CHOOSING THE BEST MODEL

FELIPE BUCHBINDER

MODELS WE'VE SEEN SO FAR

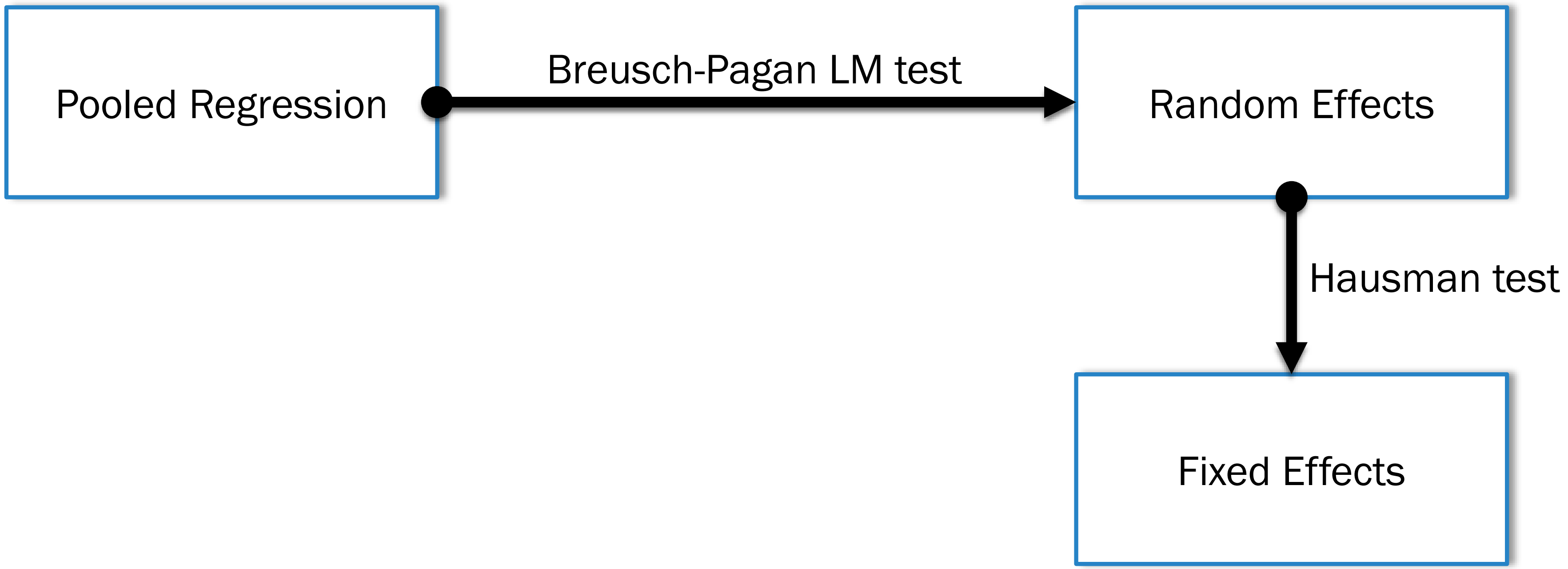
- Pooled Regression (PR)
- First Differences (FD)
- Fixed Effects (FE)
- Random Effects (RE)
- Quasi-Demeaning (QD) + Cochrane-Orcutt, Prais-Winsten and Hildreth-Lu (CO/PW/HL)

START SIMPLE: POOLED REGRESSION

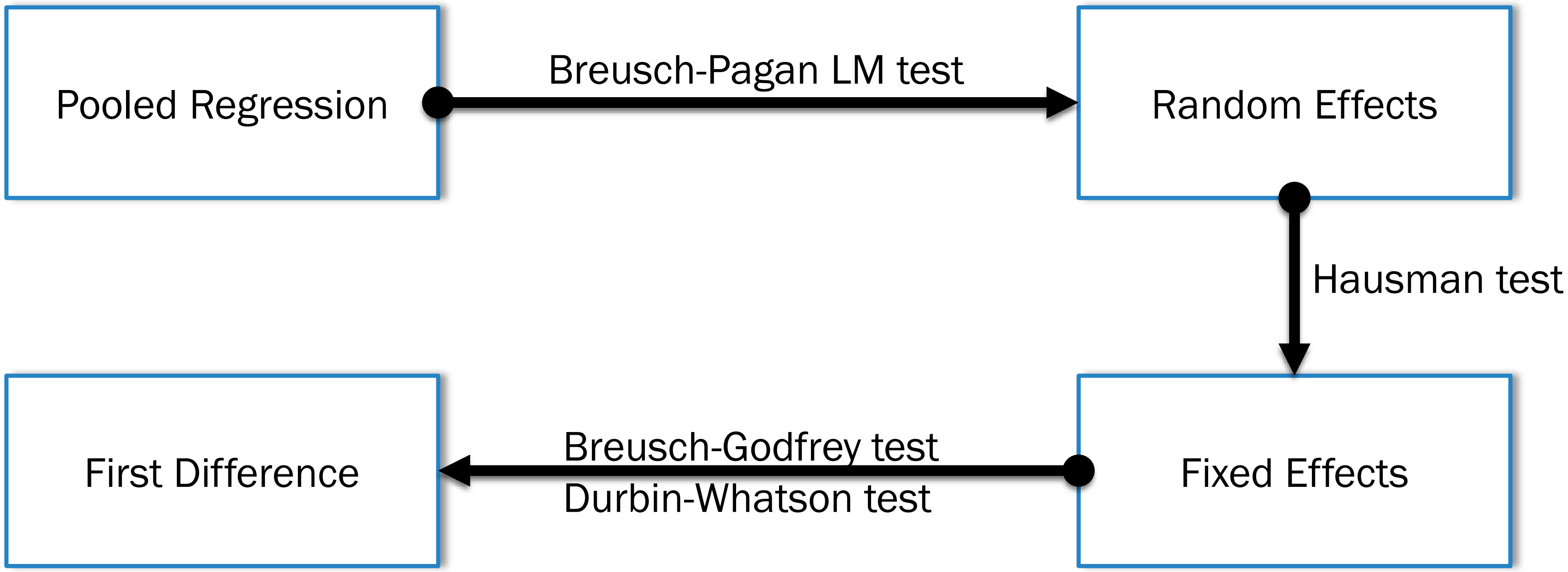
Pooled Regression

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

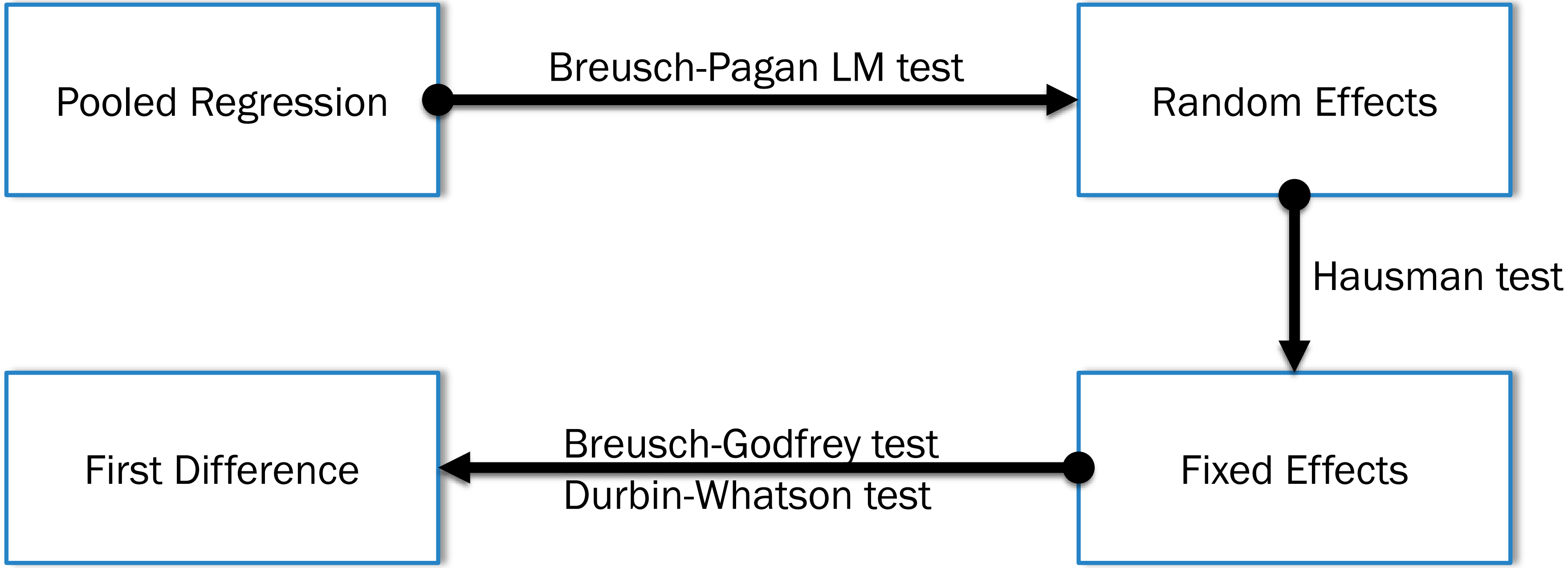
RUN A HAUSMAN TEST.
IF YOU REJECT H_0, DO A FIXED EFFECTS MODEL INSTEAD.



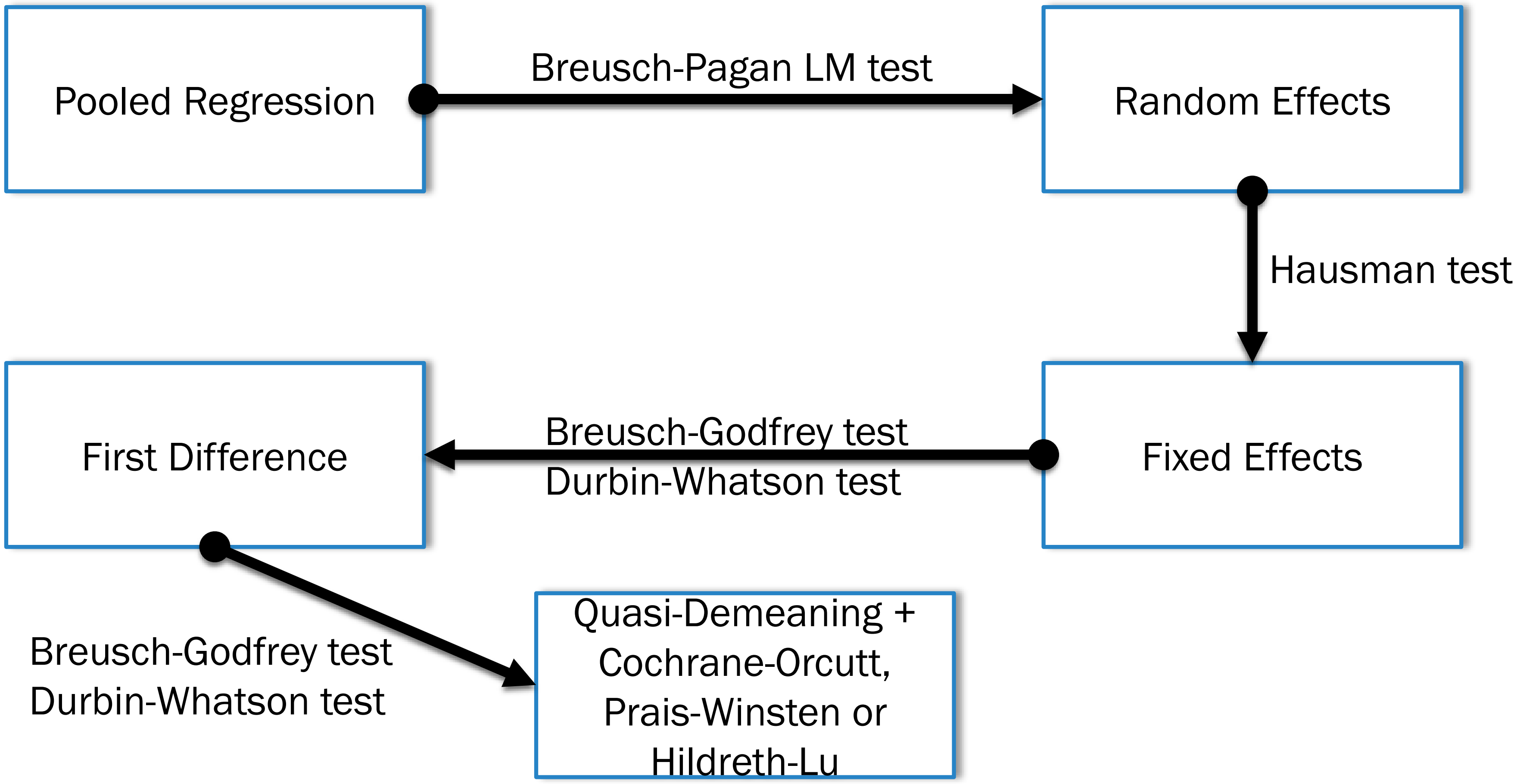
RUN A BREUSCH-GODFREY TEST OR A DURBIN-WHATSON TEST. IF YOU REJECT H_0, DO A FIRST DIFFERENCE MODEL INSTEAD.



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

$$\boxed{\text{Pooled Regression}} \xrightarrow{\text{Breusch-Pagan LM test}} \boxed{\text{Random Effects}}$$

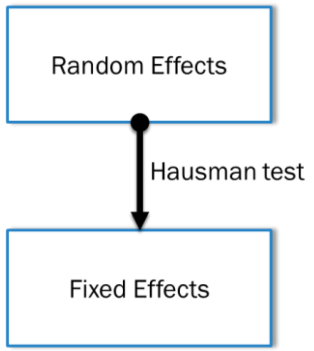
- Neglecting $\mathrm{U_i}$ will lead to heteroskedasticity if $\mathrm{U_i} \neq 0$, in which case Random Effects will be better than Pooled Regression.
- BPLM tests for heteroskedasticity.
- 4 steps:

1. Regress $\boldsymbol{y_{it}} = \mathbf{X_{it}\beta} + \boldsymbol{\epsilon}_{\mathbf{it}}$ (Pooled Regression)
2. Standardize and square the residuals. Call it $\boldsymbol{e_{it}^2}$.
3. Regress $\boldsymbol{e_{it}^2} = \mathbf{X_{it}}\boldsymbol{\gamma} + \boldsymbol{\nu}_{\mathbf{it}}$
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 $X's$.

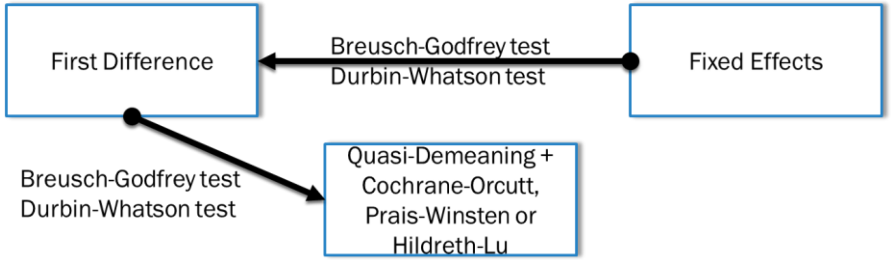
HAUSMAN TEST



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

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

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:

$$e_{it} = \rho_1 e_{it-1} + \rho_2 e_{it-2} + \cdots + \rho_p e_{it-p} + \mathbf{X\beta} + \nu_{it}$$

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

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

KEY TAKEAWAY