(1) $C_t = \beta_0 + \beta_1 C_{t-1} + \beta_2 Y_t + \beta_3 R_t + \beta_4 W_{t-1} + u_t$

$u_t = \rho u_{t-1} + \varepsilon_t$

$t = 1954.1 - 2019.4$

(2) $\rho C_{t-1} = \rho \beta_0 + \rho \beta_1 C_{t-2} + \rho \beta_2 Y_{t-1} + \rho \beta_3 R_{t-1} + \rho \beta_4 W_{t-2} + \rho u_t$

(1) − (2) $C_t - \rho C_{t-1} = \beta_0 (1-\rho) + \beta_1 (C_{t-1} - \rho C_{t-2}) + \beta_2 (Y_t - \rho Y_{t-1})$

$+ \beta_3 (R_t - \rho R_{t-1}) + \beta_4 (W_{t-1} - \rho W_{t-2}) + \varepsilon_t$

or

$C_t^* = \beta_0 (1-\rho) + \beta_1 C_{t-1}^* + \beta_2 Y_t^* + \beta_3 R_t^* + \beta_4 W_{t-1}^* + \varepsilon_t$

Non linear least squares
iterate

test whether $\rho = 0$ t-statistic on $\hat{\rho}$.

OVB

$$y_t = \alpha + \beta x_t + \gamma z_t + u_t \quad t = 1, .., T$$

Say no data on z_t.

OLS on constant and x_t.

is $\hat{\beta}$ unbiased?

pitfalls
horse race