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(// : // :)

(TSFPF)

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(Zad et al., 2002)

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(Abyar,2007) (

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(Abyar, 2007)

() Mohamadi & Sadr Alashrafi

() Faryadras et al. .

(DEA)

Hajiyani et)

(al., 2005

() Meeusen et al. () Aigner et al.

(MOLS)

$$y_{it} = f(x_{it}, t; \beta) + (v_{it} - u_{it})$$

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() Kumbhakar

Henderson & Simar () Park et al.

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: Berndt &

() Karagiannis & Sarris

y_{it} () Christensen,

x_{ijt} t i

t i j

t

2. Data Envelopment Analysis (DEA)

() Mosavi & Khaliliyan .

1 . Modified ordinary least squares

$\Phi(\bullet) \quad \pi \approx 3.14$

$\exp(u_{it})$ (Battese & Coelli, 1988)

$\lambda = -2\{\ln L(H_0) - \ln L(H_1)\}$

$\gamma = \delta_0 = \delta_m = 0 \quad (m = 1, \dots, h)$

$\delta_m = 0 \quad (m = 1, \dots, h)$

$(m = 1, \dots, h)$ (Stevenson, 1980)

$\delta_0 = \delta_m = 0$ (Aigner et al.; 1977)

$(e_{it} = v_{it} - u_{it})$

v_{it}

u_{it}

$u_{it} \quad v_{it}$

u_{it}

(Battese & Coelli, 1995)

$y_{it} = \beta_0 + \beta_1 t + \frac{1}{2} \beta_{11} t^2 + \sum_{j=1}^n \beta_j x_{jit} + \frac{1}{2} \sum_{j=1}^n \sum_{k=1}^l \beta_{jk} x_{jit} x_{kit} + \sum_{j=1}^n \beta_j x_{jit} t + e_{it}$

$u_{it} \approx N(\delta_0 + \sum \delta_m z_{mi}, \sigma_u^2)$

$SE_{it}^0 = \exp\left[\frac{(1 - E_{it})^2}{2\beta}\right]$

E_{it} SE_{it}^0

$E_{it} = \sum_{j=1}^n \left(\beta_j + \sum_{k=1}^l \beta_{jk} x_{kit} + \beta_{jt} t \right)$

$\beta = \sum_{j=1}^n \sum_{k=1}^l \beta_{jk} < 0, \quad 0 < SE_{it}^0 \leq 1$

z_{mi}

w_{it}

$\delta_m \quad N(0, \sigma_U^2)$

(z_{mi})

$\sigma_s^2 = \sigma_u^2 + \sigma_v^2$

$\gamma = \frac{\sigma_u^2}{\sigma_v^2}$

(Kumbhakar & Lovell; 2000)

$\sigma_u^2 = \mu_u^2 [\Phi(\rho)]' (2 [\Phi(\rho)]' + 4 + \sigma^2 [\Phi(\rho)]' (\pi [\Phi(\rho)]') / 2\pi$

(Forsund, 1996)

$\rho = \mu_{it} / \sigma \quad \mu_{it} = (\delta_0 + \sum \delta_m z_{mi})$

u_{it}

$(Kumbhakar & Lovell; 2000)$

$\sigma_u^2 = \mu_u^2 [\Phi(\rho)]' (2 [\Phi(\rho)]' + 4 + \sigma^2 [\Phi(\rho)]' (\pi [\Phi(\rho)]') / 2\pi$

$\rho = \mu_{it} / \sigma \quad \mu_{it} = (\delta_0 + \sum \delta_m z_{mi})$

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:(Reinhard et al., 2002)

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X2 ()

X1 (

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X4 (

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X3 (

$$\ln SE_{it}^0 = \rho_0 + \sum_{m=1}^h \rho_m z_{mi} + \varepsilon_{it}$$

X5 (

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$$\rho_m \quad m(1, \dots, h) \quad \rho_0$$

(

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X6

$$v_{it}^* \quad (\varepsilon_{it} = v_{it}^* - u_{it}^*)$$

z1

$$u_{it}^* \quad N(0, \sigma_v^{*2})$$

() z3

() z2

$$u_{it}^* \approx N(\rho_0 + \sum \rho_m z_{mi}, \sigma_v^{*2})$$

() z5

() z4

z6

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$$\beta_{Tj} = 0 (j = 1, \dots, 6)$$

$$\gamma$$

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$$\gamma = \delta_0 = \delta_m = 0 \quad (m = 1, \dots, h)$$

$$\delta_0 = \delta_m = 0 \quad (m = 1, \dots, h)$$

$$\delta_m = 0 \quad (m = 1, \dots, h)$$

$$(\delta_T = \delta_{TT} = 0)$$

$$\beta_{jk} = 0 \quad (j, k = 1, \dots, 6)$$

$$\beta_T = \beta_{TT} = \beta_{Tj} = 0 (j, k = 1, \dots, 6)$$

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$\alpha = 0.05, \chi^2$	λ
	$(m = 1, \dots, h) \gamma = \delta_0 = \delta_m = 0$
	$(m = 1, \dots, h) \delta_0 = \delta_m = 0$
	$(m = 1, \dots, h) \delta_m = 0$
	$\delta_T = \delta_{TT} = 0$
	$\beta_{jk} = 0 (j, k = 1, \dots, 6)$
	$\beta_T = \beta_{TT} = \beta_{Tj} = 0 (j, k = 1, \dots, 6)$
	$\beta_{Tj} = 0 (j = 1, \dots, 6)$

χ^2

() Kodde & Palm

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t	t
	β_{x35}
	* β_{x36}
	* β_{x44}
	β_{x45}
	* β_{x46}
	* β_{x55}
	β_{x56}
	β_{x66}
	* β_T
	β_{TT}
	β_{Tx1}
	* β_{Tx2}
	β_{Tx3}
	β_{Tx4}
	* β_{Tx5}
	* β_{Tx6}
*	σ^2
	γ
	Log likelihood function

x5

x4

x3

x2

x1

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x6

t			t		
/ *	/	ρ_0	/	/	δ_0
/	/	ρ_{z1}	/ *	/	δ_{z1}
/	/	ρ_{z2}	/	/	δ_{z2}
/	/	ρ_{z3}	/ *	/	δ_{z3}
/	/	ρ_{z4}	/ *	/	δ_{z4}
/	/	ρ_{z5}	/	/	δ_{z5}
/ *	/	ρ_{z6}	/	/	δ_{z6}
/	/	ρ_{z7}	/	/	δ_{z7}
/	/	ρ_{z8}	/ *	/	δ_{z8}
/	/	ρ_{z9}	/ *	/	δ_{z9}
/	/	ρ_T	/	/	δ_T
/ *	/	ρ_{TT}	/	/	δ_{TT}

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z3 z2 z1 z5 z4

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