(P9) a) 1) H_0: RW with drift $\beta=1\ (P_t)$, $\gamma=0\ (\Delta P_t)$

H_a: stationary (AR(1))

$$t = -\frac{0,02}{0,014} = -1,43$$

$$DF_{NT,5\%} = -2,88$$

$\Rightarrow P_t$ – non-stationary

2) H_0: RW $\quad \beta=1\ (P_t)$, $\gamma=0\ (\Delta P_t)$

H_a: stationary

$\beta<1$ / $\gamma<0$

$$t = \frac{-0,97}{0,075} = -12,93 < -2,88$$

$\Rightarrow \Delta P_t$ – stationary

b) $y_t = \beta_2 y_{t-1} + u_t$

$H_0: \beta_2 = 1$

$H_a: \beta_2 < 1$, if $|\beta_2| < 1$ $\Rightarrow \sqrt{T}(\hat{\beta}_2 - \beta_2) \to N(0,1)$

else if $\beta_2 = 1$

$\Rightarrow \hat{\beta}_2$ – superconsistent

so that $\sqrt{T}(\hat{\beta}_2 - \beta)$

won't be a "spike"

around zero

insted of $\sqrt{T}$

mult by T

1) $T(\hat{\beta}_2 - 1) = 183 \cdot (-0{,}02)$

$= -3{,}66$

$T^{crit}_{5\%} = -13{,}72$

$\Rightarrow P_t$ - non-stationary

2) $T(\hat{\beta}_2 - 1) = 183 \cdot (-0{,}97)$

$= -177{,}5$

$-177{,}5 < T^{crit}_{1\%}$

$\Rightarrow \Delta P_t$ - stationary

c) 1) $\Delta P_t = \beta_1 + (\beta_2 - 1) P_{t-1} + u_t$

$H_0: \beta_2 = 1$

$\beta_1 = 0$

$H_a: \beta_2 \neq 1$ or $\beta_1 \neq 0$

$F^{obs} = 1$

$F^{crit}_{5\%} = 4{,}67$ $\Rightarrow$ P_t - non-stationary

2) $F = t^2$ $\Rightarrow$ no - const.

$\Rightarrow$ results will be eq. to t - test

Cointegration

$\Delta y_t = y_t - y_{t-1}$

$\Delta^2 y_t = \Delta y_t - \Delta y_{t-1}$

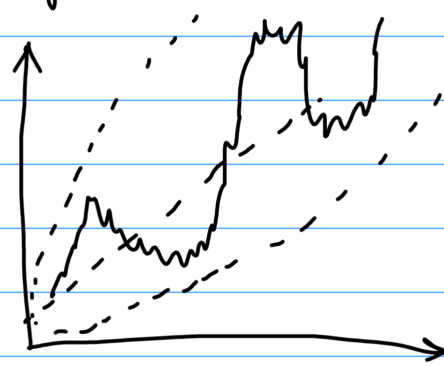
P1 $I(1)$ - process stationary after Δ

$I(d)$ - process stationary after Δ^d

P2 TS - process $y_t = \alpha_0 + \underbrace{\alpha_1 t}_{\text{det. trend}} + \underbrace{u_t}_{\text{stationary process}}$

Detrending : $y_t - \hat{\alpha}_1 t$ - stationary

DS - process: $y_t = \beta_0 + y_{t-1} + u_t$ RW with drift



Differencing: $\Delta y_t = y_t - y_{t-1} = \beta_0 + u_t$

P4

Several TS are cointegrated:

1) all of one order of integration

2) $\exists$ lin. comb. of these TS is stationary

① X_t, y_t, z_t are $I(1)$

② Let $\alpha_0 + \alpha_1 X_t + \alpha_2 y_t + \alpha_3 z_t = e$

stationary L.C.

$$y_t = -\frac{\alpha_0}{\alpha_2} - \frac{\alpha_1}{\alpha_2} X_t - \frac{\alpha_3}{\alpha_2} z_t + \frac{e}{\alpha_2}$$

Practically: 1) Check order of integration

DF for y_t → non-stationary

=> DF for Δy_t → stationary

=> $y_t - I(1)$

2) $y_t \mid X_t, z_t$ => $\hat{\varepsilon}_t$ - check stationarity

(P7)

$$y_t = \alpha + y_{t-1} + \varepsilon_t$$

$$X_t = \beta + X_{t-1} + u_t$$

$$y_t = \pi_0 + \pi_1 \cdot X_t + v_t$$

$H_0: \pi_1 = 0$ (which is true)

$$\Rightarrow \quad y_t = \pi_0 + v_t$$

$y_t - I(1) \Rightarrow v_t$ also $I(1)$

(P10) ARDL(1,1)

$$y_t = \alpha_1 + \alpha_2 y_{t-1} + \alpha_3 X_t + \alpha_4 X_{t-1} + u_t \quad \Big| - y_{t-1}$$

y_t and X_t are $I(1)$

$$\Delta y_t = \alpha_1 - (1-\alpha_2) y_{t-1} + \alpha_3 X_t - \alpha_3 X_{t-1}$$
$$+ \alpha_3 X_{t-1} + \alpha_4 X_{t-1} + u_t$$

$$\Delta y_t = \alpha_1 - (1-\alpha_2) y_{t-1} + \alpha_3 \Delta X_t$$
$$+ (\alpha_3 + \alpha_4) X_{t-1} + u_t$$

$$\Delta y_t = \alpha_3 \Delta X_t - \underbrace{(1-\alpha_2)}_{=\pi} \left[y_{t-1} - \underbrace{\frac{\alpha_1}{1-\alpha_2}}_{=\beta_1} - \underbrace{\frac{\alpha_3+\alpha_4}{1-\alpha_2}}_{=\beta_2} X_{t-1} \right] + u_t$$

ECM: $$\Delta y_t = \alpha_3 \Delta X_t - \pi \left[\underbrace{y_{t-1} - \beta_1 - \beta_2 X_{t-1}}_{\varepsilon_{t-1}} \right] + u_t$$

As y_t and X_t - cointegrated

$$\Rightarrow \quad \varepsilon_{t-1} = y_{t-1} - \beta_1 - \beta_2 X_{t-1} \quad - \quad I(0)$$

π - speed of adjustment

$\pi = 0$ — no adj.

$\pi = 1$ — instant adj