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## Theory and Methodology

# Assessing the relative efficiency and productivity growth of vehicle inspection services: An application of DEA and Malmquist indices

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### Abstract

The purpose of this paper is to analyze efficiency and productivity growth of the Norwegian Motor Vehicle Inspection Agencies for the period 1989–91. Efficiency measures are calculated by a non-parametric approach known as data envelopment analysis (DEA) which has particular applicability in the service sector. Productivity is measured by the Malmquist index and defined as the ratio between efficiency, as calculated by the DEA, for the same production unit in two different time periods. Total productivity growth has been found, but there is a variation among individual units. The observed total productivity can be accredited to decreasing input volumes and increased capacity. The main contributor to the observed total productivity growth is the frontier technical change effect which is found to be remarkably positive. The calculated efficiency measures show that there is, on the average, an input saving potential of 21–29% for the sector as a whole. The individual units are found to be rather unstable with respect to efficiency scores across the years of observation. The efficiency scores are not affected by the size of the units. © 2000 Elsevier Science B.V. All rights reserved.

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### 1. Introduction

The relationship between motor vehicle accidents and compulsory vehicle inspection is well documented. Compulsory vehicle inspection, it is contended, is a necessary means of reducing road accidents. Little research has, however, been de-

voted to studies on the efficiency and productivity measurement of vehicle inspection services. This is the main concern of this paper. The underlying rationale is as follows: If vehicle inspections contribute toward reduction of road accidents, then improving the performance of vehicle inspection services would contribute toward the reduction of road accidents.

Hence, the question that we pose is, are there any potentials for efficiency and productivity improvement in the vehicle inspection services, and if so, how can these potentials be achieved?

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In this paper we apply a new approach based on frontier production function to study productivity growth of the Norwegian Motor Vehicle Inspection Agencies. The framework is that of data envelopment analysis (DEA). The DEA approach defines a non-parametric best practice frontier and then measures efficiency relative to that frontier. The productivity growth of a unit (agency) can then be measured by a Malmquist index as improved efficiency relative to a benchmark frontier. The Malmquist indices for a sequence of years can consistently be chained and the resulting total productivity growth indices for each agency can be calculated as indices for frontier productivity growth and indices for catching up with the frontier.

The main advantages of DEA that make it suitable for measuring the efficiency of vehicle inspection agencies are: (i) it allows the simultaneous analysis of multiple outputs and multiple inputs, (ii) it does not require an explicit a priori determination of a production function, (iii) efficiency is measured relative to the highest observed performance rather than against some average and (iv) it does not require information on prices. Since the Motor Vehicle Inspection Agencies are part of the public sector where economic behavior is uncertain and there is no price information on the services produced, the Malmquist index based on DEA approach is well suited for productivity measurement in this sector.

The methodology has previously been applied in a number of industries to study productivity growth. Some recent applications have been to investigate the efficiency of Norwegian banking [1,2], to study the efficiency of Swedish public day care centers [3], to study the efficiency of Swedish hospitals [7] and to study the Swedish electricity retail distribution [14].

The remainder of this paper is as follows. Section 2 gives a brief summary of the organizational framework and objectives of the Motor Vehicle Inspection Agencies in Norway. Section 3 presents the methodology, i.e. DEA and the Malmquist productivity indices. Section 4 presents the data. In Section 5 the DEA and the decomposed Malmquist indices are applied and the results presented. Some managerial implications and ways

of improving efficiency are discussed in Section 6. Concluding remarks are given in Section 7.

## **2. The motor vehicle inspection agencies in Norway**

The Motor vehicle Inspection Agencies are state owned. The Directorate of Public Roads (DPR) is the head office. The DPR is divided into 19 separate entities, each representing a province. Thus the provincial DPR function as the regional head office for each individual inspection agency. At the regional level the inspection agencies operate within a well-defined area or location, each performing the same types of services: issuing of drivers licenses, technical controls, etc. There are 67 Vehicle Inspection Agencies spread across the country.

In order to guarantee a homogenous quality of services offered by the inspection agencies, statistics on inspection outcomes are collected and analyzed. The statistics are a follow-up of every subsidiary of the DPR, and are comprised of the total number of days worked efficiently by each employer and the total number of operations performed during the year.

Thus guaranteeing a homogenous quality of services (output) enables the use of yardstick-competition as a management device. Yardstick-competition functions in the organization because input and output are standardized. Furthermore, various types of vehicles are more or less equally distributed around the country, assuring consistency in statistics.

The management control for the branches has three check points. The managers at the headquarters supervise the regional managers, and the regional head office supervise all the unit managers.

The overall objectives of the Vehicle Inspection Agencies are the following:

1. adequate level of traffic mobility,
2. high level of traffic safety,
3. preservation of environmental conditions,
4. provide good service to the public.

The agencies contribute towards achieving adequate level of traffic mobility by ensuring that motor vehicles are in good mechanical condition and that driving habits and behavior are satisfactory.

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