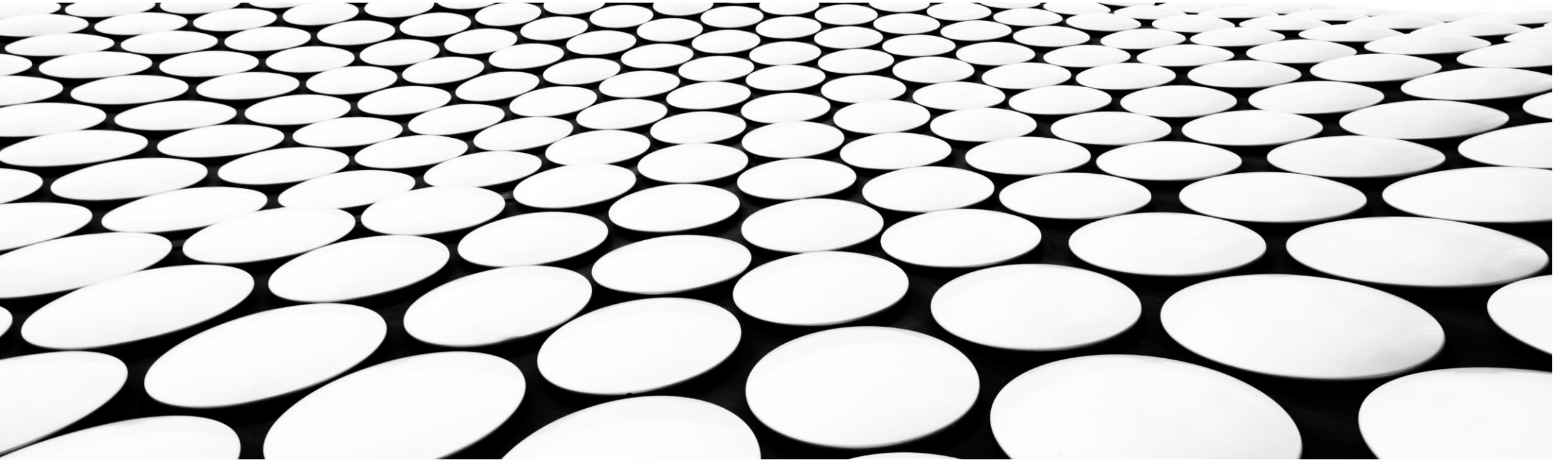

CHOOSING THE BEST MODEL

FELIPE BUCHBINDER





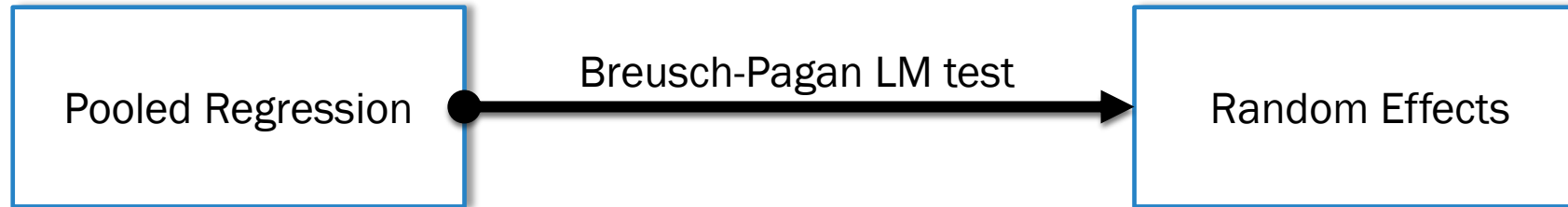
MODELS WE'VE SEEN SO FAR

- Pooled Regression (PR)
- First Differences (FD)
- Fixed Effects (FE)
- Random Effects (RE)
- Quasi-Demeaning (QD) + Cochrane-Orcutt, Prais-Winsten and Hildreth-Lu (CO/PW/HL)

START SIMPLE: POOLED REGRESSION

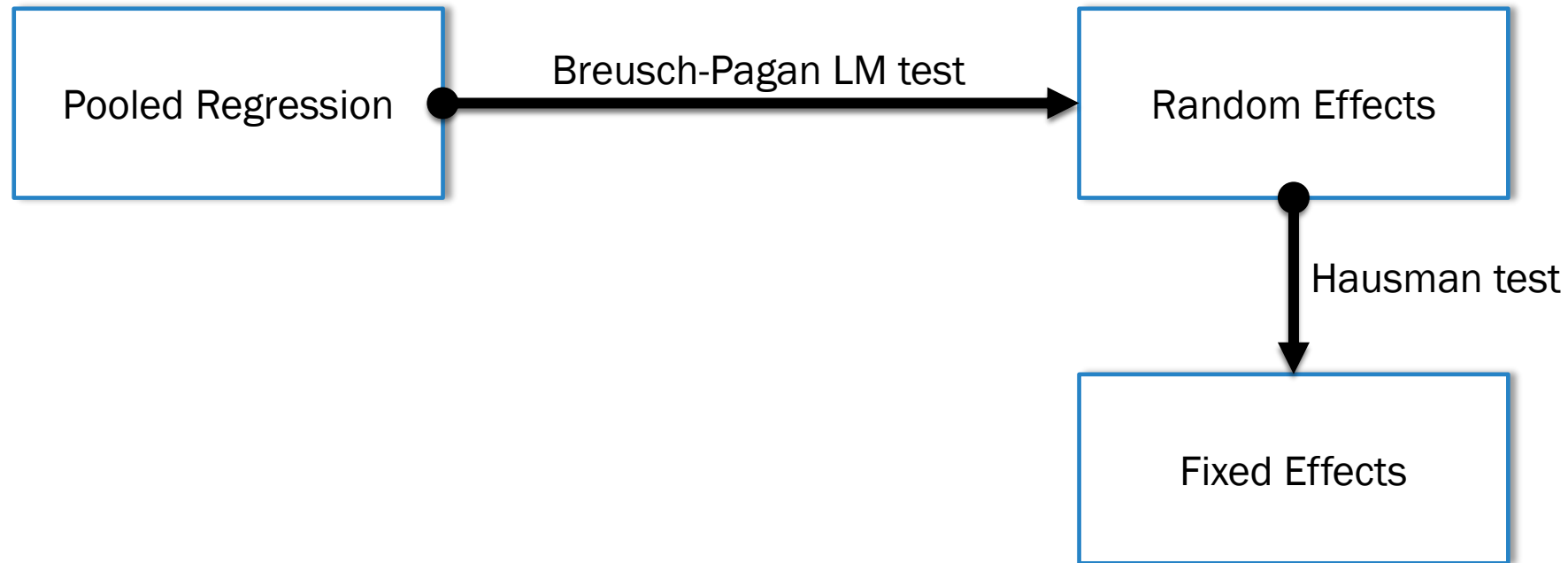
Pooled Regression

RUN A BREUSCH-PAGAN LAGRANGE MULTIPLIER TEST.
IF YOU REJECT H_0 , DO A RANDOM EFFECTS MODEL INSTEAD.

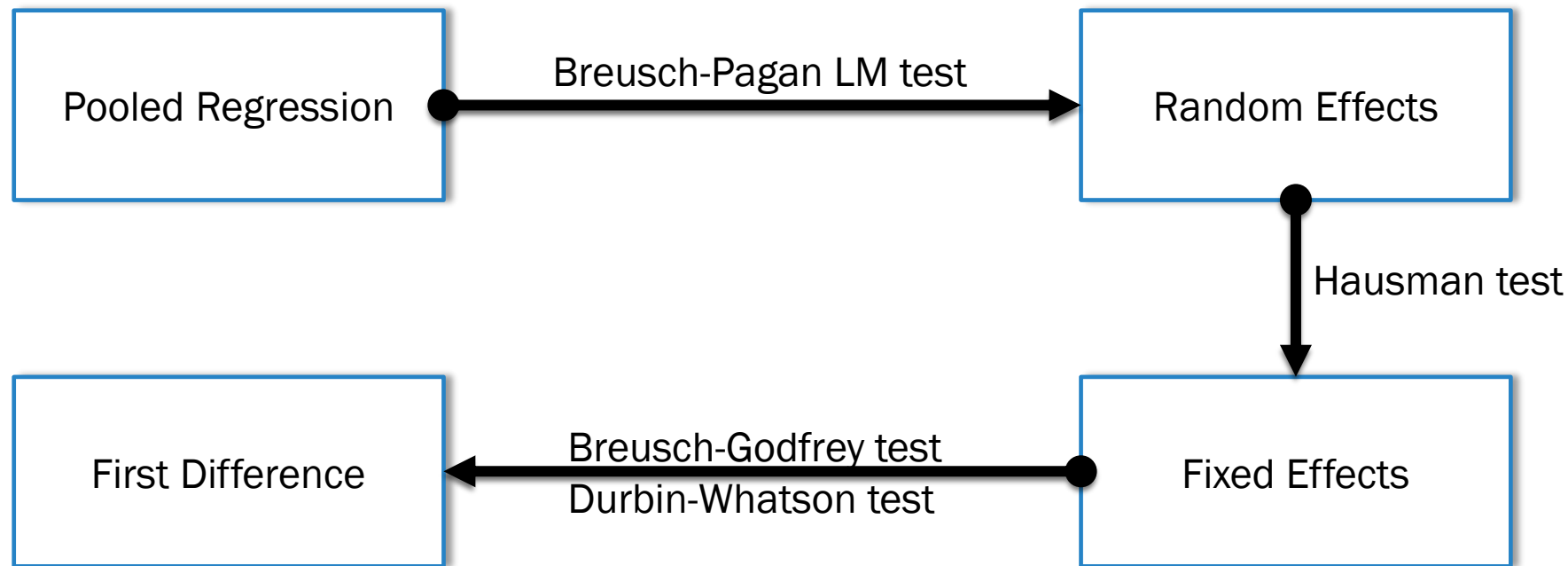


RUN A **HAUSMAN** TEST.

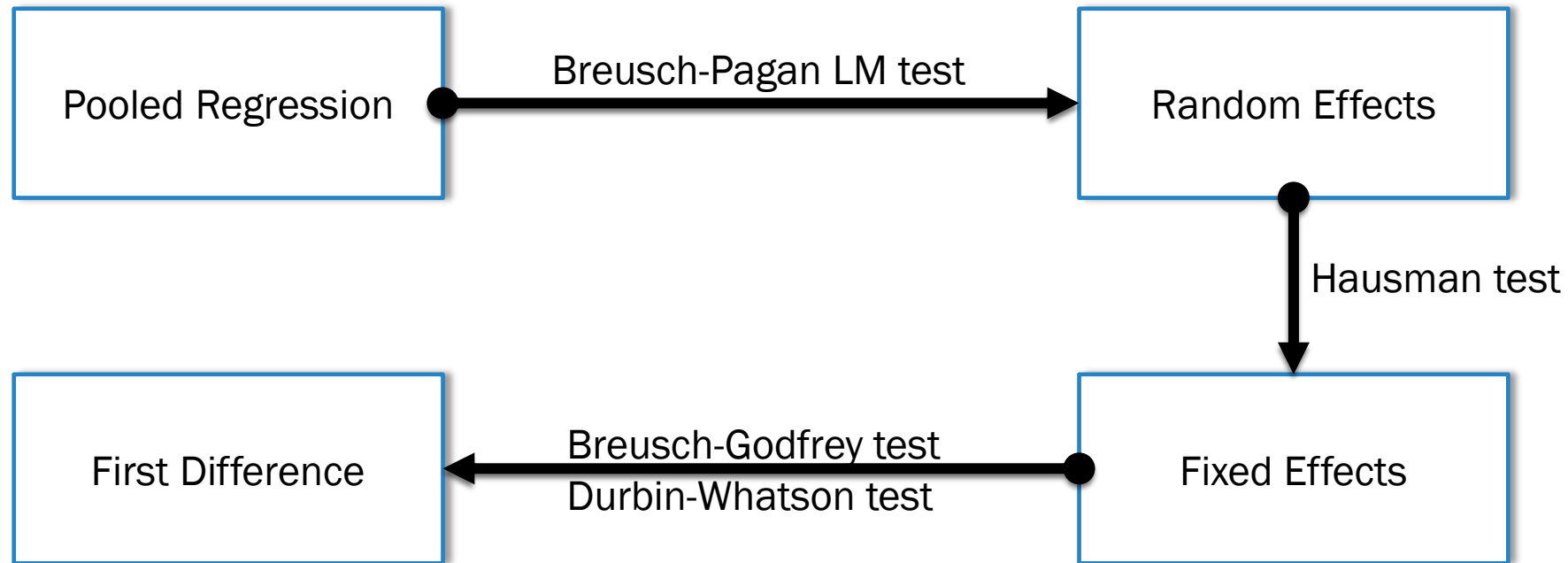
IF YOU REJECT H_0 , DO A **FIXED EFFECTS** MODEL INSTEAD.



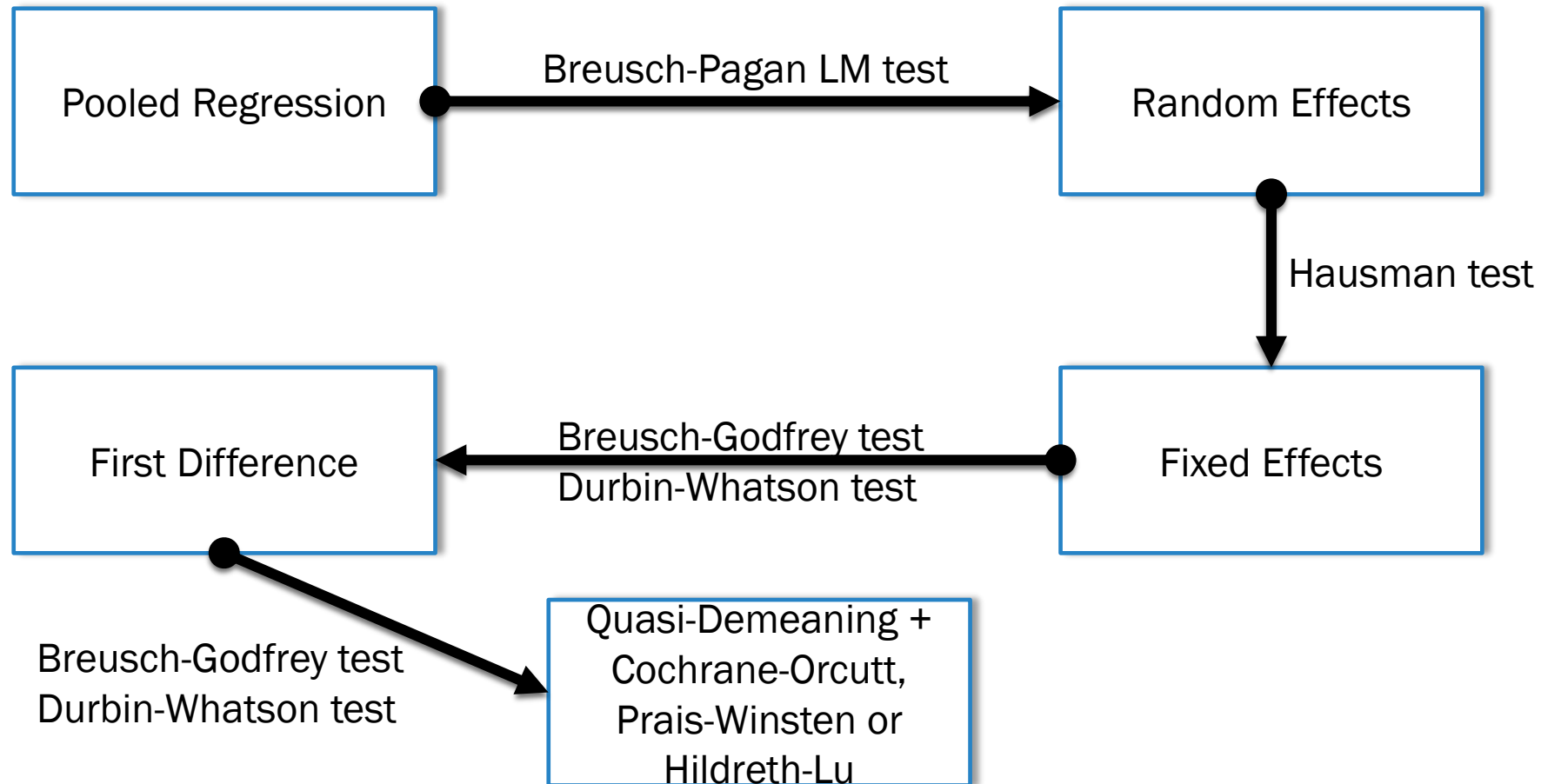
RUN A **BREUSCH-GODFREY TEST** OR A **DURBIN-WHATSON TEST**.
IF YOU REJECT H_0 , DO A **FIRST DIFFERENCE MODEL** INSTEAD.



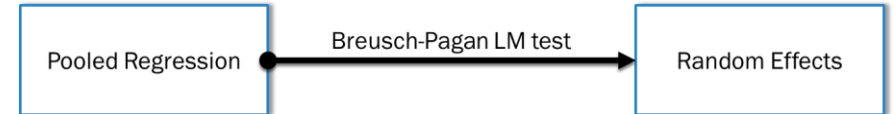
RUN A **BREUSCH-GODFREY TEST** OR A **DURBIN-WHATSON TEST** **AGAIN**, THIS TIME ON YOUR **FIRST DIFFERENCE MODEL**.



IF YOU REJECT H_0 , USE QUASI-DIFFERENTIATION TO ACHIEVE SERIALLY UNCORRELATED RESIDUALS



BREUSCH-PAGAN LM TEST

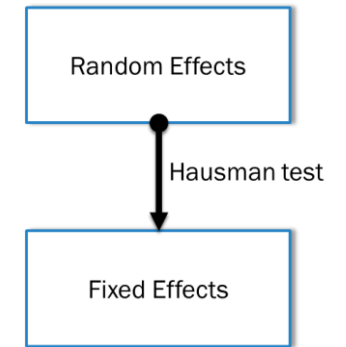


- Neglecting U_i will lead to heteroskedasticity if $U_i \neq 0$, in which case Random Effects will be better than Pooled Regression.
- BPLM tests for heteroskedasticity.
- 4 steps:
 1. Regress $y_{it} = X_{it}\beta + \epsilon_{it}$ (Pooled Regression)
 2. Standardize and square the residuals. Call it e_{it}^2 .
 3. Regress $e_{it}^2 = X_{it}\gamma + v_{it}$
 4. Use this regression to calculate the test statistic:

$$LM = \frac{\text{Explained Sum of Squares}}{2} \sim \chi_p^2$$

Where p is the number of X' s.

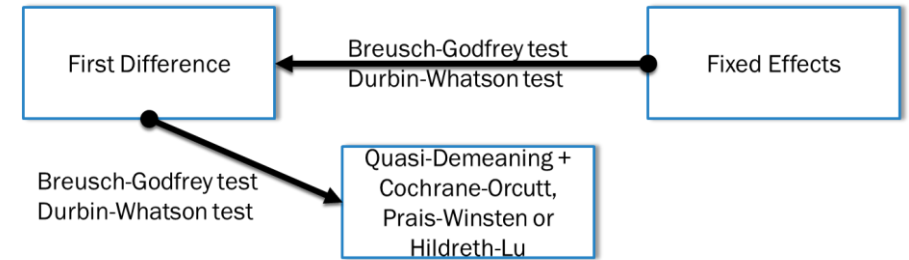
HAUSMAN TEST



- Two consistent estimators: \mathbf{b}_{FE} and \mathbf{b}_{RE} .
- Is $V(\mathbf{b}_{FE}) = V(\mathbf{b}_{RE})$, in which case we would use FE? ...
- ... or is $V(\mathbf{b}_{RE}) < V(\mathbf{b}_{FE})$, in which case we would use RE?
- If $V(\mathbf{b}_{FE}) = V(\mathbf{b}_{RE})$, then...

$$H = (\mathbf{b}_{FE} - \mathbf{b}_{RE})^T (\boldsymbol{\Sigma}_{\mathbf{b}_{FE}} - \boldsymbol{\Sigma}_{\mathbf{b}_{RE}})^{\dagger} (\mathbf{b}_{FE} - \mathbf{b}_{RE}) \sim \chi^2_{\text{rank of matrix } (\boldsymbol{\Sigma}_{\mathbf{b}_{FE}} - \boldsymbol{\Sigma}_{\mathbf{b}_{RE}})}$$

BREUSCH-GODFREY TEST



- Generalizes DW test of serial correlation from AR(1) to AR(p)
- Regress residuals on previous p lags and on X's:

$$e_{it} = \rho_1 e_{it-1} + \rho_2 e_{it-2} + \dots + \rho_p e_{it-p} + \mathbf{x}\boldsymbol{\beta} + v_{it}$$

- Under null hypothesis that $\rho_k = 0 \forall k$ (residuals serially independent),

$$(T - p) \cdot R^2 \sim \chi_p^2$$

KEY TAKEAWAY

