expression:

$$\frac{\partial \ln D_I(y,x)}{\partial \ln x_i} \Bigg/ \frac{\partial \ln D_I(y,x)}{\partial \ln x_j} = k_{ij}\left(\frac{w_i x_i / C}{w_j x_j / C}\right)$$

for $i, j = 1,\ldots,N$ and $i \neq j$ (10)

where C is the actual total cost. Given that the first partial derivative of the log distance function with respect to the log of input i represents the i-th input optimal cost share, the k_{ij} coefficient may be seen as the ratio of the optimal input cost shares compared to the ratio of the actual input cost shares.

4. EMPIRICAL SPECIFICATION

In order to estimate the model, we have specified by sector flexible (translog) input distance function systems, as follows:

$$\begin{aligned}\ln(1) = {} & \alpha_0 + \alpha_y \ln y_{ht} + \sum_{i=1}^{M} \beta_i \ln x_{hit} \\ & + \frac{1}{2}\alpha_{yy}(\ln y_{ht})^2 + \frac{1}{2}\sum_{i=1}^{M}\sum_{j=1}^{M}\beta_{ij}\ln x_{hit}\ln x_{hjt} \\ & + \sum_{i=1}^{M}\beta_{yi}\ln y_{ht}\ln x_{hit} + \sum_{t=1}^{T}\gamma D_t + \delta D_{SOUTH} + \varepsilon_{ht}\end{aligned} \quad (11)$$

$$\frac{w_i x_i}{C(y,w)} = \beta_i + \sum_{j=1}^{M}\beta_{ij}\ln x_{hjt} + \beta_{yi}\ln y_{ht} + v_{iht}$$

where y is turnover, xi (i=1,…,M) denotes the input vector – including labour (number of employees, L), operating costs for materials and services (CMS) and capital (tangible and intangible fixed asset values, K) – and h denotes firms[13]. All monetary variables were opportunely deflated at 2000 prices. As for turnover and CMS, specific production price indices were used[14]. Deflation of the capital time series variable was carried out using a perpetual inventory method. Since capital stock value may be affected by jumps due to monetary revaluation, it was necessary to adjust the deflated capital series to account for these changes. Therefore, it was assumed that the last capital value reflected the most accurate estimate as it embodies all the previous adjustments. Adjusted capital stock series for the entire period was then determined by starting from the last year and proceeding backwards by subtracting yearly deflated net investments.

A set of dummy variables was also included. D_t ($t = 1,\ldots,T$) are time dummies controlling for technical progress (or regress). The geographical dummy D_{SOUTH} takes on value 1 if firms are located in the Mezzogiorno area and 0 otherwise (that is, for firms located in Northern and Central regions), thus capturing the effect on the distance function of time-invariant characteristics associated with location. By including such dummies into the model, we aimed at testing whether – and if so, to which extent – Southern economic environment and time play a role in affecting technical efficiency. Intuitively, given that the first equation in the distance function system (11) must equal zero, a negative sign for D_{SOUTH} and D_t would mean an upward shift of the distance function, thus indicating a deterioration in performance (obviously the inverse is valid when a positive sign occurs). Based on the discussion provided in Section 1, we expect a negative sign for D_{SOUTH}, which would confirm the existence of a technical gap suffered by Southern firms, according to the predictions of the "structural and technological gap" view.

The stochastic input distance function has then be used to calculate technical efficiency indices for each firm in each year, as well as mean technical efficiency by year and for the whole period. Following Greene (1980) and Grosskopf *et al.* (2001), measure of technical efficiency by firm and by year are given by:

$$\mathrm{TE}_{ht} = \frac{1}{exp\left(ln\mathrm{D_I}(\mathrm{y},\mathrm{x}) + \left|min(\hat{\varepsilon})\right|\right)} \quad (12)$$

where the intercept correction – obtained by adding the absolute value of the most negative residual – forces the predicted values of $\ln D_I(y,x)$

[13] Due to the singularity problem one of the cost share equation was dropped, the results not being affected by the choice on the dropped share equation. As one of the aims of this study is to analyse the coefficients of allocative distortion for each input pair, the model has been run two times, getting parameters estimates for two share equations (for instance, including K and L, and dropping CMS) and then re-running the system of equations including the dropped share equation and dropping another one.

[14] To this purpose we used ATECO 2 digits industry-specific production price indices, with base year in 2000.