Modeling Firms

Short Course on CGE Modeling, United Nations ESCAP

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Introduction

- Now that we understand the formulation of demand in a typical CGE model, we turn to the question of supply.
- We'll start with the basic cost minimization problem, and then turn to the problem of production in a competitive economy.
- In the process, we'll look at the CES function, which is widely used in constructing various components of CGE models.

Session Outline

1. The cost minimization problem
2. Building the model in GAMS
   - Setting up the model
   - Calibration
   - Simulation and testing

Cost Minimization

- Suppose that the firm uses inputs of labor (L) and capital (K), for which it must pay market prices w and r.
- Its technology is described by the production function $q = q(K, L)$. This function represents the relationship between inputs and the maximum output that can be produced, and is assumed to be continuous and to exhibit diminishing returns to each factor and CRTS.
- The firm seeks to minimize its expenditure for a given level of output, $\bar{q}$.

The Solution

- At an optimum, each factor price is equal to the value of the marginal product of that factor.
- Solving explicitly for the optimal input bundles yields the firm's factor demand functions.

Example - CES Technology

A very common way of describing the production technology is the CES function:

$$q = \gamma[\delta K^{\rho} + (1 - \delta)L^{\rho}]^{1/\rho}$$

where:

- $\rho \leq 1$ and $\rho \neq 0$ is a curvature parameter, representing how easily capital and labor can be substituted ($\sigma = 1/(1 - \rho)$ is the elasticity of substitution).
- γ is a scale factor, representing the overall level of productivity.
- δ is a share parameter, reflecting the importance of capital in the production process.

GAMS Program - Sets

Now let us consider exactly how the problem can be expressed in the GAMS language.

Our first task is to create a set which will index the factors:

```
SET J Factors /K,L/ ;
ALIAS (J, JJ);
```

The keyword `ALIAS` defines another set called `JJ` that has exactly the same elements as `J`.

GAMS Program - Parameters

Next, we need to define labels for all of the parameters and exogenous variables in the model. We are also going to define labels for the initial values of our endogenous variables:

```
PARAMETERS
GAMMA       Shift parameter in production
DELTA(J)    Share parameters in production
RHO         Elasticity parameter in production
Q           Output level
R(J)        Factor prices
EO          Initial expenditure
```