Advanced Econometrics: 2SLS and Instrumental Variables

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1 Impact Assessment in Agricultural Economics Using Instrumental Variables: Microcredit and Farm Productivity

Context and Data

We investigate whether access to microcredit increases agricultural productivity for rural households in Malawi, following Diagne & Zeller (2001, IFPRI Research Report 116). The dataset is publicly available from the World Bank Microdata Library: https://microdata.worldbank.org/index.php/catalog/1009.

Key Variables

- `prod`: Crop yield or value of agricultural output per acre (dependent variable)
- `credit`: Dummy variable, 1 if household accessed microcredit, 0 otherwise
- `dist`: Distance to nearest microfinance institution (in km) — *instrument*
- `land`: Land owned (acres)
- `labor`: Family labor used (person-days)
- `age`: Age of household head
- `edu`: Years of schooling of household head
- `hhsize`: Household size

Model, Endogeneity, and Instrument

We are interested in the model:

$$\texttt{prod}_i = \beta_0 + \beta_1 \texttt{credit}_i + \beta_2 \texttt{land}_i + \beta_3 \texttt{labor}_i + \beta_4 \texttt{edu}_i + \beta_5 \texttt{age}_i + u_i$$

Endogeneity: `credit` is endogenous because unobserved ability or motivation may affect both the likelihood of borrowing and productivity.

Instrument: `dist` (distance to microfinance) is used as an instrument for `credit`. It affects the probability of borrowing but is plausibly exogenous to unobserved productivity.

How IV Solves the Problem

By using `dist` as an instrument, we isolate the variation in microcredit access that is due to exogenous proximity, not to unobserved household characteristics.

Testing the Instrument

- **Relevance:** First-stage regression of `credit` on `dist` should show a strong negative association (F-statistic > 10).
- **Exogeneity:** `dist` should not be correlated with the error term in the productivity equation (Sargan-Hansen test if overidentified).

Assignment and Analysis Steps

1. **Import the data** and provide summary statistics.
2. **Estimate the productivity equation by OLS** (likely biased).
3. **Estimate the equation by IV/2SLS**, using `dist` as an instrument for `credit`.
4. **Test instrument relevance** (first-stage F-test).
5. **Test instrument exogeneity** if possible.
6. **Interpret the IV results** and compare to OLS.
7. **Discuss policy implications** for microcredit programs.

References

- Diagne, A., & Zeller, M. (2001). "Access to Credit and Its Impact on Welfare in Malawi." IFPRI Research Report 116.
- World Bank Microdata Library: https://microdata.worldbank.org/index.php/catalog/1009
- R package `AER`: https://cran.r-project.org/web/packages/AER/AER.pdf