Illustration of *Mutual Causality*, $y \Leftrightarrow x$, implying Covariance of Regressor with Residual

$$\left.\begin{aligned} y &= \beta x + \gamma z + \varepsilon_y \\ x &= \theta y + \lambda w + \varepsilon_x \end{aligned}\right\} \Rightarrow \begin{cases} Cov(x, \varepsilon_y) = Cov(\varepsilon_y, \theta y + \lambda w + \varepsilon_x) = Cov(\varepsilon_y, \theta y) \\ \qquad = Cov(\varepsilon_y, \theta(\beta x + \gamma z + \varepsilon_y)) = Cov(\varepsilon_y, \theta\varepsilon_y) = \theta Var(\varepsilon_y) \\ Cov(y, \varepsilon_x) = Cov(\varepsilon_x, \beta x + \gamma z + \varepsilon_y) = Cov(\varepsilon_x, \beta x) \\ \qquad = Cov(\varepsilon_x, \beta\varepsilon_x) = \beta Var(\varepsilon_y) \end{cases}$$