



Tropentag, October 7-9, 2008, Hohenheim

“Competition for Resources in a Changing World:
New Drive for Rural Development”

Derived Demand for Water and Substitution Possibilities Between Water and other Production Inputs in the Mining Industry of South Africa

TERESA LINZ

University of Bonn, Center for Development Research (ZEF), Germany

Abstract

Despite the fact that industrial water withdrawals represent a large share of total water extraction in most countries, industrial water use has received little attention. This study contributes to the present literature by estimating the derived demand for water for a sample mine in the Middle Olifants sub-basin of South Africa. Production technology is represented by a variable cost function and approximated by a translog form. The variable cost function is based on the assumption that the mine chooses the quantities of all inputs so as to minimise its total variable costs of producing an exogenously determined quantity of output. Total variable costs as the dependent variable are the sum of monthly expenditures on five inputs: water, electricity, labour, capital and diesel. The model is estimated with primary monthly time series data for January 2004 – September 2007. Cost share equations of each input are established and estimated using Seemingly Unrelated Regression (SUR) and Iterative Zellner-Efficient maximum likelihood estimates. Since the five share equations always add up to unity the sum of the disturbances across the five equations is zero, implying that the disturbance covariance matrix is singular and nondiagonal. For this reason one of the share equations has to be dropped and indirect estimates have to be derived from homogeneity restrictions and the directly estimated coefficients. The mean cost share of water in the sample data shows that it is with 2.4% relatively small compared to the other input cost shares. The estimates are checked for positivity and concavity, which are necessary conditions for a cost function to be well behaved. Expect of the input capital positivity is fulfilled and the Hessian matrix is negative semidefinite. Allen partial elasticities of substitution (AES) can be calculated with the cost shares of each input and respective estimates. Estimation results of own and cross price elasticities of demand for production factors give some insight into changes in factor utilisation which might result from relative price changes.

Keywords: Cost function, factor price elasticity, industrial water demand, time series data