Discussion of "Student Outcomes in Principles: Online vs Face-to-face Delivery"

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- Purpose: Measure the impact on academic performance from taking an economics principles online versus face-to-face.
- Important contribution: account for endogenous selection into online courses.
  - Control factors approach - compare simple t-tests with regression with a number of controls.
  - Identify selection factors - instrumental variables?
- Performance in online courses is not statistically significantly different from performance in face-to-face courses.

- Informative literature review.
  - In the re-write, do not make focus a summary, speak to how literature motivates your question.
  - Might cite *very recent* literature into how online teaching strategies have changed. Makes case for answering your question again.
- Nice experimental design
  - Same instructor, web-based homework, same lectures, same exams, closed-book exams under both formats.

- Two-stage least squares is an instrumental variables technique. Be explicit.

$$y_i = \alpha e_i + x_i'\beta + \epsilon_i$$

- y_i is outcome variable, e_i is endogenous variable, correlated with ϵ_i, x_i are exogenous controls.
- Decompose e_i into exogenous and endogenous parts.

$$e_i = \gamma z_i + \upsilon_i$$

$$\hat{e}_i = \hat{\gamma}_i z_i$$

$$e_i = \hat{e}_i + \hat{\upsilon}_i$$

- z_i is a vector of instruments *and* x_t, instruments are *exogenous* variables that help explain e_i (age, distance, previous experience).
- $\hat{e}_i$ is exogenously explained choice to take online class, $\hat{\upsilon}_i$ contains the endogenous influence.

- Instrumental variable regression rarely looks pretty.
- Tell a convincing story as to why instruments are exogenous.
- Durbin-Wu-Hausman test for endogeneity:
  - Put residuals from first stage regression (υ_i) into second stage.
  - If coefficient is significant = Endogeneity problem definitely needs to be addressed.
- Test for exogeneity (only for over-identified models):
  - Regress residuals from second stage regression (ϵ_i) on instruments.
  - Fail to reject F-test = Exogeneity.
- Test for weak instruments: First stage - Partial F-test and R^2 on instruments. Measures how well instruments explain endogenous variable.

- Small sample size may be generating all the lack of significance.
- Include dummy for USD student, this exclusion could cause endogeneity.
- Because first stage is a probit, what you are doing is actually an MLE procedure.
  - Imposes assumptions of normality and homoskedasticity on error term.
  - Use a linear-probability model (simple OLS with dummy dependent variable) for true 2SLS
- Check robustness across IV methods: 2SLS, MLE, GMM.