CHAPTER 7

IMPLEMENTING PRODUCER THEORY

This chapter introduces several elements useful for applied economists by implementing the theory of producer behavior. The first section reviews traditional production theory as well as concepts developed under the duality theory as applied to analysis of producer behavior. In the second section we present the translog functional form, which is used in chapters 8 and 9 to estimate the long- and short-run cost functions for the Swiss electric distribution utilities. The third section presents possible ways to account for heterogeneity of output and technological environment of the firm in a cost model. Finally, a survey of the most important econometric analysis of electricity cost functions is discussed in the last section of this chapter.

7.1 Review of traditional production theory

The microeconomic theory of production is well documented in the literature, e.g., Shephard, R.W. (1953), Chambers (1988), Jehle (1991) and Varian (1992), and it is not the purpose of this section to repeat this material in detail. Instead, this section focuses on some elements of the microeconomic theory of production that are relevant for the development of a cost model for the Swiss electricity distribution industry.
Long- and short-run cost functions

We model the production of firms in an industry which use \( g+c \) inputs \( x = (x_1, x_2, \ldots, x_{g+c}) \) to produce \( m \) outputs \( y = (y_1, y_2, \ldots, y_m) \). A reasonable way to represent the firm's technology of turning inputs into output in the long run is to specify a transformation function, \( T(x_1, \ldots, x_{g+c}, y_1, \ldots, y_m) = 0 \), in the multiple output case or as a production function, \( y = f(x_1, x_2, \ldots, x_{g+c}) \) in the single output case.

If the firm faces competitive input markets and chooses input bundles to minimize costs in the long run, then the cost minimizing process can be represented as

\[
\min_x C = \sum_{j=1}^{g+c} w_j x_j
\]
\[
\text{s.t. } f(x) \geq y
\]

where \( C \) represents long-run total cost, \( w_j \) is the price of input \( x_j \), and \( f \) is the production function relating the vector of inputs \( x \) to the output vector \( y \).

The solution to (7.1) is of the form \( C(y, w) \), where \( y = (y_1, y_2, \ldots, y_m) \) and \( w = (w_1, w_2, \ldots, w_{g+c}) \), as before.

Given that the transformation function \( T(x_1, \ldots, x_{g+c}, y_1, \ldots, y_m) = 0 \) has a strictly convex input structure, McFadden (1978) has shown that the cost function, \( C(y, w) \) has the following properties (regularity conditions):

1. \( C(y, w) > 0 \) for \( w > 0 \) and \( y > 0 \) (non-negativity)
2. if \( w' > w \), then \( C(y, w') \geq C(y, w) \) (non-decreasing in \( w \))
3. concave and continuous in \( w \)
4. \( C(y, w) \) is homogeneous of degree one in input prices: \( C(y, tw) = t C(y, w) \) for \( t > 0 \)
5. if \( y > y' \), then \( C(y, w) \geq C(y', w) \) (non-decreasing in \( y \))
6. \( C(0, w) = 0 \) (no fixed costs).