Measuring the Wealth Elasticity of Risky Assets Demand: Evidence from the Wealth and Assets Survey

Christian Bontemps, Toulouse School of Economics,

Thierry Magnac, Toulouse School of Economics,

and

David Pacini, University of Bristol
Motivation

If household financial wealth increases by 1%, how much is going to change the household demand for risky assets?

Answering this question poses many challenges. There is one which has received little attention:

Survey data on financial wealth and risky assets holdings are often interval-censored.

What is interval-censoring?

---

1Heterogeneity, participation and adjustment costs, indivisibilities, measurement error,...
Objective and Challenges

We aim to explore the effects of interval-censoring in estimates of the financial wealth elasticity of risky assets demand using data from the Wealth and Assets Survey (WAS).

- Why should we care about interval-censoring in this context?
- How can we deal with the detrimental effects of interval-censoring?
Content

- Illustration using Wealth and Assets Survey.
- Imputation works under "specific" assumptions.
- Interval-censoring is a type of measurement error (better than non-response).
- Instrumental variable approach is not feasible.
- Set-identification approach seems to be the natural way to proceed.
(Some) Related Literature

- Risky Assets Demand:
  Uhler and Cragg (1971); Friend and Blume (1975); Siegel and Hoban (1982); King and Leape (1998); Perraudin and Sorensen (2000); Brunnermeir and Nagel (2008); Chiappori and Paiella (2011); Calvet and Sodini (2013).

- Interval-Censoring:
  Stewart (1983); Manski and Tamer (2002); Bontemps, Magnac and Maurin (2011); Beresteanu, Molchanov and Molinari (2011).
Organization

- Research Question and the Econometric Model.
- Data and Problem.
- Identification Analysis.
- Summary, Conclusion and Extensions.
1. Econometric Model
Research Question

What is the wealth elasticity of risky assets demand in the UK?

- Why? Policy advice may depend on this elasticity.²
- No evidence for the UK.³
- What do we need?
  - A model of household portfolio decisions.
  - Data on wealth and risky assets holdings: Wealth and Assets Survey.

²Calvet and Sodini (2013)
³Evidence from other countries is difficult to extrapolate to UK.
Approach(es)

- Recover the parameter $\beta_1$ in:

\[ \ln(r_{it}) = \beta_1 \ln(w_{it}) + u_{it} \]

from data on risky asset holdings $r_{it}$ and financial asset holdings $w_{it}$.

- Two possible justifications:
  - Simply assume the log-log specification.
  - Derive from primitive assumptions.

- We opt for the second approach. Why?
Econometric Model

- Log-log specification: \( \ln(r_{it}) = \beta_1 \ln(w_{it}) + u_{it} \)
- Two-way disturbance term: \( u_{it} = \eta_i + \delta_t + v_{it} \).
- The idiosyncratic term \( v_{it} \) is predetermined:
  \[
  E(\Delta v_{it} z_{it}) = 0
  \]
  where \( z_{it} := \ln(w_{it}), \ln(w_{it-1}), \ldots \) as opposed to strictly exogenous.\(^4\)
- \( \beta_1 \) is the wealth elasticity of risky assets demand. Increasing \((\beta_1 < 1)\), constant \((\beta_1 = 1)\), or decreasing \((\beta_1 > 1)\) relative risk aversion.

\(^4\)Disturbance \( v_{it} \) can affect future log financial wealth \( \ln(w_{it+1}) \). In this case, OLS and FE estimators have undesirable theoretical properties.
2. Data and Problem
Wealth and Assets Survey

- We use data on risky assets holdings and financial assets holdings from the Wealth and Assets Survey (WAS). Why?
- Risky assets holdings $r_{it}$ include stock- and mutual fund-like assets.
- Financial assets holdings $w_{it}$ include risky assets holdings and cash- and saving account-like assets.
- Existing literature (for countries other than UK) tends to favor the hypothesis of constant or decreasing relative risk aversion ($\beta_1 \geq 1$).

\[5\] Brunnermeir and Nagel (08) constant for the US; Chiappori and Paiella ('11) constant for Italy; Calvet and Sodini ('13) decreasing for Sweden.
## Imputed Case Analysis

Table 1. OLS, FE and IV Estimates

<table>
<thead>
<tr>
<th>Imputed Data</th>
<th>OLS-IM (1)</th>
<th>FE-IM (2)</th>
<th>FE-IM (3)</th>
<th>FE-IM (4)</th>
<th>IV-IM (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$</td>
<td>1.047</td>
<td>1.005</td>
<td>.978</td>
<td>1.048</td>
<td>.658</td>
</tr>
<tr>
<td></td>
<td>(.008)</td>
<td>(.030)</td>
<td>(.036)</td>
<td>(.036)</td>
<td>(.097)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Only Large Changes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Mills Ratio</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Constant</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Observations</td>
<td>15,228</td>
<td>4,139</td>
<td>825</td>
<td>2,564</td>
<td>4,139</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.61</td>
<td>.34</td>
<td>.55</td>
<td>.35</td>
<td>.01</td>
</tr>
<tr>
<td>$F$ - First Stage</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,901</td>
</tr>
</tbody>
</table>
Interval-Censoring

- Results based on imputed data suggests an elasticity between .4 and .8 (meaning increasing relative risk aversion). Different from evidence for other countries.

- To avoid non-response, households in the WAS may report an interval rather than an exact amount for asset holdings.

- Does interval-censoring affect the previous preliminary conclusion?

\[6\] Similar strategy used in other surveys. e.g., HRS, PSID, SWIH and HFCS.
# Interval-Censoring in WAS

## Table 2. Number and Proportion of Interval-Censored Observations

<table>
<thead>
<tr>
<th></th>
<th>Wave 1</th>
<th>Wave 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>log-risky</td>
<td>log-wealth</td>
</tr>
<tr>
<td>Numeric</td>
<td>7,386</td>
<td>6,304</td>
</tr>
<tr>
<td>Censored</td>
<td>3,281  (30%)</td>
<td>4,363  (41%)</td>
</tr>
<tr>
<td>Total Obs.</td>
<td>10,667</td>
<td>10,667</td>
</tr>
</tbody>
</table>
### Complete Case Analysis

#### Table 3. OLS, FE and IV Estimates

<table>
<thead>
<tr>
<th></th>
<th>OLS-CC (6)</th>
<th>FE-CC (7)</th>
<th>FE-CC (8)</th>
<th>FE-CC (9)</th>
<th>IV-CC (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$</td>
<td>1.017</td>
<td>.975</td>
<td>.943</td>
<td>.981</td>
<td>.377</td>
</tr>
<tr>
<td></td>
<td>(.011)</td>
<td>(.054)</td>
<td>(.069)</td>
<td>(.054)</td>
<td>(.123)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Only Large Changes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Mills Ratio</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Constant</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Observations</td>
<td>9,095</td>
<td>1,715</td>
<td>286</td>
<td>1,690</td>
<td>1,715</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.61</td>
<td>.31</td>
<td>.51</td>
<td>.31</td>
<td>.01</td>
</tr>
<tr>
<td>$F$ - First Stage</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>350</td>
</tr>
</tbody>
</table>
Problem

- Complete data indicate an elasticity between .1 and .6 (meaning increasing relative risk aversion).

- Differences between imputed and complete case analysis suggest paying more attention to interval-censoring.

- What is the explanation for these differences? Interval-censoring is not random.
Should We …

▶ Ignore interval-censoring?
   We need more assumptions, which do not seem sensible in our context.

▶ Impute values within the interval?
   Again we need more assumptions, which do not seem sensible in our context.

▶ Use an instrument?
   Actually we cannot.
What We Could Do Is ...

- Interval measurements yield interval estimates. Investigate the identified set delivered by the Econometric Model under interval-censoring.
- Two imprecise could make one precise. Ask another measurement for risky and financial assets? \(^7\)

\(^7\)As in the *Enquete des Patrimoine.*
3. Identification Analysis
Set Identification

Does the Econometric Model impose enough restrictions to ‘recover’ the elasticity of interest $\beta_1$ from interval-censored data?

- It depends on what we understand by ‘recover’.
  - If ‘recover’ means point-identification, the answer is no.
  - If ‘recover’ means set-identification, the answer is yes.
The Identified Set

- Characterize all the values of $\beta_1$ compatible with the intervals observed in the data (the identified set).

- We are not aware of techniques accomplishing this task.

- We have a characterization of the identified set based on the concept of support function.

- We are in the process of implementing an estimator for the identified set.

- Conceptual and computational challenges.
4. Summary, Conclusion and Extensions
Summary

- We aim to estimate the wealth elasticity of household risky asset demand from the WAS.
- Imputed and complete case analysis deliver different results.
- We are in the process of exploring alternative solutions to deal with interval-censoring.
Conclusion

▶ Economic theory supplies identifying assumptions.
▶ We cannot ignore interval-censoring.
▶ The wealth elasticity of risky asset demand may be one.
Extensions

- Implementing the estimator of the identified set.
- International comparisons.
- Length of intervals?
Additional Slides
Expected Utility Model

- Primitive Assumptions:
  - Individuals choose assets holdings by maximizing utility subject to a budget restriction
  - Utility Function: Risk-free asset and risky asset entering a HARA function.
  - Risky Asset Price: evolves in time according to a stochastic process.
  - Budget Restriction: Wealth evolves according to a stochastic process.

- The demand function is linear in wealth.
- Decomposition of the disturbance term $u_{it}$: $u_{it} = \eta_i + \delta_t + v_{it}$
- By-product: test for CRRA assumption. Why?
Can We Ignore Interval-Censoring?

- Complete case analysis is valid when interval-censoring is random.

- Using only complete cases involves a loss in precision of estimators.

- If interval censoring is not random, interval-censoring renders estimators based on complete cases inconsistent and tests do not control for size.
Can We Solve the Problem by Imputing?

- Imputation is valid when interval-censoring is random.
- This assumption may be too restrictive: Imputed and complete case estimates should be similar.
- If interval-censoring is not random, interval-censoring renders estimators based on imputed data inconsistent, tests do not control for size, and confidence intervals have confidence level different from the one advertised.
Can We solve the Problem by Using an Instrument?

- Interval-censoring is a measurement error problem.
- Common strategy to deal with measurement error is to find an instrument.
- Instruments are infeasible when measurement error comes from interval censoring (if the ”instrument” is correlated with the covariate then so is with the disturbance by construction)

\[
y = x^\star \beta + u^\star \\
x = dx^\star + (1 - d)x^m \\
E(zu) = 0 \text{ and } E(zx) \neq 0
\]