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Optimal Procurement Decision with a Carbon Tax for the Manufacturing Industry

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Abstract

A carbon tax, which has been implemented in several countries, is a cost-effective scheme for reducing carbon emission and developing sustainable supply chains. Two problems, how to make the optimal decision on order quantity and how to select appropriate suppliers for a manufacturer, are studied in this paper in consideration of a carbon tax. For the first problem, a dynamic programming model is developed to study the impact of the carbon tax on calculating the optimal order quantity. In reality, the manufacturer could choose a traditional or a greener supplier. The greener supplier is relatively expensive but yields lower emissions. To obey the emission regulations, the manufacturer should pay for the cost which is incurred by carbon emission. Firstly, in this paper, the expected emission cost is formulated, then, the structural properties of the model are derived. In particular, the optimal order quantity is characterized to minimize the expected total discounted cost. In addition, the effective range of the carbon tax is established to assist government to setup a reasonable carbon tax for a certain industry. For the second problem, a supplier evaluation procedure is proposed to select appropriate suppliers to satisfy the random market demand for the manufacturer. A numerical example from the metal industry is taken to illustrate the properties of the model and the procedure of supplier evaluation. Finally, possible extensions of the model are discussed.

Keywords Carbon tax; Procurement management; Supplier selection; Dynamic programming

1. Introduction

Nowadays, many business firms have realized the need to improve their social responsibility, especially for the carbon-intensive firms. Facing environmental regulations, a firm needs to take a
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