

Cost Function Estimation in the Water Industry – Functional Forms and Efficiency Measures

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Core Issues in Paper

- ❑ Water facility manager make decisions on plant location, output expansion, input mix etc. based on interactive effects of input prices and outputs
 - ❑ Output – volume, population served etc.
 - ❑ Cost function estimation is ideal
 - ❑ Ignorance of underlying technology makes flexible functional forms (FFF) useful
 - ❑ Lack of guidance on functional form choices and reliability of efficiency estimates
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- Paper compares two competing Functional forms, translog and Hyperbolically Adjusted Cobb-Douglas (HACD)
 - sensitivity to nonlinearities
 - effect on efficiency estimates

 - HACD proposed by Shaffer (1998) and found to be sensitive to nonlinearities and distinguishing between U-shaped and monotonically declining average costs
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Model Specifications

□ Translog

$$\ln C = \alpha + \sum_i \beta_i \ln Y_i + \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln Y_i \ln Y_j + \sum_i \omega_i \ln P_i + \frac{1}{2} \sum_i \sum_j \omega_{ij} \ln P_i \ln P_j + \sum_j \sum_i \lambda_{ji} \ln P_j \ln Y_i + \varepsilon$$

□ HACD

$$\ln C = \alpha + \sum_i \theta_i \ln Y_i + \sum_i \eta_i \frac{1}{\ln Y_i} + \sum_{i \neq j} \sum_{j \neq i} \rho_{ij} \frac{1}{\ln Y_i \ln Y_j} + \sum_i \nu_i \ln P_i + \frac{1}{2} \sum_i \sum_j \nu_{ij} \ln P_i \ln P_j + \sum_j \sum_i \mu_{ji} \frac{\ln P_j}{\ln Y_i} + \varepsilon$$

Model Estimation

- ❑ SURE
 - ❑ Regularity conditions
 - Non-negativity
 - Monotonicity,
 - Homogeneity
 - Concavity
 - ❑ Imposing local concavity using Cholesky factorization
 - ❑ Richard and Mizon (1986) functional form test
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Findings

Elasticity of Substitution and Input Elasticity Estimates

Translog		HACD	
Elasticity	Estimated param	Elasticity	Estimated param
ζ_{kk}	-0.054* (0.028)	α_{kk}	-0.066* (0.038)
ζ_{ll}	-2.099* (0.910)	α_{ll}	-31.822* (17.211)
ζ_{lk}	0.287* (0.111)	α_{lk}	0.912* (0.511)
ξ_{kk}	-0.051* (0.027)	ϵ_{kk}	-0.061* (0.035)
ξ_{ll}	-0.092* (0.040)	ϵ_{ll}	-2.856* (1.497)
ξ_{lk}	0.013* (0.005)	ϵ_{lk}	0.079* (0.044)

Values in parentheses are standard errors

Economies of Scale Estimates

Translog		HACD	
Estimated parameter	Estimated value	Estimated parameter	Estimated value
ξ_q	4.700* (1.688)	ν_q	0.480* (0.264)
ξ_s	2.310* (1.046)	ν_s	0.430* (0.210)

Values in parentheses are standard errors

Summary/Conclusion

- ❑ HACD provides a better fit to the data
 - ❑ While HACD estimates suggest economies of scale to increases in quantity of water and population served, the translog estimates suggest diseconomies to scale.
 - ❑ Contrasting results for cost economies parameters.
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Thank You
