associated with Conscientiousness and Emotional Stability, but positively associated with Openness to Experience. In contrast, the individual fixed effects (FE) estimates, reported in Column 2, reveal a much less pronounced relationship. Compared to the pooled estimates, the FE coefficients are smaller in absolute magnitude and generally less statistically significant. For example, the FE estimates are statistically significant at the 5% level or better only for

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<sup>6</sup> For comparison and illustrative purposes, we focus on these two seemingly opposite groups. We do not include the remaining group—individuals who were either consistently affected or unaffected by home damage across two consecutive survey waves—as changes in personality traits within this group are less pronounced than those observed in the two groups presented here.

Emotional Stability and Openness to Experience, and the corresponding coefficients are notably smaller in absolute value.

Columns 3 and 4 of Table 2 report the results from two instrumental variable (IV) estimators at the mean, revealing two main patterns. First, the statistically significant estimates of the instrument indicate that it is empirically strong.<sup>7</sup> Specifically, the coefficients on the cyclone exposure variable in the first-stage pooled and FE regressions—reported in Columns 1 and 2 of Appendix Table A3, respectively—are positive and highly statistically significant at the 1% level. These results suggest that individuals affected by a cyclone occurring within 100 km of its eye are more likely to report weather-related home damage. For instance, consistent with the findings of Nguyen and Mitrou (2024b), the first-stage estimate from the FE-IV regression indicates that such individuals are approximately 1.04 percentage points more likely to report home damage (Column 2 of Appendix Table A3). Importantly, the first-stage F-statistics, reported in the notes to Table 2, exceed 18 in both IV regressions, thereby strongly rejecting the null hypothesis of a weak instrument (Stock & Yogo 2005).

Second, the IV estimates of home damage are statistically insignificant for all personality traits, regardless of whether individual fixed effects are included. Thus, the estimates from both IV specifications indicate no statistically significant effect of weather-related home damage on any of the Big Five personality traits at the mean.

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<sup>7</sup> The remaining results from the instrumental variable regressions at the mean are reported in Appendix Table A3 and are generally consistent with prior evidence. For example, in line with earlier Australian findings (Nguyen & Mitrou 2024b, 2025b), the first-stage regression results (Columns 1 and 2) indicate that individuals residing in socioeconomically disadvantaged areas—measured by higher unemployment rates or classification as non-major city areas—are more likely to report weather-related home damage. Furthermore, the second-stage estimates (reported in Columns 3 to 12) show that selected individual- and household-level characteristics, including age, gender (in pooled regressions only), education, and household size, are statistically associated with certain Big Five personality traits.

For brevity and focus, we present only the results from the quantile FE-IV regressions—our preferred specification—in the main text. It should also be noted that while the quantile FE-IV regressions account for endogeneity via the instrument, they do not report first-stage estimates (Powell 2022). Results from alternative quantile estimators are reported in Appendix Table A4.



The quantile FE-IV estimates (Columns 5 to 13 of Table 2) reveal statistically significant effects of weather-related home damage on three of the Big Five personality traits, with both the magnitude and significance of these effects varying across the trait distributions. Figure 2 provides a graphical summary of these estimates across nine deciles for the three affected traits. Notably, the estimates for Conscientiousness are consistently negative and statistically significant at the 1% level across all nine deciles (Panel B of Table 2). Moreover, the effect increases in absolute magnitude toward the lower end of the distribution, peaking at the 10th quantile. Specifically, weather-related home damage is associated with a reduction in Conscientiousness of only 0.04 SD at the 90th quantile, compared to a much larger reduction of 0.32 SD at the 10th quantile—roughly eight times the magnitude observed at the upper end ( $\approx -0.32 / -0.04$ ).

A similar pattern is observed for Emotional Stability. The estimates are again consistently negative and statistically significant at the 1% level across all deciles (Panel C). The effects are more pronounced among individuals at the lower end of the Emotional Stability distribution, increasing in absolute value from a reduction of 0.07 SD at the highest end to a peak impact of 0.39 SD at the 30th quantile, after which the effect decreases slightly.

By contrast, for Openness to Experience, the estimates are statistically significant and positive across almost all deciles (Panel E), indicating that individuals exposed to home damage tend to exhibit increased levels of this trait. The estimates are somewhat volatile at the lower end of the distribution but increase from the median onward, peaking at the 70th quantile before tapering off slightly. Notably, the effect at the highest quantile is approximately double that observed at the lowest quantile ( $\approx 0.20 / 0.10$ ).

For the remaining two traits—Agreeableness (Panel A) and Extraversion (Panel D)—the estimates are generally statistically insignificant, aligning with the results from the pooled and FE regressions (Columns 1 and 2, respectively), or inconsistent across the distribution. One

notable exception is at the 90th quantile of Agreeableness, where the effect of home damage is positive and statistically significant at the 1% level, indicating a 0.16 SD increase in this trait following exposure to home damage (Panel A; Column 13). Similarly, individuals at the 60th quantile of the Extraversion distribution experience a 0.06 SD increase in this trait, whereas those at the 20th quantile show a 0.08 SD decrease. These opposing effects across the distribution likely explain the statistically insignificant average effect of home damage on Extraversion observed in the mean-based FE-IV model. Likewise, the inconsistent and generally insignificant effects across the distribution of Agreeableness contribute to the lack of a significant effect at the mean.

Overall, the preferred quantile FE-IV regressions indicate that weather-related home damage significantly reduces Conscientiousness and Emotional Stability, while increasing Openness to Experience. Moreover, the results highlight heterogeneous effects: individuals at the lower end of the Conscientiousness and Emotional Stability distributions are more adversely affected, whereas those at the higher end of the Openness distribution experience larger increases. These substantial and varying impacts across the trait distributions underscore the importance of moving beyond average effects. As discussed below, our finding that the most pronounced impacts are observed among individuals who are typically more economically disadvantaged carries important policy implications, suggesting that such individuals may be disproportionately affected by extreme weather events.

#### ***4.3. Economic implications of the estimated impacts of weather-related home damage***

To provide an economic perspective on the estimated impacts of weather-related home damage, this subsection examines the relationship between each of the Big Five personality traits and individual earnings. Specifically, we estimate regressions of individual earnings—measured as

annual regular market income<sup>8</sup>—on each of the Big Five traits, controlling for a standard set of individual, household, and local area characteristics, as defined in  $X_{it}$  in Equation (1) and described in detail in Section 3. To address potential multicollinearity among the personality traits, we include each trait separately in the regressions. Moreover, we estimate a pooled OLS model, which does not account for individual fixed effects—in line with most prior studies (for a recent review, see Alderotti *et al.* (2023)).<sup>9</sup>

The regression results, presented in Appendix Table A5, reveal two noteworthy patterns. First, the estimates are statistically significant at the 1% level for all personality traits except Agreeableness. Specifically, earnings are positively associated with Conscientiousness, Emotional Stability, and Extraversion, and negatively associated with Openness to Experience. These findings suggest that individuals with higher levels of Conscientiousness, Emotional Stability, and Extraversion, but lower levels of Openness to Experience, tend to have higher earnings.

This pattern is broadly consistent with findings from a meta-review by Alderotti *et al.* (2023), which reports a positive association between individual earnings and Conscientiousness, Emotional Stability (or the reverse of Neuroticism, as referred to in their study), Extraversion, and Openness, and a negative association with Agreeableness.<sup>10</sup> Our findings align more

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<sup>8</sup> Individual annual regular market income is defined as the sum of wage and salary earnings, business income, investment income, and regular private pension income (measured in thousands of 2010 AU\$, adjusted for inflation using the CPI). To enable the use of the natural logarithm transformation, we assign a value of AU\$1 to a small number of individuals with zero or negative annual regular market income. This allows us to express the dependent variable in logarithmic form, facilitating the interpretation of regression coefficients as approximate percentage changes. We obtain qualitatively similar results when using equivalised household disposable income. As noted above, this regression includes several time-invariant explanatory variables, such as gender and migration status, consistent with other specifications that do not control for individual fixed effects. The sample is restricted to individuals in HILDA with complete data on all included variables.

<sup>9</sup> However, unreported individual FE regression results—which exploit within-individual variation over time—yield weaker associations, both in magnitude and statistical significance. Importantly, the estimated relationships between the Big Five personality traits and earnings, even when using individual FE models, should not be interpreted as causal due to persistent endogeneity concerns. Identifying the causal impact of personality traits on life outcomes, including earnings, remains a significant methodological challenge and represents an important avenue for future research (Borghans *et al.* 2008; Almlund *et al.* 2011; Heckman *et al.* 2021; Alderotti *et al.* 2023).

<sup>10</sup> Alderotti *et al.* (2023) also note that the results vary depending on the empirical methodology, country context, and the ranking and disciplinary focus of the journal in which the study is published.

closely with those of a recent economics study by Flinn *et al.* (2025), which uses German data to demonstrate that higher levels of Conscientiousness and Emotional Stability, coupled with lower levels of Agreeableness, are associated with higher earnings and greater job stability.

Second, the magnitude of the estimated associations is economically meaningful. For example, the pooled regression coefficient for Conscientiousness on log earnings is 0.17 (Appendix Table A5, Column 2), indicating that a one standard deviation increase in Conscientiousness is associated with an approximate 17% increase in individual earnings. Among the three personality traits found to be positively associated with earnings in this study, Conscientiousness exhibits the strongest effect. In contrast, the negative and statistically significant coefficient for Openness to Experience (−0.08 in Column 5) suggests that a one standard deviation increase in this trait is associated with an approximate 8% reduction in earnings.

These regression results, when considered alongside our earlier findings on the effects of weather-related home damage on personality traits presented in Subsection 4.2, yield two key insights. First, our quantile FE-IV estimates indicate that weather-related home damage significantly reduces Conscientiousness and Emotional Stability while increasing Openness to Experience. When juxtaposed with the earnings regression results—showing that Conscientiousness and Emotional Stability are positively associated with earnings, whereas Openness is negatively associated—these findings suggest that weather-related home damage may indirectly suppress earnings by altering personality traits in ways associated with lower income.

Second, in relative terms, the estimated impacts are economically meaningful. For example, the largest estimated effect of weather-related home damage on Conscientiousness—a reduction of 0.32 SD at the 10th quantile (Table 2, Panel B, Column 5)—corresponds to an estimated earnings loss of approximately 5.4% (i.e.,  $0.17 \times 0.32 \approx 0.054$ ). Likewise, the

maximum estimated effect on Emotional Stability—a reduction of 0.39 SD at the 30th quantile (Table 2, Panel C, Column 7)—is associated with an earnings decline of around 2.3% (i.e.,  $0.06 \times 0.39 \approx 0.023$ ). For Openness to Experience, the maximum estimated increase of 0.29 SD (Table 2, Panel E, Column 11) implies an earnings reduction of approximately 2.3% (i.e.,  $-0.08 \times 0.29 \approx -0.023$ ).

Overall, the findings presented in this subsection underscore the potential economic relevance of personality shifts induced by extreme weather events. When considered alongside our earlier result in Subsection 4.2—that weather-related home damage disproportionately reduces Conscientiousness and Emotional Stability (traits positively associated with earnings) among individuals at the lower end of their respective personality distributions, while increasing Openness to Experience (a trait negatively associated with earnings) among individuals at the higher end—the evidence suggests that those who are already more economically disadvantaged may be disproportionately affected. This highlights a potential amplifying effect of extreme weather events on existing economic inequalities. In this context, our findings align with a broader body of research indicating that socioeconomically disadvantaged individuals are often more severely affected by natural disasters (Dell *et al.* 2014; Hsiang & Kopp 2018; Botzen *et al.* 2019). Taken together, these results highlight the critical need for targeted support measures to strengthen resilience and offer assistance to vulnerable groups.

## **5. Heterogeneity**

To investigate potential heterogeneity in the effects of home damage on the Big Five personality traits and to identify vulnerable subpopulations, we employ a quantile FE-IV regression model. This model is estimated separately for two distinct groups, defined by gender (male vs. female) and age (young vs. old, classified relative to the median age of the

population).<sup>11</sup> These characteristics were selected based on prior research suggesting that changes in personality traits in response to major life events may vary by gender and age (Cobb-Clark & Schurer 2012; Elkins *et al.* 2017; Haehner *et al.* 2024; Nguyen & Mitrou 2025a).

Figure 3 presents subgroup estimates by gender, revealing notable differences in the impact of weather-related home damage on the Big Five personality traits. These effects vary by trait and across the distribution of each trait. Specifically, the estimated effects of home damage on Conscientiousness are generally more negative and statistically significant for females across most deciles, except at the four lowest deciles, where the estimates are comparable between the two groups. The gender difference is statistically significant—at least at the 5% level—from the median to the upper end of the distribution, as evidenced by non-overlapping 95% confidence intervals. These findings suggest that weather-related home damage has a more detrimental effect on Conscientiousness for females than for males.

For Emotional Stability, the pattern is mixed. The effect of home damage is more pronounced for females at the 10th, 40th, and 90th quantiles, whereas the opposite is observed at the 20th and 30th quantiles, where the effects are stronger for males. A similar pattern is observed for Openness to Experience: the estimated effects are more pronounced for females at the 30th, 40th, and 80th quantiles, but stronger for males at the 20th and 60th quantiles.

Figure 3 also shows that, consistent with the pooled regression results, the estimated effects are most statistically significant for the three previously identified traits—Conscientiousness,

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<sup>11</sup> We conducted a similar heterogeneity analysis of the impact of home damage on the mean of each of the Big Five personality traits using the FE-IV model across subgroups defined by gender and age. Consistent with the population-level FE-IV estimates at the mean, all subgroup estimates of home damage are statistically insignificant (see Appendix Table A6). Furthermore, the results in Appendix Table A6 support the empirical strength of the instrument, as the first-stage F-statistic generally exceeds the conventional threshold of 10. However, in certain cases—such as the separate regression for females—the F-statistic falls below 10, indicating potential weak instrument concerns; accordingly, these estimates should be interpreted with caution. We refrain from conducting additional heterogeneity analyses based on other characteristics due to the lack of a strong theoretical or empirical rationale, or because of limited statistical power resulting from small sample sizes or weak instruments.

Emotional Stability, and Openness to Experience. Among these, the effects are most pronounced at the lower end of the Conscientiousness and Emotional Stability distributions, and at the upper end of the Openness to Experience distribution.

Furthermore, Figure 3 shows that, consistent with the pooled regression results, the estimated effects of home damage are generally not statistically significant for Agreeableness and Extraversion. However, notable subgroup effects emerge depending on gender and the point in the distribution. For example, the estimates for Agreeableness are positive and statistically significant (at the 5% level or better) for males from the 20th to the highest decile, except at the 50th and 60th percentiles. In contrast, the estimates are negative and statistically significant for females at the 20th, 40th, 50th, and 60th percentiles. Gender differences in the impact of home damage on Agreeableness—generally reflecting more positive effects for males—are statistically significant at the 20th, 40th, 50th, 80th, and 90th percentiles, as evidenced by non-overlapping 95% confidence intervals.

For Extraversion, the effects of weather-related home damage are positive and statistically significant for females at selected quantiles, including the 20th, 60th, 70th, and 80th percentiles. In contrast, the effects for males are negative and statistically significant at the 10th, 20th, and 80th percentiles, but positive at the 50th, 60th, and 70th percentiles. Gender differences in the impact of home damage on this trait—exhibiting a mixed pattern across the distribution—are statistically significant at the 10th, 20th, 30th, 70th, and 80th percentiles, as evidenced by non-overlapping 95% confidence intervals.

Figure 4 presents the quintile FE-IV estimates of the effect of home damage by age group, revealing heterogeneous effects across selected quantiles and personality traits. In particular, for Conscientiousness, the estimates are more pronounced—i.e., more negative and statistically significant—for older individuals in the upper quantiles (60th to 90th quantiles). These age-

related differences are statistically significant at the corresponding quantiles, as evidenced by non-overlapping 95% confidence intervals.

A similar pattern is observed for Openness to Experience, where the estimates are generally larger for older individuals, with statistically significant age differences at the 10th, 40th, 50th, and 80th quantiles. An exception occurs at the 90th quantile, where the estimate is higher and statistically significant only for younger individuals. In contrast, for Emotional Stability, the estimates are more pronounced for younger individuals in the lower quantiles (10th to 70th quantiles), with statistically significant differences between age groups at these quantiles, as indicated by non-overlapping 95% confidence intervals.

Regarding Agreeableness, the subgroup estimates differ in direction: they are positive and statistically significant for older individuals at all quantiles except the 50th, 60th, and 70th, while for younger individuals, the estimates are negative and statistically significant at all quantiles except the 50th, 60th, 70th, and 90th. The age-related differences are statistically significant at all quantiles except the 50th, 60th, and 70th.

A similar pattern is observed for Extraversion, where the estimates are positive and statistically significant for older individuals at the 10th, 30th, 40th, 60th, and 70th quantiles, and negative and statistically significant for younger individuals at the 10th, 20th, 50th, 60th, and 70th quantiles. The age-based differences at the 10th, 20th, 30th, 60th, and 70th quantiles are statistically significant, as indicated by non-overlapping 95% confidence intervals.

Overall, these heterogeneous effects suggest no clear pattern of differential impacts by gender. However, consistent age-related patterns emerge: the effects of home damage are more pronounced for younger individuals in Emotional Stability, and for older individuals in



Conscientiousness and Openness to Experience. Moreover, the effects are positive for older individuals and negative for younger individuals in both Agreeableness and Extraversion.<sup>12</sup>

## **6. Conclusion**

This paper has presented an initial investigation into the causal effects of natural disaster-induced home damage on the Big Five personality traits. To address endogeneity concerns, the analysis employs an individual fixed effects instrumental variable framework, leveraging a time-varying and plausibly exogenous measure of exposure to local cyclones.

The study yields three key findings. First, weather-related home damage significantly reduces Conscientiousness and Emotional Stability while increasing Openness to Experience. These effects are highly heterogeneous: statistically significant impacts emerge only in quantile regression models, with individuals at the lower end of the Conscientiousness and Emotional Stability distributions more adversely affected, and those at the upper end of the Openness distribution experiencing greater increases.

Second, the estimated effects are not only statistically significant but also substantial in magnitude and economically meaningful. Specifically, weather-related home damage is associated with reductions in Conscientiousness of up to 0.32 SD, in Emotional Stability of up to 0.39 SD, and an increase in Openness to Experience of up to 0.29 SD. These personality changes are associated with lower earnings potential and may translate into income losses of up to 5%, with socioeconomically disadvantaged individuals most severely affected.

Third, while no consistent gender-based patterns are observed, the results reveal notable age-related heterogeneity. The negative effects on Emotional Stability are more pronounced among

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<sup>12</sup> However, when considered alongside the previously documented associations between each of the Big Five personality traits and individual earnings (see Subsection 4.3), these age-related differences in the impact of home damage suggest that the net effect of home damage on age-related earnings disparities via personality traits remains ambiguous, contingent on which traits are most affected and the nature of their association with individual earnings.

younger individuals, whereas the effects on Conscientiousness and Openness to Experience are stronger among older individuals. Additionally, Agreeableness and Extraversion tend to increase for older individuals and decline for younger ones.

These findings carry both methodological and policy implications. Methodologically, the findings highlight the importance of addressing the endogeneity of self-reported home damage and underscore the value of examining distributional effects beyond average treatment effects. From a policy perspective, the novel finding that natural disaster-induced home damage can causally alter personality traits in ways associated with lower income highlights the need for targeted support for affected individuals. The disproportionate impact on already disadvantaged populations further underscores the importance of resilience-building interventions and tailored assistance to the most severely affected groups, in order to mitigate long-term socioeconomic harm and reduce inequality.

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Table 1: Sample means of key variables by weather-related home damage status

	With home damage	Without home damage	With - Without (1) - (2)
	(1)	(2)	(3)
Age (years)	47.141	46.700	0.441
Male	0.461	0.462	-0.001
ESB immigrant	0.089	0.094	-0.005
NESB immigrant	0.080	0.110	-0.030**
Year 12 <sup>(a)</sup>	0.137	0.150	-0.013
Vocational or training qualification <sup>(a)</sup>	0.449	0.386	0.063***
Bachelor or higher <sup>(a)</sup>	0.141	0.213	-0.071***
Household size	2.896	2.815	0.081
Local area unemployment rate (%)	5.381	5.303	0.078***
Local area SEIFA index	4.452	5.573	-1.121***
Major city <sup>(a)</sup>	0.369	0.622	-0.253***
Exposure to any cyclone within 100 km <sup>(a)</sup>	0.150	0.082	0.068***
Agreeableness	0.059	0.022	0.037
Conscientiousness	-0.124	0.034	-0.158***
Emotional Stability	-0.111	0.028	-0.140***
Extroversion	0.011	-0.008	0.019
Openness to Experience	0.141	-0.003	0.143***
Observations	672	50,213	

Notes: Figures are sample means. The “with home damage” consists of individuals with self-reported weather-related home damage in the past year, while the “without home damage” includes those with no reported damage.

<sup>(a)</sup> indicates a binary variable. Tests are performed on the significance of the difference between the sample mean for treated and control groups. The symbol \*denotes significance at the 10% level, \*\* at the 5% level, and \*\*\* at the 1% level.

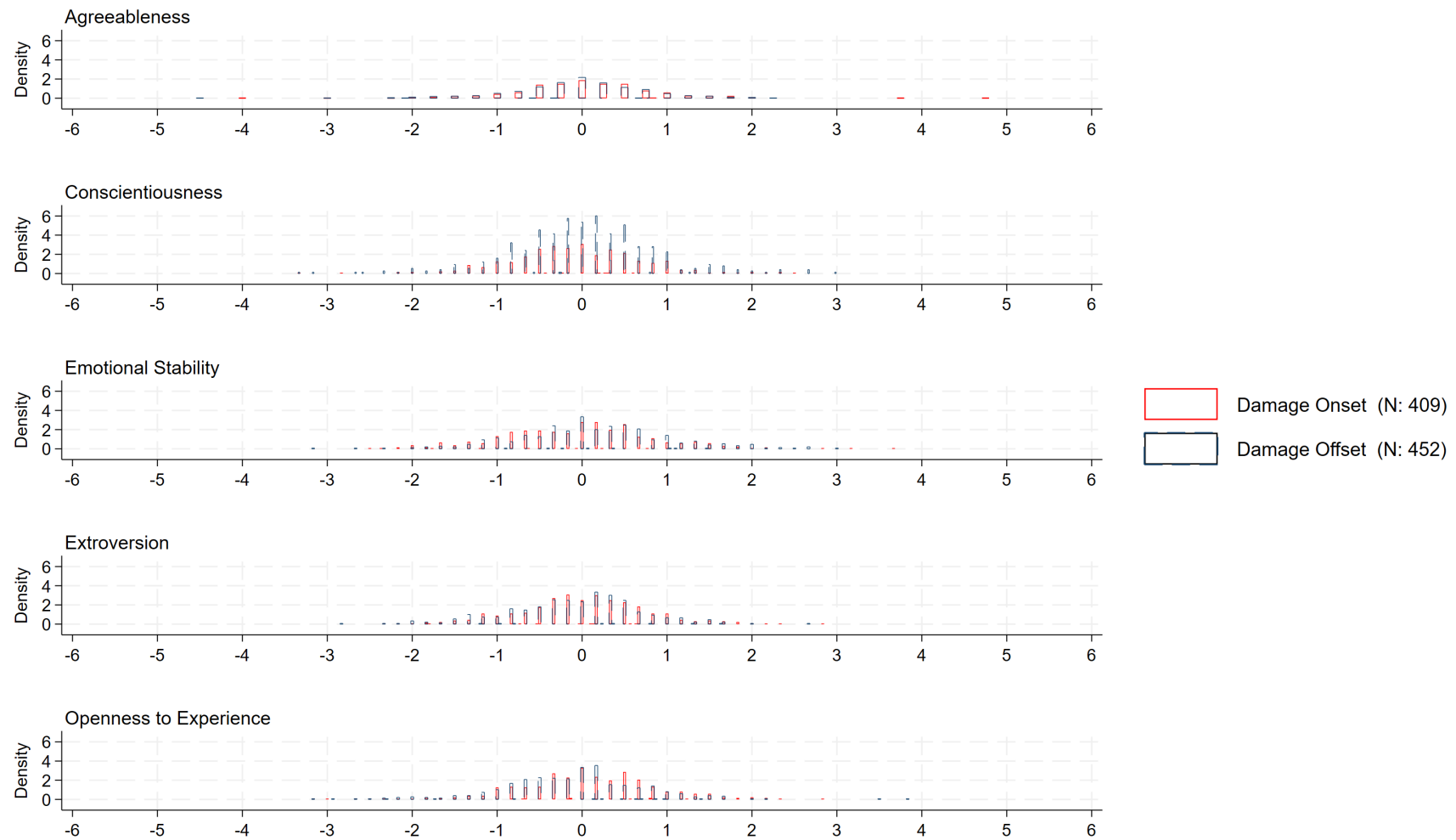
Table 2: Estimates of natural disaster-related home damage on the Big Five personality traits - Results from various estimators

Specification:	Pooled	FE	IV	FE-IV	Quantile FE-IV								
Regression at:	Mean	Mean	Mean	Mean	Q10th	Q20th	Q30th	Q40th	Q50th	Q60th	Q70th	Q80th	Q90th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
<b>Panel A: Agreeableness</b>													
Home damage	0.06*	0.05*	1.32	0.45	0.00	-0.03	-0.09*	0.01	0.02	-0.01	0.02	0.01	0.16***
	[0.04]	[0.03]	[1.61]	[1.18]	[0.01]	[0.03]	[0.05]	[0.01]	[0.02]	[0.03]	[0.02]	[0.04]	[0.03]
<b>Panel B: Conscientiousness</b>													
Home damage	-0.13***	-0.03	0.40	-0.58	-0.32***	-0.19***	-0.30***	-0.28***	-0.19***	-0.31***	-0.15***	-0.07***	-0.04***
	[0.04]	[0.03]	[1.52]	[1.06]	[0.05]	[0.00]	[0.04]	[0.03]	[0.01]	[0.08]	[0.03]	[0.00]	[0.01]
<b>Panel C: Emotional Stability</b>													
Home damage	-0.13***	-0.07**	1.40	1.38	-0.26***	-0.30***	-0.39***	-0.25***	-0.17***	-0.10***	-0.18***	-0.11***	-0.07***
	[0.04]	[0.03]	[1.60]	[1.18]	[0.04]	[0.04]	[0.05]	[0.05]	[0.03]	[0.02]	[0.03]	[0.01]	[0.01]
<b>Panel D: Extroversion</b>													
Home damage	0.05	0.02	0.69	0.11	-0.11*	-0.08**	0.05	-0.01	-0.03	0.06***	-0.02	-0.04*	0.03*
	[0.04]	[0.02]	[1.51]	[0.96]	[0.06]	[0.03]	[0.04]	[0.01]	[0.03]	[0.00]	[0.03]	[0.02]	[0.02]
<b>Panel E: Openness to Experience</b>													
Home damage	0.21***	0.08***	-0.04	-1.04	0.10***	0.03	0.07***	0.04***	0.18***	0.21***	0.29***	0.16*	0.20***
	[0.04]	[0.03]	[1.54]	[1.10]	[0.01]	[0.03]	[0.02]	[0.01]	[0.02]	[0.03]	[0.00]	[0.09]	[0.01]

Notes: Results for each column and panel are from a separate regression. “Pooled” (“FE”) results are from the regression (1) without (with) controlling for individual FEs. “IV” (“FE-IV”) results from instrumental variable regressions (i.e., equations (1) and (2)) without (with) controlling for individual FEs. Observations: 50,885; Unique persons: 16,242; Mean of instrument (x100): 8.30; Pooled F statistic: 18.96; FE F statistic: 21.61. “F statistic” denotes the F statistic for the strength of the excluded instrument in the first stage regression. Instrument: Exposure to any cyclone within 100 km. Other explanatory variables include age (and its square), education, household size, urban, local area socio-economic variables, state/territory dummies, wave dummies, and survey quarter dummies. Gender and migration status variables are also included in pooled and IV regressions. Robust standard errors, clustered at the individual level, are reported in parentheses. The symbol \* denotes significance at the 10% level, \*\* at the 5% level, and \*\*\* at the 1% level.

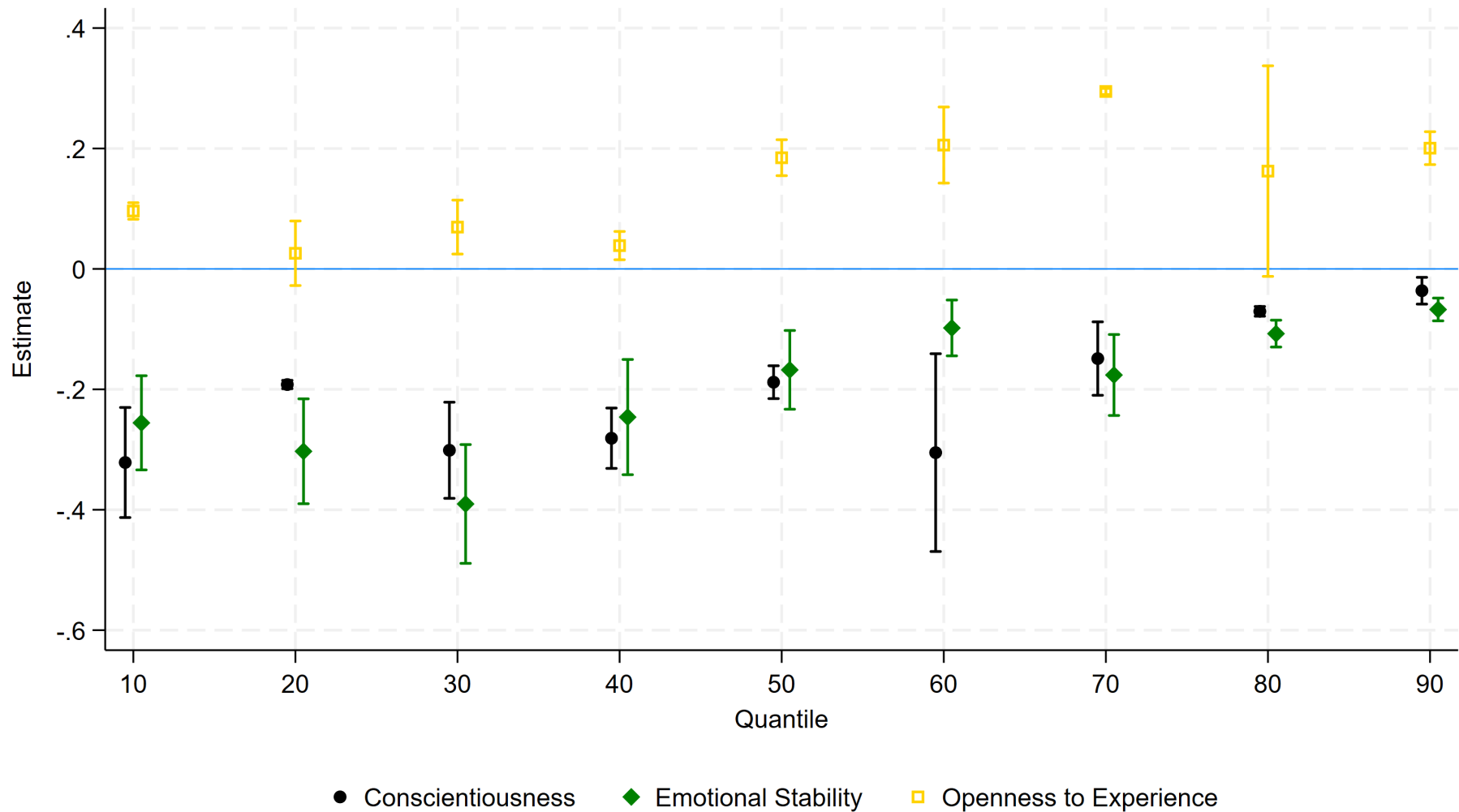


Figure 1: Histogram of change in the Big Five personality traits by change in natural disaster-related home damage status



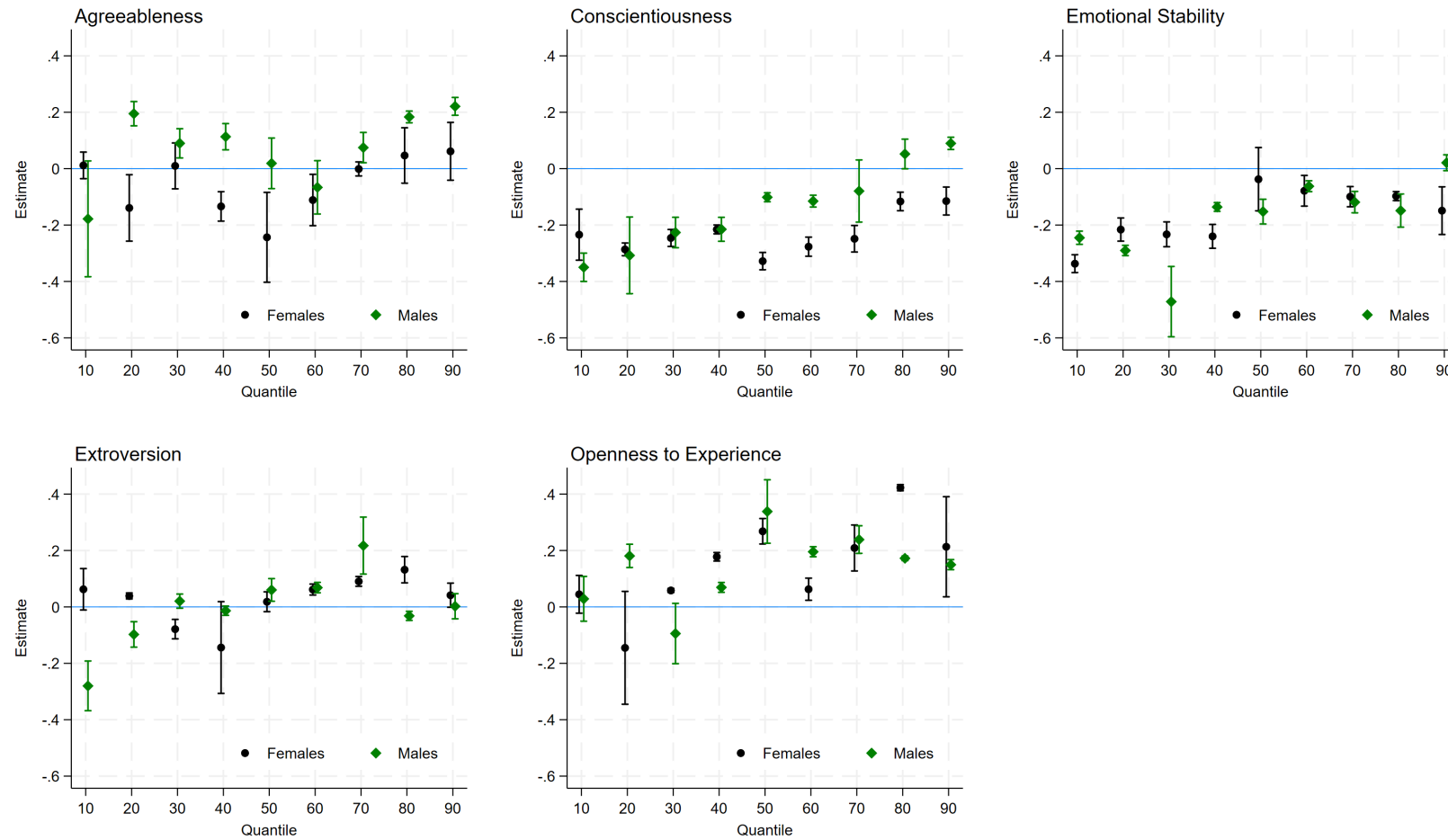
Notes: The “Damage Onset” group comprises individuals who did not report home damage in the previous wave but did in the current wave, while the “Damage Offset” group includes those who reported home damage in the previous wave but not in the current wave. *N* denotes the number of observations in each respective group. The outcome variable is the change in the respective Big Five personality trait relative to the previous survey wave.

Figure 2: Estimates of weather-related home damage on selected Big Five personality traits along the distribution



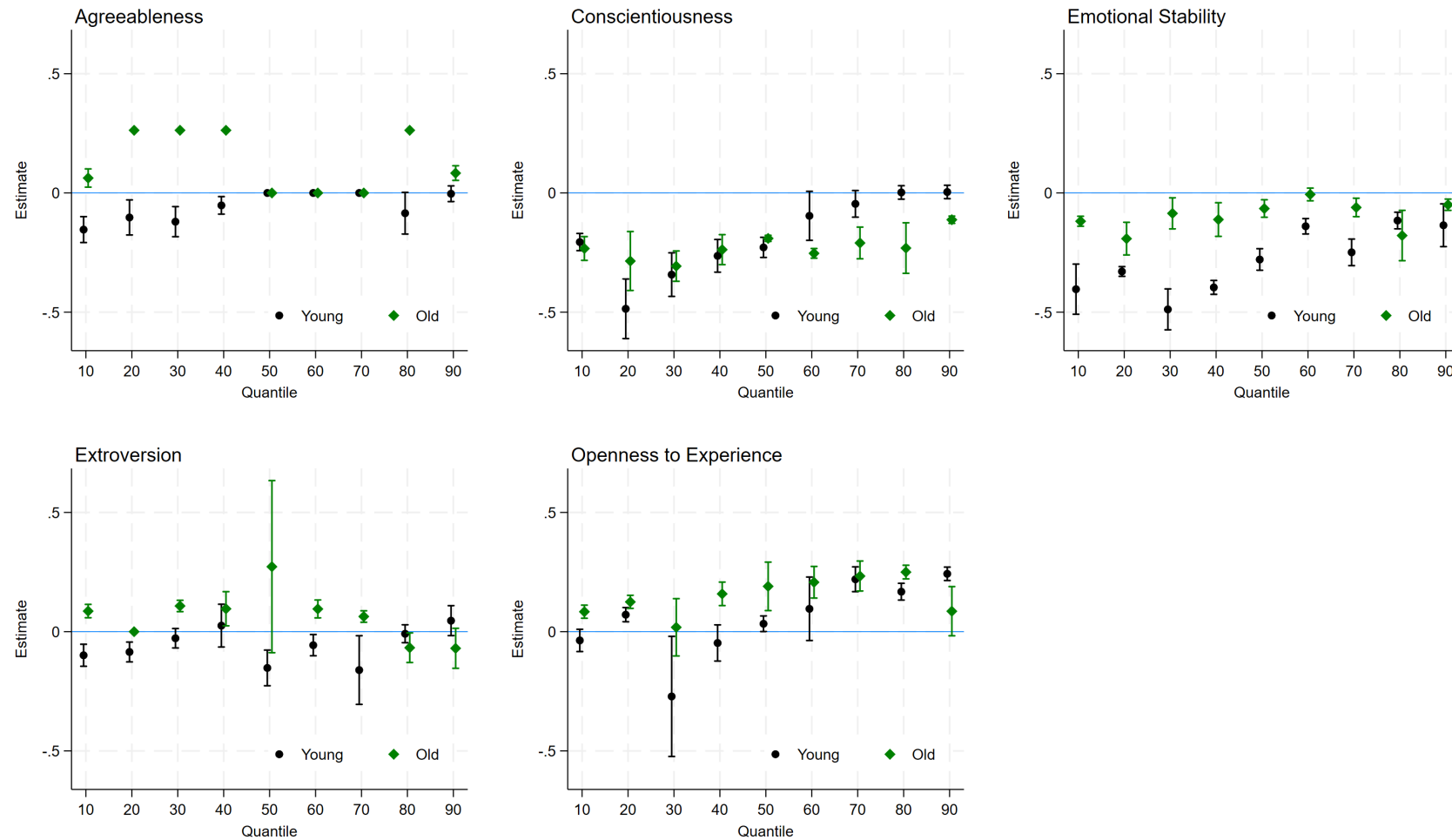
Notes: Results (estimates and their corresponding 95% confidence intervals) reported in each quantile and panel are from a separate quantile FE-IV regression. Instrument: Exposure to any cyclone within 100 km. Other explanatory variables include age (and its square), education, household size, urban, local area socio-economic variables, state/territory dummies, wave dummies, and survey quarter dummies. Results are reported in Table 2.

Figure 3: Heterogenous impacts of weather-related home damage on the Big Five personality traits along the distribution – By gender



Notes: Results (estimates and their corresponding 95% confidence intervals) reported in each subgroup and quantile are from a separate quantile FE-IV regression. Instrument: Exposure to any cyclone within 100 km. Other explanatory variables include age (and its square), education, household size, state/territory dummies, year dummies, and survey quarter dummies.

Figure 4: Heterogenous impacts of weather-related home damage on the Big Five personality traits along the distribution – By age group



Notes: Results (estimates and their corresponding 95% confidence intervals) reported in each subgroup and quantile are from a separate quantile FE-IV regression. Instrument: Exposure to any cyclone within 100 km. Other explanatory variables include age (and its square), education, household size, state/territory dummies, year dummies, and survey quarter dummies.

## **Online Appendix**

for refereeing purposes and to be published online

Appendix Table A1: Variable description and summary statistics

Variable	Description	Mean	Min	Max	Standard deviations		
					Overall	Between	Within
Age	The respondent's age at the survey time (years)	46.706	15.00	101.00	18.36	18.44	3.89
Male	Dummy variable: = 1 if the individual is male and zero otherwise	0.462	0.00	1.00	0.50	0.50	0.00
Born overseas in ESB country	Dummy variable: = 1 if the individual was born overseas in an English-Speaking Background (ESB) country and zero otherwise	0.094	0.00	1.00	0.29	0.29	0.00
Born overseas in NESB country	Dummy variable: = 1 if the individual was born overseas in a Non-English-Speaking Background (NESB) country and zero otherwise	0.110	0.00	1.00	0.31	0.32	0.00
Year 12	Dummy: = 1 if the individual completes Year 12 and zero otherwise	0.150	0.00	1.00	0.36	0.33	0.15
Vocational or training qualification	Dummy: = 1 if the individual has a vocational or training qualification and zero otherwise	0.387	0.00	1.00	0.49	0.46	0.14
Bachelor degree or higher	Dummy: = 1 if the individual has a bachelor degree or higher and zero otherwise	0.212	0.00	1.00	0.41	0.39	0.13
Household size	Number of household members	2.816	1.00	16.00	1.43	1.24	0.74
Local area unemployment rate	Yearly unemployment rate at the individual's residing local government area (%)	5.304	2.30	7.50	0.79	0.46	0.64
Local area SEIFA decile	Socio-Economic Indexes for Areas (SEIFA) decile at the individual's residing local government area	5.558	1.00	10.00	2.86	2.65	1.11
Major city	Dummy variable: = 1 if the individual lives in a major city and zero otherwise	0.619	0.00	1.00	0.49	0.46	0.17
Exposure to any cyclone within 100 km	Dummy variable: = 1 if an individual's residential postcode was within 100 km of any cyclone eye last year and zero otherwise	0.083	0.00	1.00	0.28	0.15	0.23
Agreeableness	Average scores from responses to four questions asking about the individual's Big-Five personality traits: sympathetic, kind, cooperative, and warm; standardized	0.022	-4.61	1.70	0.98	0.85	0.52
Conscientiousness	Average scores from responses to six questions asking about the individual's Big-Five personality traits: orderly, systematic, inefficient (reversed), sloppy (reversed), disorganised (reversed), and efficient; standardized	0.032	-3.96	1.86	0.99	0.88	0.46
Emotional Stability	Average scores from reversed responses to six questions asking about the individual's Big-Five personality traits: envious, moody, touchy, jealous, temperamental, and fretful; standardized	0.027	-3.83	1.65	0.99	0.86	0.50
Extroversion	Average scores from responses to fix questions asking about the individual's Big-Five personality traits: talkative, bashful (reversed), quiet (reversed), lively, and extroverted; standardized	-0.008	-3.16	2.39	1.00	0.91	0.42
Openness to Experience	Average scores from responses to fix questions asking about the individual's Big-Five personality traits: deep, philosophical, creative, intellectual, complex, and imaginative; standardized	-0.001	-2.96	2.60	0.99	0.88	0.47
Home damage	Dummy variable: = 1 if home destroyed or damaged due to a weather-related disaster last year and zero otherwise	0.013	0.00	1.00	0.11	0.07	0.09

Notes: Statistics are calculated from the baseline sample of 50,885 individual-wave observations from 16,242 unique individuals.

Appendix Table A2: Correlation among the Big Five personality traits

	Agreeableness	Conscientiousness	Emotional Stability	Extroversion	Openness to Experience
Agreeableness	1.00				
Conscientiousness	0.29	1.00			
Emotional Stability	0.15	0.33	1.00		
Extroversion	0.19	0.14	0.18	1.00	
Openness to Experience	0.28	0.08	-0.22	0.07	1.00

Notes: Statistics are calculated from the baseline sample of 50,885 individual-wave observations from 16,242 unique individuals. All correlations are statistically significant at 1% level.

Appendix Table A3: Remaining results from instrumental variable regressions at the mean

Regression:	First stage		Second stage									
Dependent variable:	Home damage		Agreeableness		Conscientiousness		Emotional Stability		Extroversion		Openness to Experience	
Specification:	Pooled	FE	Pooled	FE	Pooled	FE	Pooled	FE	Pooled	FE	Pooled	FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Exposure to any cyclone within 100 km	0.90*** [0.26]	1.04*** [0.25]										
Age	0.02 [0.01]	-0.08 [0.06]	0.01*** [0.00]	0.03*** [0.00]	0.02*** [0.00]	0.04*** [0.00]	0.00 [0.00]	-0.00 [0.00]	-0.01*** [0.00]	-0.02*** [0.00]	0.00 [0.00]	0.02*** [0.00]
Age squared	-0.00 [0.00]	0.00 [0.00]	-0.00*** [0.00]	-0.00*** [0.00]	-0.00*** [0.00]	-0.00*** [0.00]	0.00*** [0.00]	0.00** [0.00]	0.00*** [0.00]	0.00*** [0.00]	-0.00*** [0.00]	-0.00*** [0.00]
Male	-0.02 [0.10]		-0.50*** [0.01]		-0.18*** [0.01]		-0.04*** [0.01]		-0.21*** [0.01]		0.08*** [0.01]	
Born overseas in ESB country <sup>(a)</sup>	0.00 [0.18]		0.01 [0.02]		0.05** [0.02]		0.02 [0.02]		0.08*** [0.03]		0.13*** [0.02]	
Born overseas in NESB country <sup>(a)</sup>	-0.01 [0.15]		-0.02 [0.02]		0.06*** [0.02]		-0.15*** [0.02]		0.03 [0.02]		0.02 [0.02]	
Year 12 <sup>(b)</sup>	-0.00 [0.18]	0.07 [0.40]	0.09*** [0.02]	0.05* [0.03]	0.09*** [0.02]	0.06** [0.02]	0.06*** [0.02]	-0.09*** [0.03]	-0.03 [0.02]	-0.06*** [0.02]	0.23*** [0.02]	0.02 [0.02]
Vocational or training qualification <sup>(b)</sup>	0.22 [0.15]	0.20 [0.51]	0.11*** [0.02]	0.07*** [0.03]	0.15*** [0.02]	0.10*** [0.03]	0.07*** [0.02]	-0.11*** [0.03]	0.05*** [0.02]	-0.08*** [0.02]	0.28*** [0.02]	0.02 [0.03]
Bachelor degree or higher <sup>(b)</sup>	-0.09 [0.16]	-0.04 [0.54]	0.12*** [0.02]	0.06* [0.03]	0.22*** [0.02]	0.17*** [0.03]	0.14*** [0.02]	-0.04 [0.03]	-0.02 [0.02]	-0.02 [0.03]	0.52*** [0.02]	-0.01 [0.03]
Household size	0.07 [0.04]	0.12 [0.08]	-0.02*** [0.00]	-0.03*** [0.00]	-0.02*** [0.00]	-0.02*** [0.00]	0.01 [0.00]	-0.01** [0.00]	0.01** [0.00]	-0.01*** [0.00]	-0.06*** [0.00]	-0.02*** [0.00]
Local area unemployment rate	0.21*** [0.08]	0.23*** [0.09]	-0.01 [0.01]	-0.00 [0.01]	-0.00 [0.01]	0.00 [0.00]	-0.01 [0.01]	-0.01 [0.01]	0.00 [0.01]	0.01 [0.00]	-0.01 [0.01]	0.00 [0.00]
Local area SEIFA index	-0.09*** [0.02]	-0.04 [0.05]	0.01*** [0.00]	-0.00 [0.00]	0.02*** [0.00]	-0.00 [0.00]	0.02*** [0.00]	-0.00 [0.00]	0.02*** [0.00]	0.00 [0.00]	0.02*** [0.00]	-0.00 [0.00]
Major city	-1.26*** [0.13]	-1.25*** [0.37]	0.04* [0.02]	0.03 [0.02]	-0.01 [0.02]	0.00 [0.02]	-0.02 [0.02]	-0.00 [0.02]	0.02 [0.02]	-0.02 [0.02]	0.03 [0.02]	-0.03 [0.02]

Notes: The results for each specification (i.e., Pooled or FE), reported in each column, are from separate two-stage least squares (2SLS) regressions estimated at the mean. Estimates and standard errors from the first-stage regression are multiplied by 100 for presentation purposes. “Pooled” (“FE”) results are from the regression without (with) controlling for individual FEs. Observations: 50,885; Unique persons: 16,242. Other explanatory variables include state/territory dummies, wave dummies, and survey quarter dummies. <sup>(a)</sup> and <sup>(b)</sup> indicates “Australia born” and “Under year 12 qualification” as the comparison group, respectively. Robust standard errors, clustered at the individual level, are reported in parentheses. The symbol \* denotes significance at the 10% level, \*\* at the 5% level, and \*\*\* at the 1% level.



Appendix Table A4: Estimates of natural disaster-related home damage on the Big Five personality traits - Results from other quantile estimators

	Q10th	Q20th	Q30th	Q40th	Q50th	Q60th	Q70th	Q80th	Q90th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A1: Agreeableness - Pooled									
Home damage	0.05	0.05	0.06	0.04	0.05	0.02	0.04	0.11**	0.18***
	[0.07]	[0.05]	[0.04]	[0.05]	[0.05]	[0.05]	[0.04]	[0.05]	[0.07]
Panel A2: Agreeableness - FE									
Home damage	0.02	0.04	0.04	0.05	0.04	0.02	0.03	0.11***	0.13***
	[0.07]	[0.05]	[0.04]	[0.04]	[0.04]	[0.04]	[0.03]	[0.04]	[0.05]
Panel A3: Agreeableness - IV									
Home damage	0.03**	0.11***	0.07***	0.04**	0.04***	0.05***	0.04***	0.13***	0.14***
	[0.01]	[0.01]	[0.02]	[0.02]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Panel B1: Conscientiousness - Pooled									
Home damage	-0.25***	-0.15**	-0.17***	-0.14***	-0.16***	-0.15***	-0.10**	-0.07*	-0.02
	[0.07]	[0.06]	[0.06]	[0.05]	[0.05]	[0.04]	[0.05]	[0.04]	[0.05]
Panel B2: Conscientiousness - FE									
Home damage	-0.05	0.02	-0.01	-0.02	-0.05	-0.07	-0.04	-0.04	-0.01
	[0.07]	[0.05]	[0.05]	[0.05]	[0.04]	[0.05]	[0.05]	[0.05]	[0.05]
Panel B3: Conscientiousness - IV									
Home damage	-0.22***	-0.18***	-0.16***	-0.16***	-0.16***	-0.15***	-0.09***	-0.02*	-0.01
	[0.01]	[0.02]	[0.01]	[0.01]	[0.01]	[0.02]	[0.01]	[0.01]	[0.01]
Panel C1: Emotional Stability - Pooled									
Home damage	-0.29***	-0.24***	-0.22***	-0.16***	-0.10*	-0.06	-0.06	0.01	-0.01
	[0.08]	[0.06]	[0.06]	[0.06]	[0.05]	[0.05]	[0.04]	[0.05]	[0.05]
Panel C2: Emotional Stability - FE									
Home damage	-0.15*	-0.14**	-0.11**	-0.05	-0.04	-0.02	-0.06	-0.02	0.01
	[0.08]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.04]	[0.05]	[0.05]
Panel C3: Emotional Stability - IV									

	Q10th	Q20th	Q30th	Q40th	Q50th	Q60th	Q70th	Q80th	Q90th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home damage	-0.20*** [0.01]	-0.23*** [0.01]	-0.21*** [0.02]	-0.18*** [0.02]	-0.12*** [0.02]	-0.06*** [0.02]	-0.06*** [0.02]	-0.07*** [0.01]	-0.04*** [0.01]
Panel D1: Extroversion - Pooled									
Home damage	-0.03 [0.06]	0.01 [0.05]	0.07 [0.05]	0.02 [0.05]	0.03 [0.05]	0.03 [0.05]	0.06 [0.05]	0.07 [0.06]	0.08 [0.08]
Panel D2: Extroversion - FE									
Home damage	-0.09 [0.07]	-0.02 [0.05]	0.08** [0.04]	0.01 [0.04]	0.03 [0.05]	0.05 [0.04]	0.02 [0.05]	-0.01 [0.06]	-0.02 [0.06]
Panel D3: Extroversion - IV									
Home damage	0.03*** [0.01]	0.02* [0.01]	0.05*** [0.01]	0.02 [0.02]	0.09*** [0.02]	0.09*** [0.02]	0.09*** [0.01]	0.08*** [0.01]	0.07*** [0.01]
Panel E1: Openness to Experience - Pooled									
Home damage	0.09 [0.07]	0.16*** [0.05]	0.13*** [0.05]	0.15*** [0.04]	0.20*** [0.05]	0.26*** [0.05]	0.29*** [0.06]	0.36*** [0.06]	0.31*** [0.11]
Panel E2: Openness to Experience - FE									
Home damage	0.03 [0.05]	0.04 [0.04]	0.01 [0.04]	0.03 [0.03]	0.07* [0.04]	0.12*** [0.04]	0.12** [0.05]	0.14*** [0.05]	0.13 [0.09]
Panel E3: Openness to Experience - IV									
Home damage	0.16*** [0.01]	0.10*** [0.01]	0.11*** [0.02]	0.17*** [0.01]	0.27*** [0.01]	0.26*** [0.02]	0.29*** [0.01]	0.32*** [0.01]	0.29*** [0.00]

Notes: The results presented in each panel and column are derived from separate quantile regressions. The “Pooled” and “FE” estimators refer to quantile regression estimates based on Equation (1), without and with individual fixed effects, respectively. The “IV” estimators correspond to quantile instrumental variable regressions based on Equations (1) and (2), estimated without individual fixed effects, using exposure to any cyclone within 100 km as the instrument. Observations: 50,885; Unique persons: 16,242. Other explanatory variables include age (and its square), education, household size, urban, local area socio-economic variables, state/territory dummies, wave dummies, and survey quarter dummies. Gender and migration status variables are also included in pooled and IV regressions. Robust standard errors, clustered at the individual level, are reported in parentheses. The symbol \* denotes significance at the 10% level, \*\* at the 5% level, and \*\*\* at the 1% level.

Appendix Table A5: Correlation between the Big Five personality traits and individual earnings

	(1)	(2)	(3)	(4)	(5)
Agreeableness	0.01 [0.01]				
Conscientiousness		0.17*** [0.01]			
Emotional Stability			0.06*** [0.01]		
Extroversion				0.08*** [0.01]	
Openness to Experience					-0.08*** [0.01]
Observations	68,910	68,910	68,910	68,910	68,910

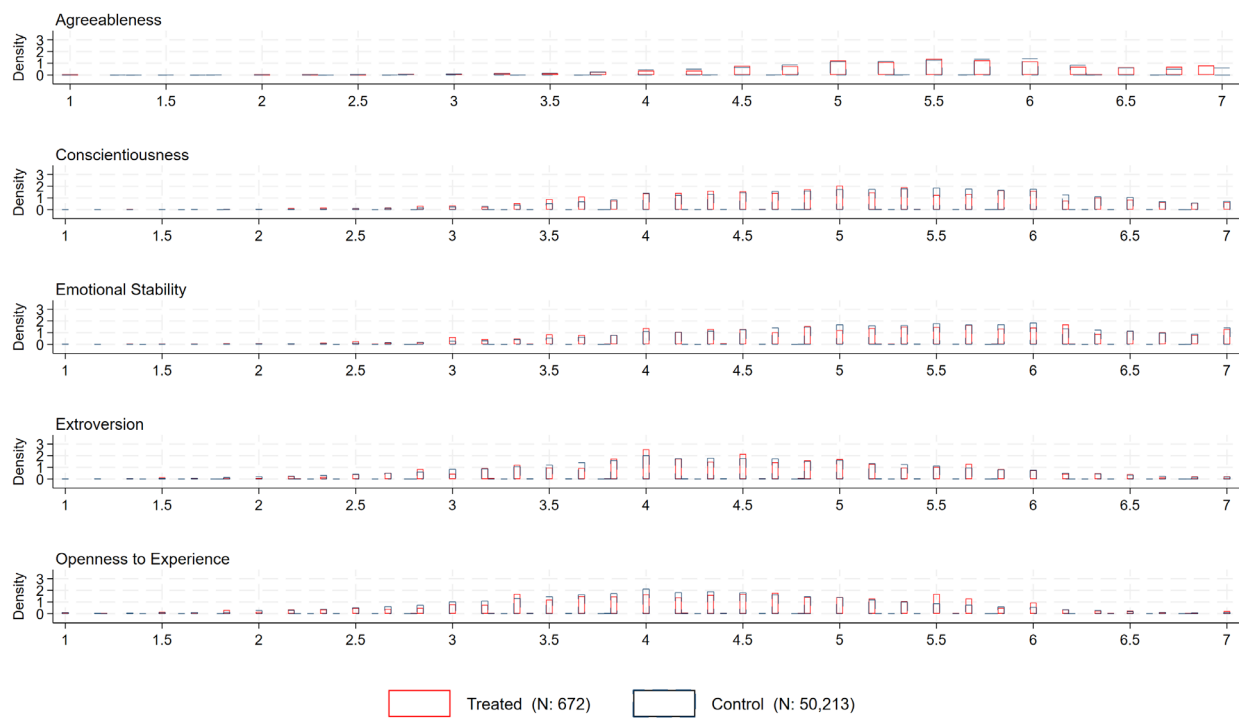
Notes: Each column and panel reports estimates from a separate pooled OLS regression. The outcome variable is individual annual regular market income, expressed in natural logarithms. Other variables include age (and its square), gender, migration status, education, household size, state/territory dummies, year dummies, and survey quarter dummies. Robust standard errors, clustered at the individual level, are reported in parentheses. The symbol \* denotes significance at the 10% level, \*\* at the 5% level, and \*\*\* at the 1% level.

Appendix Table A6: Heterogenous impact of weather-related home damage on the Big Five personality traits at the mean

Personality trait:	Agreeableness		Conscientiousness		Emotional Stability		Extroversion		Openness to Experience	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<b>Panel A: By gender:</b>	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males
Home damage	1.01 [1.92]	0.06 [1.49]	-2.84 [2.13]	1.15 [1.30]	3.18 [2.33]	0.03 [1.37]	1.12 [1.63]	-0.62 [1.20]	-2.05 [2.00]	-0.30 [1.30]
Observations	27,359	23,526	27,359	23,526	27,359	23,526	27,359	23,526	27,359	23,526
N of unique individuals	8,659	7,583	8,659	7,583	8,659	7,583	8,659	7,583	8,659	7,583
Mean of dep. variable	0.24	-0.26	0.08	-0.09	0.01	0.00	0.08	-0.10	-0.04	0.04
F test statistic	7.56	15.04	7.56	15.04	7.56	15.04	7.56	15.04	7.56	15.04
<b>Panel B: By age group:</b>	Younger	Older	Younger	Older	Younger	Older	Younger	Older	Younger	Older
Home damage	0.33 [1.60]	0.22 [1.71]	-0.32 [1.46]	-0.11 [1.49]	0.49 [1.67]	1.83 [1.64]	-0.70 [1.36]	0.79 [1.38]	0.19 [1.46]	-2.15 [1.72]
Observations	24,533	24,062	24,533	24,062	24,533	24,062	24,533	24,062	24,533	24,062
N of unique individuals	8,763	7,726	8,763	7,726	8,763	7,726	8,763	7,726	8,763	7,726
Mean of dep. variable	-0.05	0.10	-0.10	0.17	-0.20	0.25	0.04	-0.06	0.06	-0.06
F test statistic	12.41	9.73	12.41	9.73	12.41	9.73	12.41	9.73	12.41	9.73

Notes: Estimates for each column and panel are from a separate FE-IV regression at the mean. Instrument: Exposure to any cyclone within 100 km. Other explanatory variables include age (and its square), education, household size, urban, local area socio-economic variables, state/territory dummies, wave dummies, and survey quarter dummies. “F test statistic” refer to F statistic for the strength of the excluded instrument in the first stage regression at the mean. Robust standard errors, clustered at the individual level, are reported in parentheses. The symbol \* denotes significance at the 10% level, \*\* at the 5% level, and \*\*\* at the 1% level.

Appendix Figure A1: Histogram of the Big Five personality traits by home damage status



Notes: The “treated group” consists of individuals who self-reported weather-related home damage in the past year, while the “control group” includes those who reported no such damage.  $N$  denotes the number of observations in each respective group. The outcome variable is the raw score for the respective Big Five personality trait.