

Author's response to the referee and file-validation remarks

Manuscript: egusphere-2026-1005

The impact of the Canterbury earthquakes on household income and expenditure in the Canterbury region in New Zealand

Dear Editor and Referee,

Thank you for the careful review and for the file-validation guidance. We have revised the manuscript accordingly. All substantive and formatting changes are shown in the tracked-changes manuscript. Below we respond point by point and then provide a consolidated list of the relevant manuscript changes.

A. Remarks from the preceding review file validation

File-validation remark 1

With the next revision, please rename the appendix materials by removing the dots between the letter and the ordinal number. For example, "Table A.1." should be "Table A1.", etc.

Response: Implemented. We removed the dot between the appendix letter and ordinal number throughout the manuscript, including both table captions and all in-text cross-references.

Changes made in the manuscript:

- Appendix tables are now numbered A1–A3, B1–B4, C1–C2, D1–D2, E1, F1, G1–G2, H1–H2, and I1–I3.
- All corresponding references in the main text and appendix text were updated to the same format.

File-validation remark 2

With regard to the "Author contributions" section, we kindly ask you to use the authors' initials rather than their full names. For example, "Quanfu Zhang" should be given as QZ, etc. in the next revision.

Response: Implemented. The Author contributions section now uses initials only: QZ, IN, and YS.

Changes made in the manuscript:

- QZ: Conceptualization; Data curation; Formal analysis; Methodology; Software; Visualization; Writing—original draft.
- IN: Conceptualization; Methodology; Supervision; Writing—review & editing.
- YS: Methodology; Validation; Writing—review & editing.

Additional formatting and reference-list checks

Response: In addition to the two specific validation remarks, we standardised the reference list and web references to the journal format and rechecked the cited URLs during final preparation.

Changes made in the manuscript:

- Reference formatting was harmonised across journal articles, books, and web sources, including DOI/URL presentation and punctuation.
- The ISBN was added for Angrist and Pischke (2009), and same-year lettered citations were made consistent.
- Web-source access dates were rechecked and updated where appropriate (4 September 2026 in the final manuscript), including GeoNet, Stats NZ, and Reserve Bank of New Zealand sources.

B. Response to the referee

Referee comment

This revision made the major steps forward that I think the paper needed to be acceptable. Before it is published, I think the tables and figures need to be improved. There should be notes sufficient that the table can be understood without returning to the text. Order the rows by importance, with the coefficients of interest at the top, followed by important controls and constants last. Always use meaningful words to label rows, not variable names from the code.

Also, make sure the language in the discussion of the results is consistent with the precision possible given the data and methods. You are presenting dozens of regression results and highlighting those with statistical significance. However, given the odd patterns – such as larger effects for the lower-intensity treatment group – some of these are probably false positives. Make appropriately modest claims about the “truth” you may have discovered.

B1. Tables: self-contained notes, row ordering, and readable labels

Response: We agree and have systematically revised the main and appendix tables so that they can be interpreted without returning to the surrounding text. We also reorganised regression-table rows and replaced code-derived labels with meaningful descriptive labels.

Changes made in the manuscript:

- Main regression tables now identify the dependent variable, units (NZD where applicable), treatment-intensity definitions, the matched comparison group, post-earthquake timing, fixed effects, clustering level, and significance thresholds in the table notes.
- Appendix tables now additionally identify relevant sample restrictions, transformations, subgroup definitions, weighting methods, and the purpose of diagnostic or robustness specifications.
- Where a regression table reports controls and a constant, coefficients of interest are placed at the top, followed by controls, with the constant last.
- Code-style labels were replaced with descriptive terms. Examples include “Age2” → “Age of reference person squared”, “(Intercept)” → “Constant”, “relocator indicator” → “Relocation-household indicator”, and diagnostic labels such as “n_obs” and “coef_treat_post” → “Sample size” and “Treated area × post-earthquake coefficient”.
- The same principles were applied to the main tables (Tables 2–7) and the relevant appendix regression/diagnostic tables, including Tables B3–B4, C1–C2, E1, F1, G1–G2, H1–H2, and I1–I3.

B2. Figures: clearer titles and self-contained notes

Response: We revised the figure titles and notes to make the figures more self-contained and to make the estimand and interpretation more precise.

Changes made in the manuscript:

- Figure 1 now explains the MMI measure, the GeoNet and Stats NZ data sources, the meaning of the shading and epicentre marker, the geographical scope of the map, authorship of the map, and the relevant data licences.
- Figures 2 and 3 now describe the plotted quantity as estimated post-earthquake relative changes in $1 + |\text{expenditure}|$, rather than implying that the bars are raw expenditure percentage changes.
- The notes to Figures 2 and 3 explain the transformation from the $\log(1 + |\text{expenditure}|)$ coefficient to

$$100 \times [\exp(\text{coefficient}) - 1],$$

define the intensity/income groups, report significance thresholds, and state explicitly that the estimates are exploratory and are not adjusted for multiple comparisons.

B3. Statistical precision, multiple comparisons, and more modest interpretation

Response: We agree with the referee that the large number of category-level regressions requires a more cautious interpretation. We therefore revised the Results and Discussion to distinguish estimates and associations from definitive causal truths and to state the multiple-testing concern directly.

Changes made in the manuscript:

- Immediately after Figure 2, we added an explicit paragraph noting that the analysis examines many outcomes and two intensity groups without a multiple-testing adjustment. The manuscript now states that individual p values should be interpreted as exploratory and that some nominally significant estimates may be false positives.
- The same paragraph explicitly notes the non-monotonic pattern across intensity groups, including cases where low-intensity estimates exceed high-intensity estimates, and cautions against treating isolated coefficients as precise causal truths.
- We now emphasise broad patterns that recur across related outcomes and robustness specifications rather than any single statistically significant coefficient.
- Throughout the Results and Discussion, wording was moderated where appropriate: statements such as “effects” or “increases” were replaced by “estimated coefficients”, “positive estimates”, “patterns”, “associations”, or “consistent with” when the data and design do not support stronger language.
- The parallel-trends discussion now clarifies that failure to reject the pre-trend null provides supportive evidence but does not prove that counterfactual trends were identical, and that the evidence is weaker for total expenditure because only one comparable pre-earthquake expenditure coefficient is available.

B4. Heterogeneity analyses: clearer limits on causal interpretation

Response: We also tightened the language around the heterogeneity analyses, where subgroup definitions or post-earthquake choices make causal interpretation particularly limited.

Changes made in the manuscript:

- Section 5.3 is now titled “Heterogeneity by income group”. The manuscript states that income groups are defined using the contemporaneous survey-wave median, so these estimates are exploratory descriptive heterogeneity rather than causal effects for predetermined income groups.
- The notes to Figure 3 and Tables G1–G2 repeat this limitation and state that the subgroup estimates are exploratory and not adjusted for multiple comparisons.
- Section 5.4 is now titled “Heterogeneity by migration status” rather than “Heterogeneous effects of migration”.
- Table 4 is explicitly labelled “Covariate-adjusted differences between stay and relocation households (descriptive)”. The text and notes now state that relocation is self-selected and a post-earthquake outcome, so the reported coefficients are descriptive conditional associations rather than causal effects of moving.

B5. Expanded limitations and qualification of conclusions

Response: To make the degree of uncertainty transparent, we expanded the limitations discussion and qualified the concluding claims.

Changes made in the manuscript:

- The limitations section now discusses the repeated-cross-section design and the possibility of unobserved compositional change across survey waves.

- It distinguishes supportive pre-trend evidence from proof of parallel trends and highlights the especially limited pre-trend information for total expenditure.
- It discusses recall, classification, annualisation, and diary-window measurement error in HES expenditure data.
- It clarifies that the $\log(1 + |y|)$ transformation removes the original sign of entries, so receipts-and-refunds estimates refer to changes in magnitude rather than signed net resource flows.
- It discusses incomplete pre-earthquake address histories, the limitations of meshblock-level MMI as a proxy for dwelling-level damage or compensation, small subgroup samples, endogenous migration, the lower precision of the ATT-IPW robustness estimates, and the contemporaneous definition of income groups.
- The concluding discussion now focuses on the direction and pattern of the evidence and avoids presenting the full set of statistically significant category-level coefficients as equally definitive findings.

C. Additional correction identified during final author checks

Appendix Table D1: correction of descriptive statistics

Response: During the final author check, we identified a technical reporting error in Appendix Table D1. The values shown for total household income, total household regular income, and total household expenditure had previously been reported as means, whereas the intended summary statistic for these skewed monetary variables was the median. We corrected the table to report medians for all three variables.

Changes made in the manuscript:

- The displayed values for total household income, total household regular income, and total household expenditure in Table D1 were replaced with the correct medians.
- The table headings and notes now explicitly identify these three statistics as medians. Mortgages and loans remains reported as a mean because the median is zero in most years and is not informative for that variable.
- This was a descriptive-table reporting correction only. It does not alter the regression estimation, the matched samples, or the substantive conclusions of the paper.

D. Consolidated list of relevant manuscript changes

1. Removed dots from all appendix table numbers and updated every cross-reference (A1–A3 through I1–I3).
2. Replaced full author names with initials (QZ, IN, YS) in the Author contributions section.
3. Standardised the reference list to the journal format, including DOI/URL presentation, web access dates, book ISBN information, and same-year citation suffix consistency.
4. Expanded notes for the main and appendix tables so that dependent variables, units, treatment/control definitions, post period, fixed effects, clustering, transformations, subgroup/sample restrictions, weighting, and significance conventions are stated where relevant.
5. Reordered regression-table rows so that coefficients of interest appear first, followed by controls and constants last where reported.
6. Replaced code-derived table labels with descriptive, publication-ready labels.
7. Expanded Figure 1 notes and revised Figures 2–3 titles/notes to define the estimand, transformation, groups, significance coding, and multiple-comparison caveat.

8. Added an explicit multiple-testing/false-positive caution and discussion of non-monotonic intensity patterns; shifted emphasis from isolated significant coefficients to recurring patterns across outcomes and specifications.
9. Moderated causal language throughout the Results and Discussion, especially for income-group and migration heterogeneity analyses.
10. Expanded the limitations section to cover repeated-cross-section composition, parallel-trends uncertainty, expenditure measurement, the absolute-value log transformation, address missingness, MMI measurement, small subgroups, migration endogeneity, ATT-IPW precision, and contemporaneous income-group definitions.
11. Corrected Appendix Table D1 so that total household income, total household regular income, and total household expenditure are reported as medians rather than means.

Thank you again for the constructive comments and guidance. We believe that these revisions have substantially improved the clarity, transparency, and interpretive precision of the manuscript.

Sincerely,

Quanfu Zhang, Ilan Noy, and Yigit Saglam