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ScienceDirect
Transportation Research Part A 42 (2008) 321–329
TRANSPORTATION RESEARCH PART A
www.elsevier.com/locate/tra

The effects of ignoring inefficiency in the analysis of production: The case of cargo handling in Spanish ports

Juan José Díaz-Hernández [a,*], Eduardo Martínez-Budría [a], Sergio Jara-Díaz [b]

[a] *Instituto Universitario de Desarrollo Regional, Departamento de Análisis Económico, Universidad de La Laguna, Camino de La Hornera s/n, La Laguna 38071, S/C de Tenerife, Spain*
[b] *Departamento de Ingeniería Civil, Universidad de Chile, Casilla 228-3, Santiago, Chile*

Received 23 May 2006; accepted 3 October 2007

Abstract

This paper shows the distortions provoked by ignoring inefficiency in the analysis of cargo handling activities in Spanish ports. Two model specifications applied to a sample of 19 Spanish ports during the period 1990–1998 are used to estimate the effects of both technical and allocative inefficiency on marginal costs, the degree of economies of scale, and the rate of technical change. The general model is based on the shadow prices approach, thus accounting for both technical and allocative inefficiency, and the other, a particular (nested) case of the former, is the traditional neoclassical cost model assuming efficiency. The correct model confirms the existence of productive inefficiency, such that the traditional model over estimates both marginal costs and the degree of scale economies for all ports in the sample. These results show that first best prices casually calculated are above the correct ones and that potential advantages of output expansion are not always present. Finally, the rate of technical change is under-estimated by the traditional cost model, not revealing the true positive effects of the reforms searching for productive efficiency in the Spanish maritime sector.

Keywords: Inefficiency; Productive structure; Cost function; Cargo handling; Seaports

1. Introduction

Stevedore services in ports are provided combining basically two inputs: capital (cranes) and labor, with labor presenting the characteristics of a monopoly in many places. Besides the translation of this monopoly power into prices that are higher than under competition, it induces productive inefficiency if it persists in time. This makes the observed expenditure larger than what would be optimal,[1] which might induce erroneous conclusions when aspects as productivity and technical change are studied using the estimation of cost functions assuming efficiency.

* Corresponding author. Tel.: +34 922 845402; fax: +34 922 317204.
E-mail addresses: jjodiaz@ull.es (J.J. Díaz-Hernández), embudria@ull.es (E. Martínez-Budría), jaradiaz@cec.uchile.cl (S. Jara-Díaz).
[1] A similar concept is that of *X* inefficiency (Leibenstein, 1966).

0965-8564/$ - see front matter
doi:10.1016/j.tra.2007.10.002

Duality theory shows that the technical structure of production can be studied by means of a cost function, which assumes that the agent chooses the appropriate (cost minimizing) combination of inputs for the production of a given output vector at given input prices. From this function, properties as scale economies, marginal costs, and the rate of technical change can be estimated. However, firms do not always behave optimally from this viewpoint. In this case, using a cost function whose estimation does not correct for potential inefficiency might yield erroneous estimates of these important indices.

In stevedore activities in Spain there is sufficient evidence as to suspect that the choice of inputs is not efficient. Therefore, using an uncorrected cost function might yield a distorted characterization of technology, providing misleading input to the decision-making process in maritime policy. In this paper we attempt at quantifying these distortions by comparison between two cost functions: one that accounts for inefficiency using the shadow prices approach and another that assumes that the firms are true cost minimizing firms that perceive input prices as optimal.

Productive inefficiency has been measured using the concept of Frontier as formal expression of efficiency. This Frontier has been obtained using different techniques. The non-parametric approach reproduces the technical Frontier using linear programming techniques such that all deviations from the Frontier are interpreted as inefficiency. Within this approach two methodologies are found: data envelopment analysis (DEA) and free disposal hull (FDH).

Alternatively, the parametric approach involves the specification of a function for the Frontier, whose parameters are usually estimated through statistical techniques such that the results are validated with tests related with the distribution of errors. Within this latter approach, inefficiency has been modeled in two ways. One where the error term is interpreted (a) entirely as inefficiency, called the deterministic Frontier approach, or (b) as composed of inefficiency and stochastic components, named the stochastic Frontier analysis (SFA). The second way of modeling inefficiency is called the shadow price approach, where specific parameters capture deviations from the Frontier.

Both the DEA and the SFA approaches have been used to study productive efficiency in ports due to the importance of improving productivity in such an important element of the transport chain. Cullinane et al. (2006) offers a detailed synthesis of the application of these techniques in ports and presents an application to the world largest container ports, showing that the rankings of technical efficiency indexes obtained using DEA and SFA coincide. Using the same data base, Cullinane et al. (2005) show that the measures of technical efficiency differ significantly depending on the type of analysis, DEA or FDH. On the other hand, port efficiency has been also analyzed from the viewpoint of the property structure and competitiveness of ports as done by Tongzon (1995), Tongzon and Heng (2005), who studied the relations among efficiency, privatization and competitiveness.

In spite of the described interest in the study of efficiency, the distortions induced in the analysis of technology by erroneously assuming cost efficiency have been barely touched upon, nothing in the maritime sector. To the best of our knowledge, only Atkinson and Halvorsen (1984) for the USA electric sector and Kumbhakar (1992) for air transport have evaluated such distortions but only regarding allocative inefficiency. In this latter study, a panel of 19 US airlines observed from 1970 to1984 was used to show that both the degree of scale economies and the rate of technical change were estimated with bias using a neoclassical cost model, unlike the results obtained from a SFA.

In this paper we offer the comparison of two quadratic multiproduct cost models applied to a detailed data base on stevedore activities in Spanish ports. One, recently developed theoretically (Diaz-Hernández et al., 2005), accounts for both types of inefficiencies, allocative and technical, using the shadow prices approach. The other is the neoclassical cost function that assumes efficiency. The data base is a panel of 19 Spanish ports observed from 1990 to 1998, and is used to estimate, at the port level, marginal costs, the degree of scale economies and the rate of technical change, under the two approaches described.

In the following section the shadow price model applied to the quadratic specification of costs, which accounts for both technical and allocative inefficiency exactly, is presented. In Section 3 this model and the traditional neoclassical cost function are applied to the data base. Results are analyzed comparatively in terms of the distortions in marginal costs, scale economies and technical change. Section 4 concludes.