

COLORADO STATE UNIVERSITY
DEPARTMENT OF AGRICULTURAL & RESOURCE ECONOMICS

Problem Set 5
Fall 2023

Agricultural & Resource Economics / Economics 535
Applied Econometrics

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Simultaneous Equations Systems

Provide answers to the following questions in a word-processed document. This problem set is to be a team effort between two individuals. Each team must submit a unique assignment. However, you may work with other students. Show the work necessary to communicate clear answers each question. Good answers always communicate. This problem set is worth 50 points. Round all reported statistics to the fourth decimal.

The objective of this problem set is to estimate systems of equations. You will need to estimate models and conduct hypotheses tests using statistical computer software. You will also need to interpret the results. The problem set is organized around a supply and demand model of agricultural production. Data for the problem are attached.

The following is a supply and demand model for a commodity group in the aggregate in the U.S.

Demand: $P_t = \beta_{12} Q_t + \gamma_{11} S_t + \gamma_{12} I_t + \gamma_{10} + u_{1t}$

Supply: $Q_t = \beta_{21} P_t + \gamma_{21} F_t + \gamma_{20} + u_{2t}$

where

- Q_t = Index of per capita quantities
- P_t = Index of deflated prices for the commodity group
- S_t = Index of deflated prices for a substitute commodity group
- I_t = Index of deflated disposable consumer income
- F_t = Index of deflated price for farm inputs
- u_{it} = random error term in the i th equation
- β_{ij} parameter of j th endogenous variable in i th equation
- γ_{ij} parameter of j th exogenous variable in i th equation.

Practice good data analysis habits. Familiarize yourself with the data and examine plots of variables.

Answer the following questions.

1. Report a table of summary statistics and a table of correlations.
2. Determine the identification properties of each model. Examine Order and Rank Conditions. Be careful and be convincing and make sure you conduct the steps discussed in the textbook.
3. Estimate and report regression results for the two reduced form models. Report the parameter estimates, standard errors, p-values, F-Statistics, and the root error variance for both equations.

4. Estimate and report regression results for the demand and supply models using the following methods. Report the parameter estimates, standard errors, p-values, F-Statistics, and the root error variance for both equations.
 - a. Ordinary Least Squares
 - b. Two-Stage Least Squares
 - c. Three-Stage Least Squares and/or Iterated Three-Stage Least Squares.

Reporting the models within a table would be preferred. Also report the “R-squared” for each model. If your software doesn’t do it then output predicted values from each model, estimate a correlation coefficient, and square that estimate. (If your software automatically iterates 3SLS then reported the I3SLS otherwise report both.)

5. Report the error covariance matrices for the Three-Stage and/or Iterated Three-Stage Least Squares results. Discuss the measures you report. (What is the magnitude and direction of the cross-equation correlation?)
6. Briefly, discuss the economic interpretation of the estimates. Do the results agree with *a priori* expectations? (Of course, they do as they are synthetic data. But the point is to always consider what the results communicate and not just produce them.)
7. Solve the system of equations for the equilibrium price and quantity assuming mean levels of the exogenous variables. (Two equations and two variables.) Use the parameter results from the Two-Stage Least Squares and Iterated Three-Stage Least Squares models. What would a higher substitute price, income, and farm input price do to the equilibrium?
8. Compare the results of the four methods. Discuss differences in the parameter estimates and compare gains in model efficiency. Are the results for the various methods qualitatively different? Recommend a “best” model.
9. Optional Question. Test each equation for simultaneity.