

Decomposition:

$$V_{ij} = \mu + BV_{ij} + D_{ij}$$

Regression with  
BV as predictor  
on D as residual

• Var on both sides

$$\begin{aligned} \sigma_G^2 = \text{var}(v_{ij}) &= \text{var}(\mu + BV_{ij} + D_{ij}) \\ &= \text{var}(\mu) + \text{var}(BV_{ij}) + \text{var}(D_{ij}) \\ &\quad + 2\text{cov}(\mu, BV_{ij}) + 2\text{cov}(\mu, D_{ij}) \\ &\quad + 2\text{cov}(BV_{ij}, D_{ij}) \\ &= \text{var}(BV_{ij}) + \text{var}(D_{ij}) \\ &= \sigma_A^2 + \sigma_D^2 \end{aligned}$$

$$Y = \mu + \beta x + e$$

$\text{cov}(x, e) = 0$