

The efficiency of dairy farms in Austria - do natural conditions matter?

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Introduction and objectives

- 50,000 Austrian dairy farms are
 - **small**: 12 cows and 50 tons milk quota on average
 - **disadvantaged**: 70 % located in mountain areas
 - **organic**: 16 %
- Competitiveness increasingly important
 - liberalisation of markets – price reductions
 - decoupling of direct payments
- Objectives:
 - To estimate efficiency levels (EE, TE)
 - To determine whether natural conditions make a difference

Data

Specialized dairy farms from the FADN 2001-2003 averages

Variable	Sample	Min.	Max.	All dairy farms
Number	222			58,107
Mountain farms (%)	76.1			70.1
Organic farms (%)	26.1			15.5
Milk quota per farm (t)	100.4	2.4	321.3	46.5
Utilised Agric. Area (ha)	22.0	4.1	66.4	17.1
Grassland in UAA (%)	75.3	0.7	100.0	57.9
Labour (AWU)	1.85	0.61	3.82	-

Sources: BMLFUW, Invekos-Data 2001-2003; LBG 2001-2003; own calculations.

Inputs and Outputs

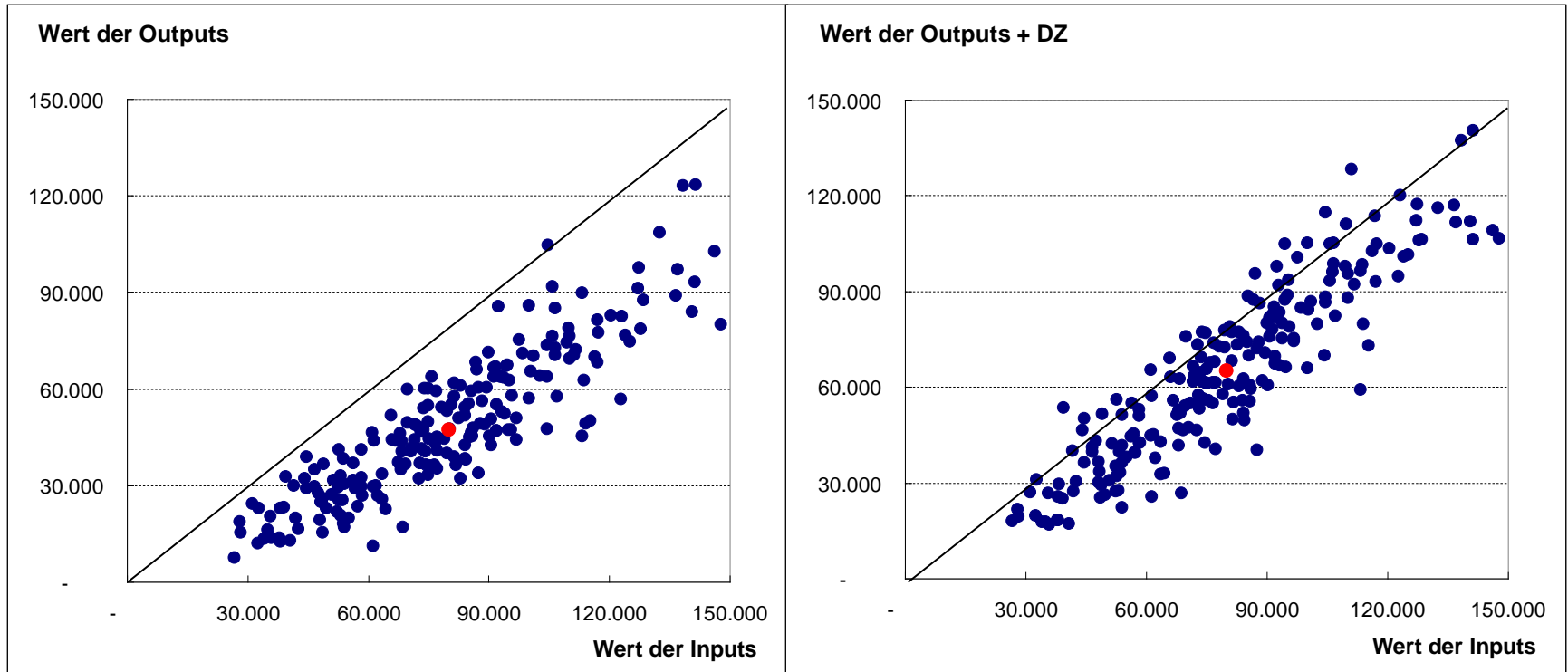
Outputs

- **Milk** production (net of milk for feeding) (kg)
- **Other** revenues (excluding direct payments) (€)

Inputs

- Unpaid **labour** units (AWU)
- Adjusted utilised agricultural **area** (ha)
- Operating costs for **animals** (€)
- Operating costs for **machines** and energy (€)
- **Other** operating costs (without buildings) (€)
- Heavy livestock units cattle (buildings) (No.)

Value of outputs vs. value of inputs (costs) without and with direct payments

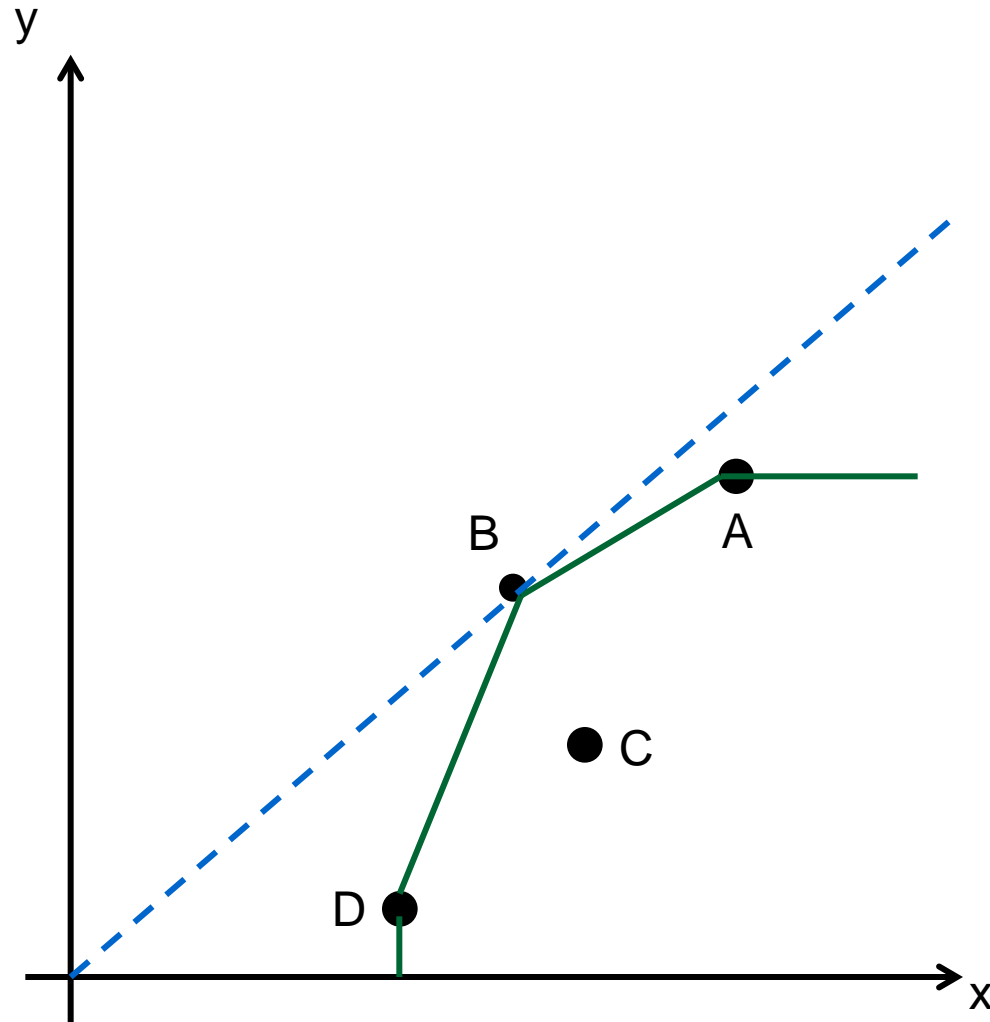


Methodology – efficiency

B is efficient

$$y/x = \max$$

*C uses more
input x and
produces less
output y*



Methodology – efficiency

$$EE = TE * AE$$

$$TE = SE * PTE$$

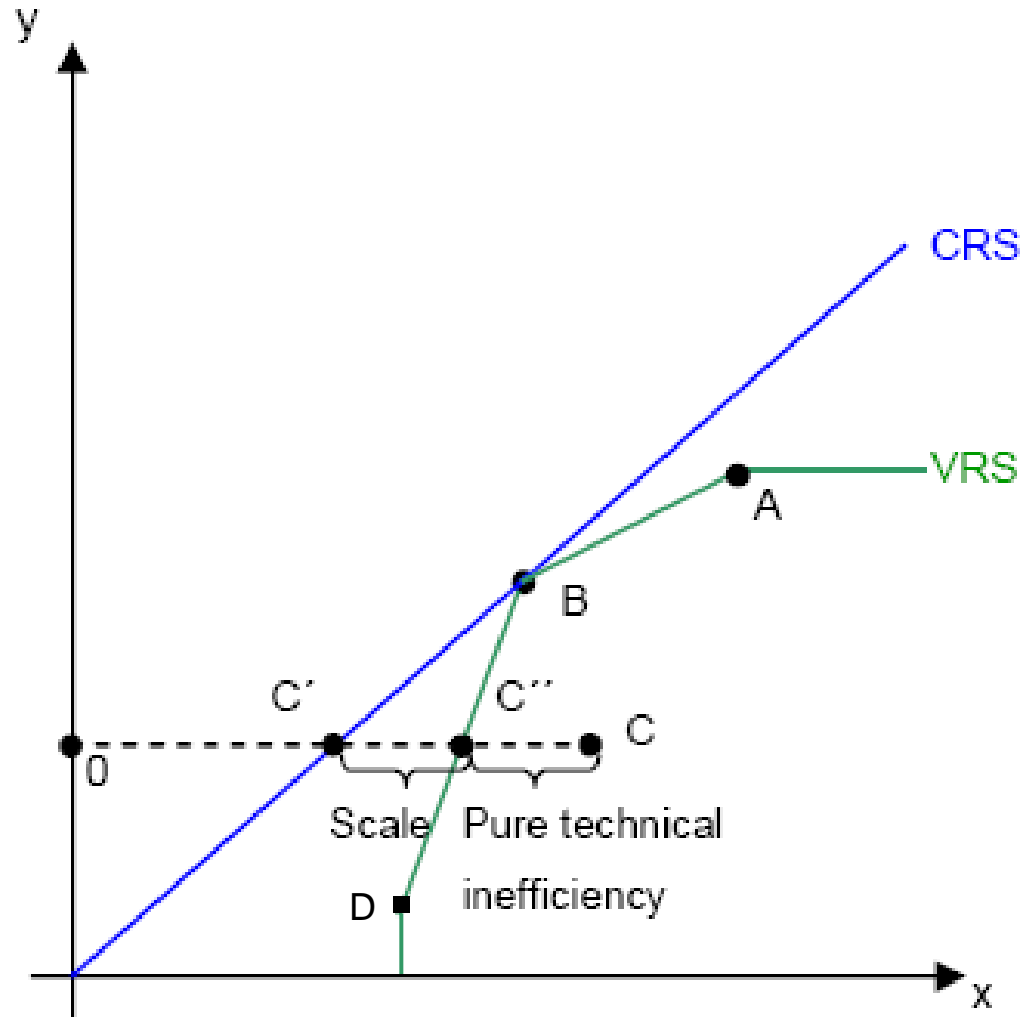
$$TE = OC' / OC$$

$$SE = OC' / OC''$$

$$PTE = OC'' / OC$$

$$\delta_i = 1 / TE$$

$$= OC / OC'$$



Methodology – estimation of TE

Two-stage procedure

1) Data envelopment analysis (DEA)

Data oriented, non-parametric, deterministic approach

Bootstrapping with 1000 replications

-> bias-corrected estimates of $\delta_i = d_i$

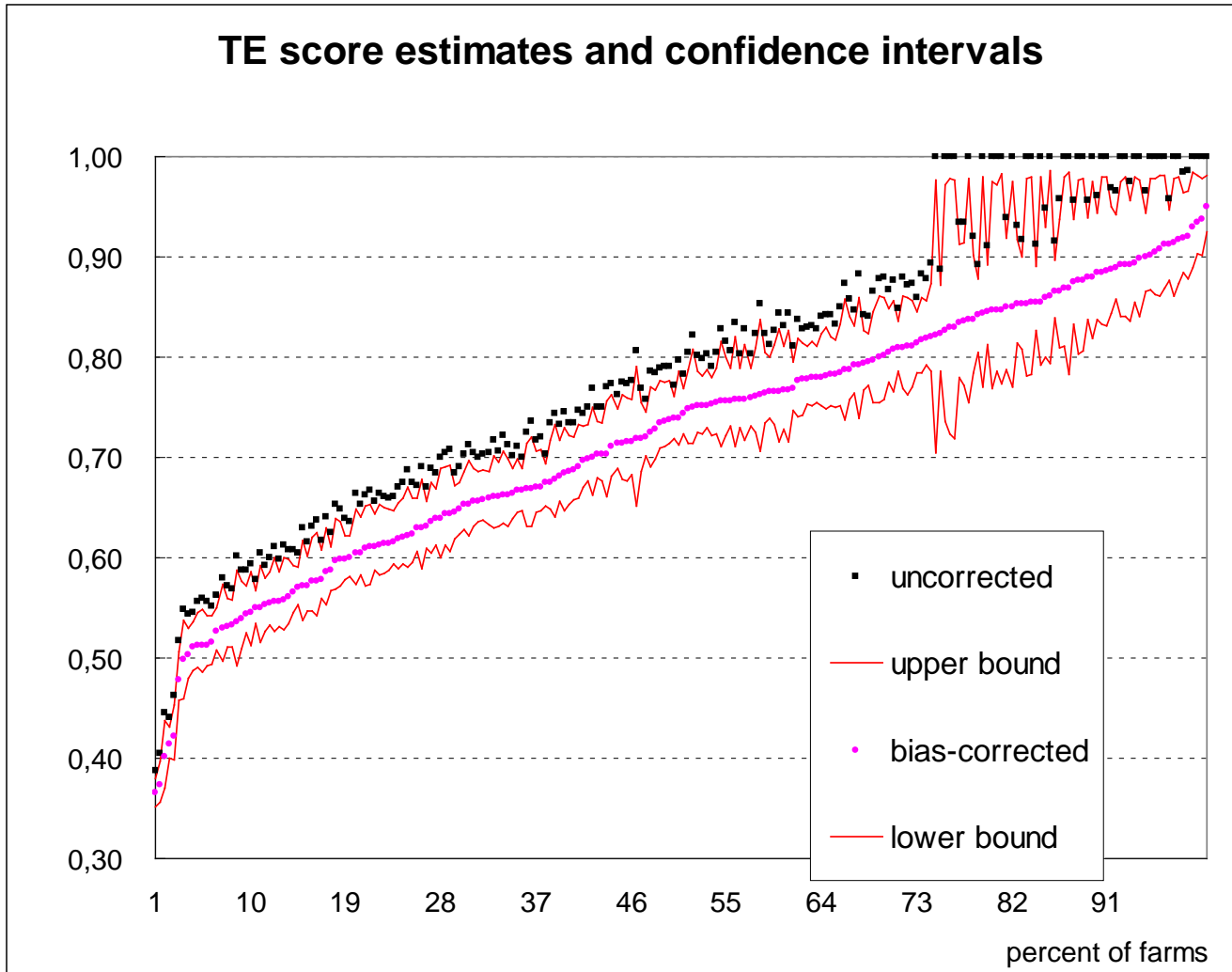
-> confidence intervals for d_i

2) Truncated regression of d_i on attributes z_i

$$d_i = z_i' \beta + \varepsilon_i \geq 1$$

$$\varepsilon_i \sim N(0, \sigma_\varepsilon^2) \text{ with left-truncation at } 1 - z_i' \beta$$

Technical efficiency scores

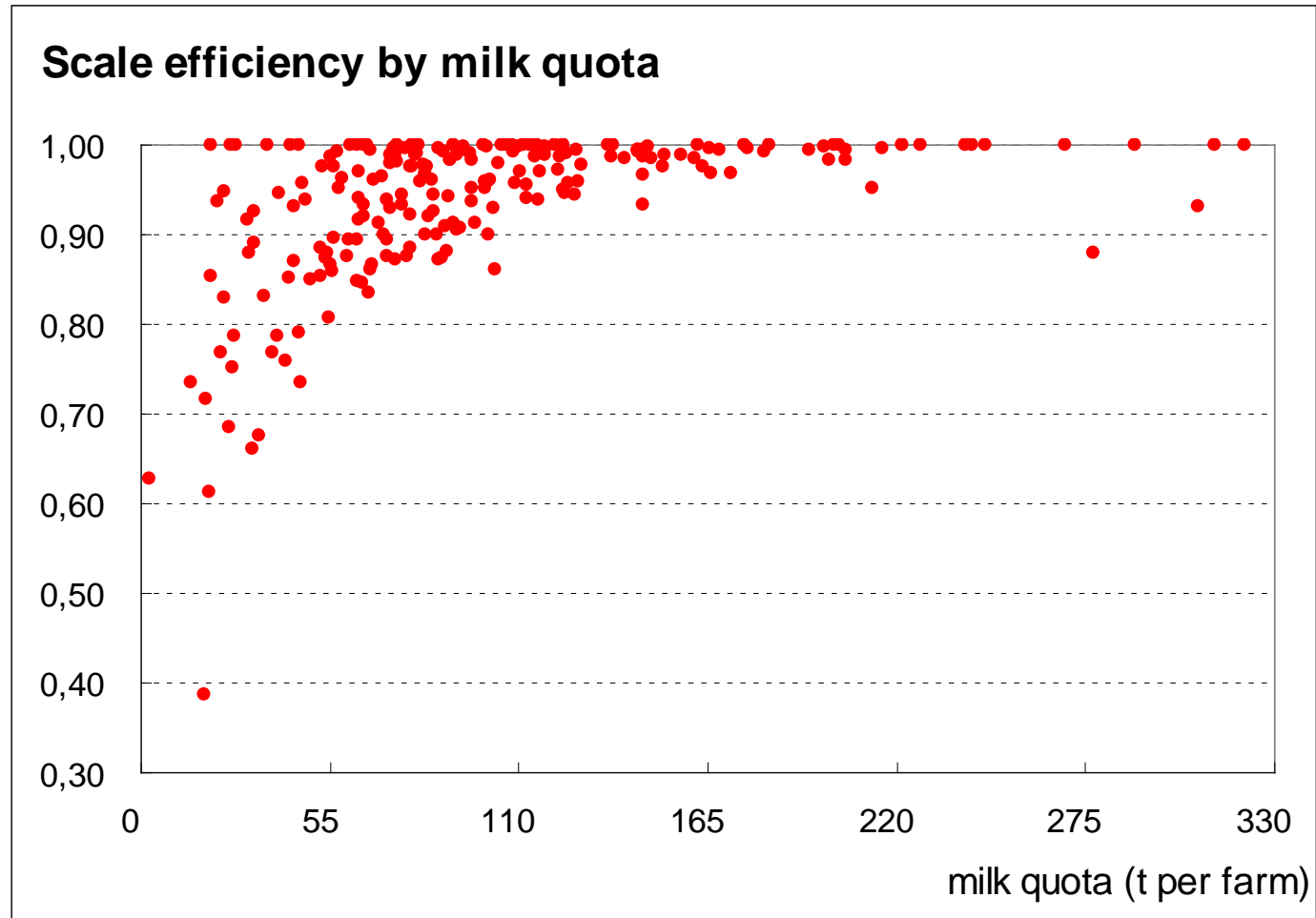


Distribution of efficiency scores by

	N	TE	PTE	SE
Cow numbers				
up to 10 cows	32	.686	.804	.849
>10 to 20 cows	109	.704	.753	.933
>20 to 30 cows	57	.741	.763	.969
>30 cows	24	.816	.823	.990
Natural conditions				
Non mountain farms	53	.753	.797	.943
Mountain farms (1+2)	152	.719	.765	.938
Mountain farms (3+4)	17	.662	.743	.896
Farms system				
Organic farms	58	.702	.761	.921
Conventional farms	164	.730	.774	.942

TE=technical efficiency, PTE=pure technical efficiency, SE=scale efficiency.

Scale efficiency scores



Attributes of farms

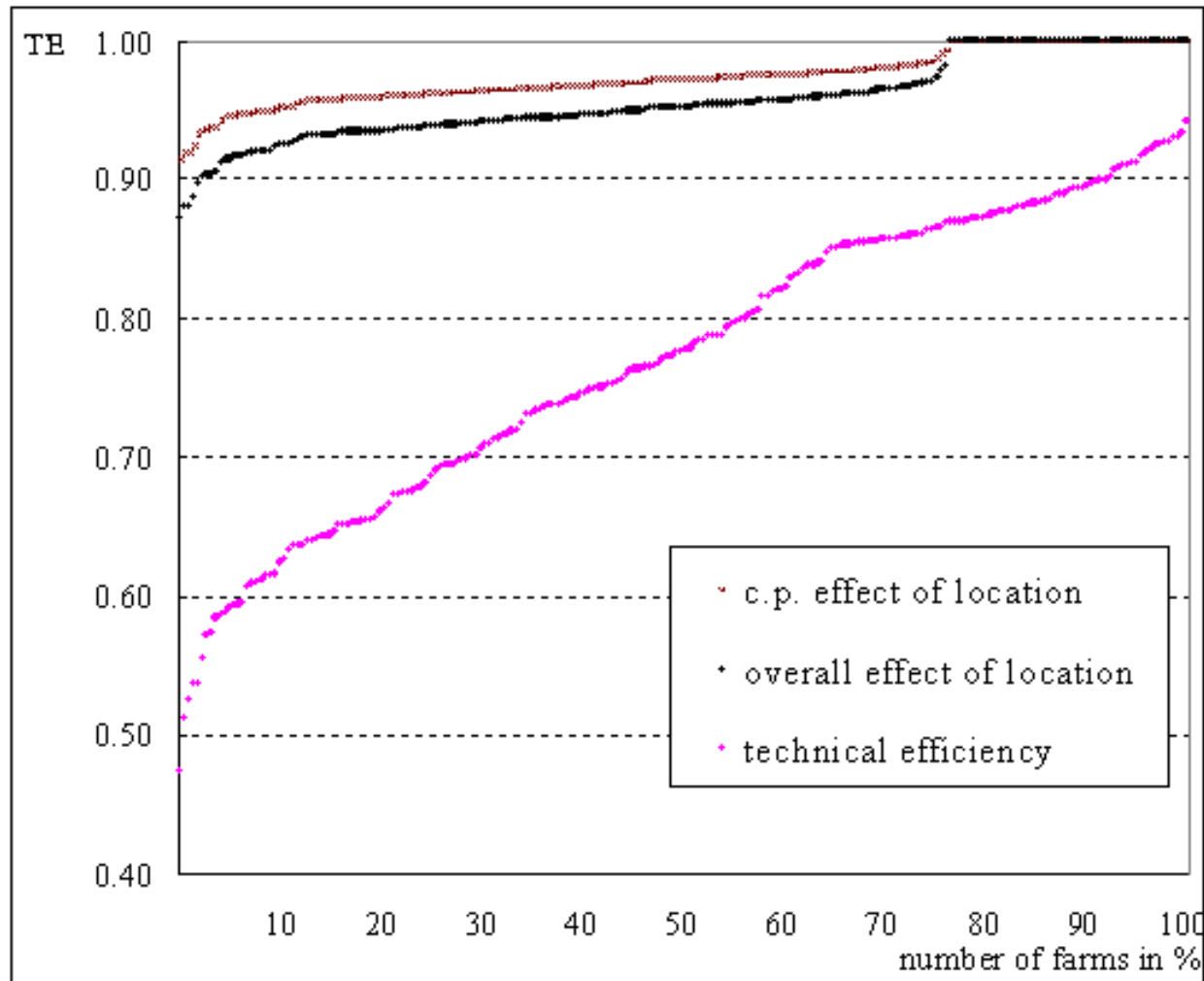
	Factor1	Factor2	Factor3	Factor4	Factor5	
Factor name	Farm size	Household size	Sea level	Specialisation	Type of farming	Uniqueness
Standard gross margin (SGM)	0.838	0.102	-0.108	0.116	-0.507	0.005
Milk quota (MQ)	0.814	0.118	0.252		0.314	0.041
Direct payments	0.649			0.552	-0.464	0.159
Off-farm activity	-0.502					0.738
Household size		0.994				0.005
Household size excl. retirees	0.110	0.939				0.099
Age of farm manager		-0.337				0.867
Vocational training	0.169	0.197		0.160	-0.131	0.888
Education	-0.134	0.124				0.954
Sea level			0.995			0.005
Mountain farm c. points (MFP)			0.660		0.305	0.455
Zone (1=alpine, 3=flat / hilly)		0.158	-0.524			0.694
MQ / SGM				0.986		0.005
Share of grassland		-0.137	0.106		0.597	0.607
Organic farming				-0.108	0.413	0.800
Cumulative variance	0.142	0.284	0.406	0.496	0.579	

Effects of attributes on TE

Variable	Flat ¹		Mountainous ²		MFP ³		MQ/SGM		Household size	
	$\hat{\beta}$	t ⁴	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
1	0.21221	9.77	+		0.00436	2.41				
2	0.20425	7.31	0.22339	6.98	0.00357	1.45				
3	0.51683	11.35	0.52851	11.14	0.00221	1.05	-0.75533	-7.12		
4	0.42930	8.65	0.43052	8.24	0.00211	1.05	-0.76427	-7.51	0.01452	3.53
5	0.50202	6.45	0.51042	6.06	0.00191	0.95	-0.77450	-7.60	0.01264	2.89
6	0.48669	8.10	0.48614	7.88	0.00278	1.37	-0.76534	-7.60	0.01340	3.25
7	0.44408	8.90	0.44019	8.46	0.00233	1.17	-0.76187	-7.52	0.01381	3.38
8	0.39747	7.76	0.39753	7.40	0.00273	1.36	-0.78239	-7.75	0.01297	3.15
9	0.46630	5.91	0.47329	5.56	0.00253	1.26	-0.79189	-7.82	0.01122	2.57

Variable	Age		Grassland		Off-farm		SGM		ϵ	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	s(ϵ)	t
1									0.16232	14.96
2									0.16226	14.97
3									0.14035	16.39
4									0.13576	16.67
5	-0.00128	-1.21							0.13524	16.71
6			-0.00071	-1.67					0.13475	16.73
7					-0.04390	-1.93			0.13471	16.75
8							0.00177	2.11	0.13420	16.77
9	-0.00119	-1.15					0.00174	2.07	0.13376	16.80

Effects of location on PTE



Conclusions

Most dairy farms in Austria were unable to cover their costs

Technical efficiency was 72 % on average

Scale efficiency was 94 % on average

Mountain farms are unable to achieve technical efficiency

Mountain farms on average have some 8 percentage points lower technical efficiency