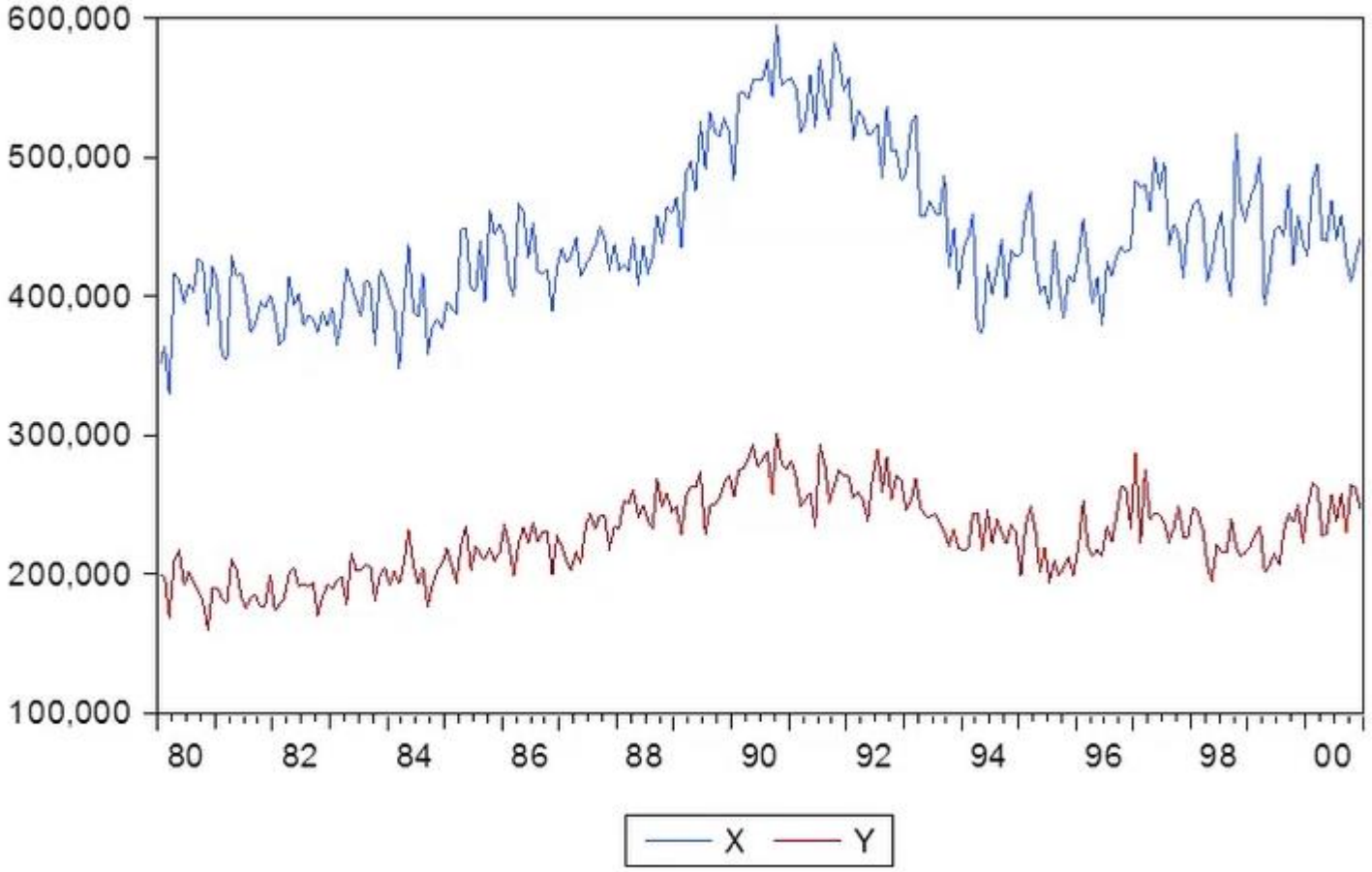
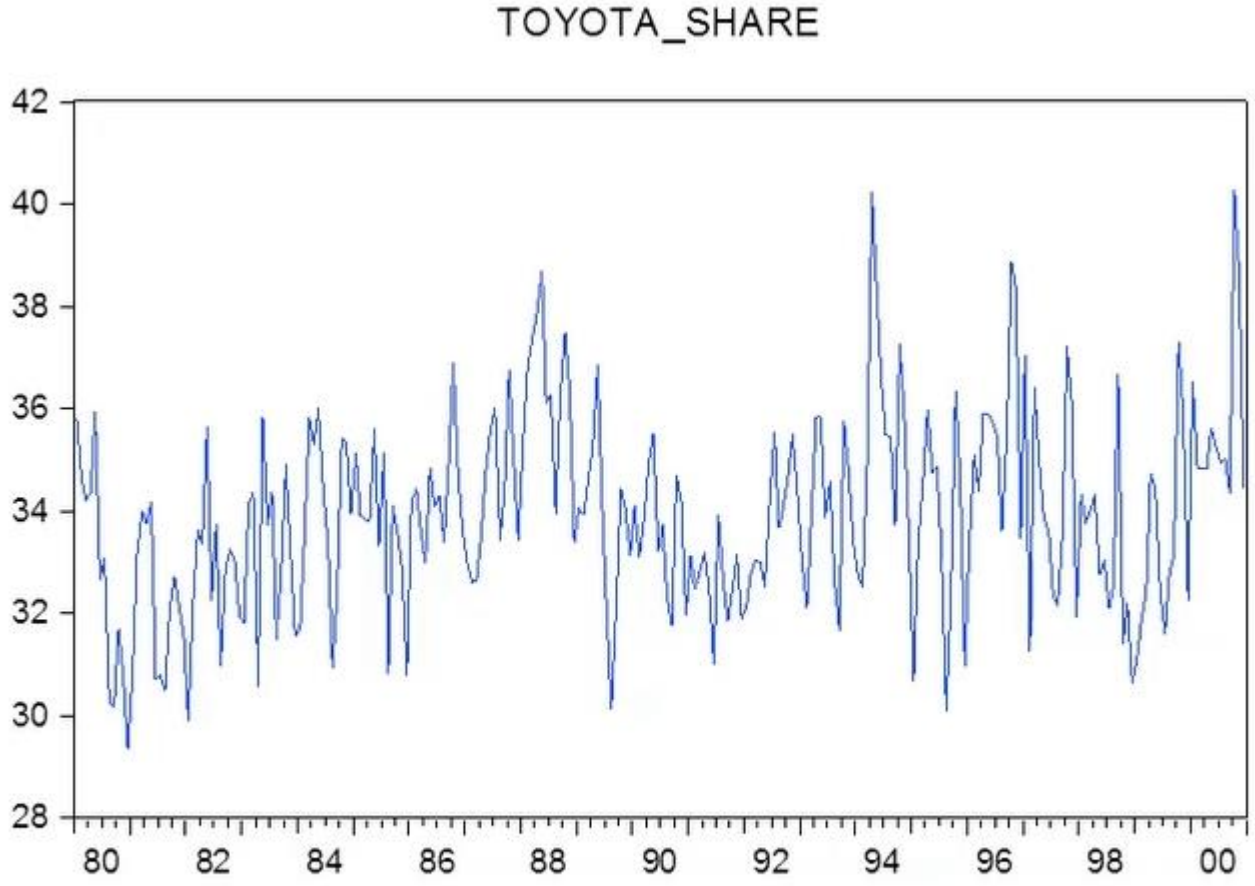
a)



No clear overall trend



relatively stable over time ± 35%

b) 5% crit. value for ADF with constant, without trend = −2.9

Cars: coeff of x_{t-1} = −0.069629

SE = 0.033067

t-stat = −2.105676 > −2.9

Toyota: coeff of y_{t-1} = −0.083219

SE = 0.036705

t-stat = −2.266284 > −2.9

→ do not reject H_0 of non-stationarity

In (a) mean is non-stationary, with a level shift during 1988-1992

c) 1st step of EG :

$y_t = 26706.43 + 0.45 x_t + e_t$

2nd step of EG :

$\Delta e_t = 24.99 - 0.29 e_{t-1} - 0.29 \Delta e_{t-1} - 0.14 \Delta e_{t-2} - 0.10 \Delta e_{t-3} + w_t$

SE = 0.068043

t = −4.305705

5% C.V. of EG = −3.4

as $t = -4.3 < -3.4$ → reject H_0 that the series are not cointegrated

error corr. term = $y_t - 0.45 x_t$

d) ACF & pACF → perhaps AR(2)?

However $2 \cdot \sigma_{SE} = 2 \cdot \frac{1}{\sqrt{n}} = 2 \cdot \frac{1}{\sqrt{239}} = 0.13$

→ some other (p)AC also significant

	AC	pAC
1	−0.456	−0.456
2	−0.041	−3.15
10	−0.348	−0.219
12	0.209	0.206

$$\Delta y_t = 619.04 - 0.62\Delta y_{t-1} - 0.30\Delta y_{t-2} - 0.26\Delta y_{t-3} - 0.27\Delta y_{t-4} - 0.23\Delta y_{t-5}$$
$$- 0.12\Delta y_{t-1} - 0.13\Delta y_{t-7} + 0.04\Delta y_{t-8} + 0.04\Delta y_{t-9} - 0.26\Delta y_{t-10}$$
$$- 0.04\Delta y_{t-11} + 0.22\Delta y_{t-12}$$

→ sign with $p < 5\%$.

$$\Delta y_t = 561.61 - 0.60\Delta y_{t-1} - 0.26\Delta y_{t-2} - 0.23\Delta y_{t-3} - 0.23\Delta y_{t-4} - 0.15\Delta y_{t-5} - 0.27\Delta y_{t-10} + 0.25\Delta y_{t-12}$$

$R^2 = 0.44$

e) now with ECM

$$\Delta y_t = 4728.01 - 0.15(y_{t-1} - 0.45x_{t-1}) - 0.52\Delta y_{t-1} - 0.19\Delta y_{t-2} - 0.16\Delta y_{t-3} - 0.18\Delta y_{t-4} - 0.13\Delta y_{t-5} - 0.27\Delta y_{t-10} + 0.25\Delta y_{t-12}$$

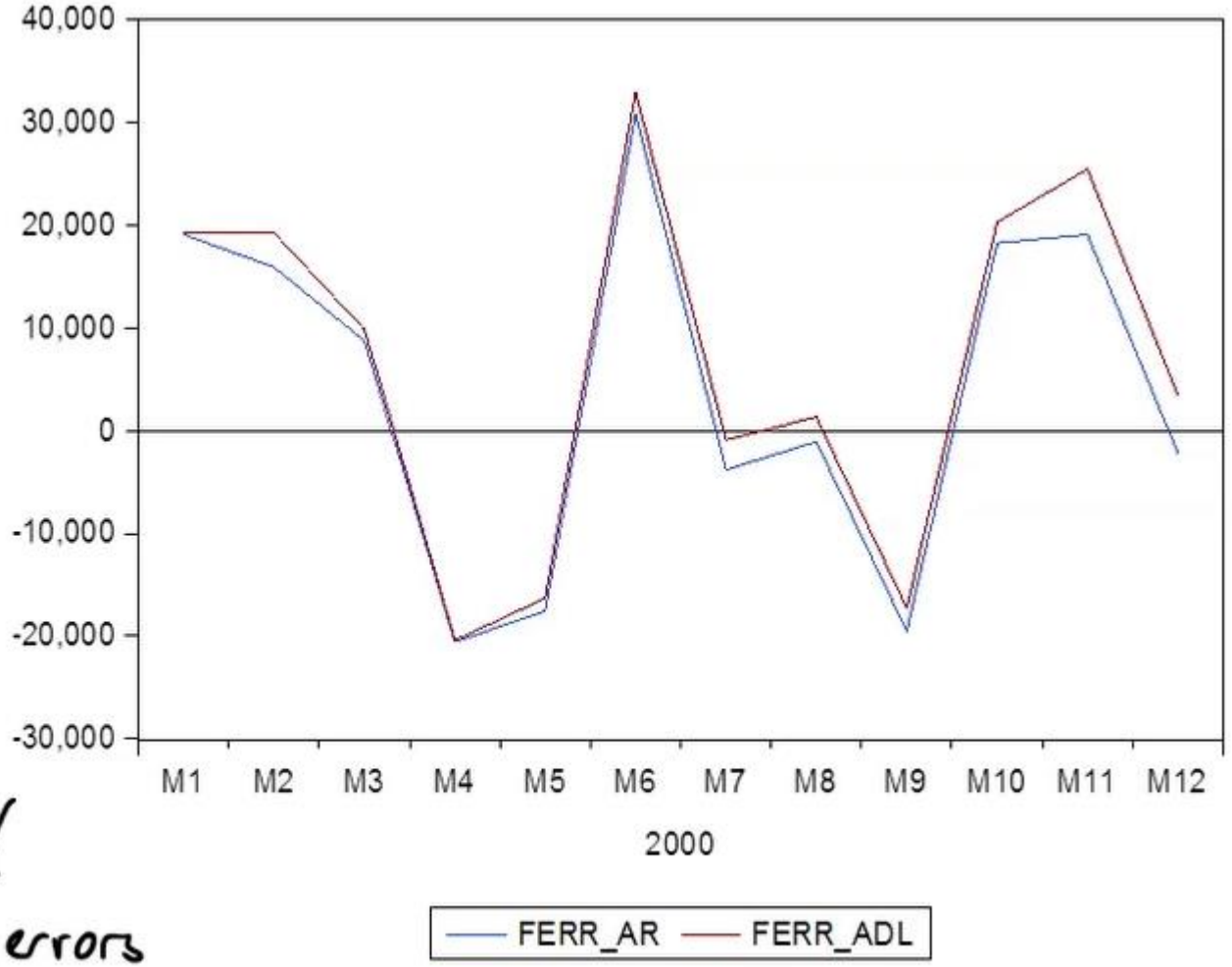
$t = -2.16$

$p = 0.03$

$SE = 0.07$

if $y_{t-1} > 0.45x_{t-1}$ → negative effect on Δy_t

so $y_t \downarrow$ → moves in direction of equilibrium



forecast errors nearly identical

f)

	AR (lags 1-5, 10, 12)	ECM (with AR 1-5, 10, 12 & ECM)
RMSE	16992	18205
MAE	14703	15586

↓ Slightly worse

sy_t can be predicted from past production figures and the data of other brands do <u>not</u> help in out-of-sample forecasting