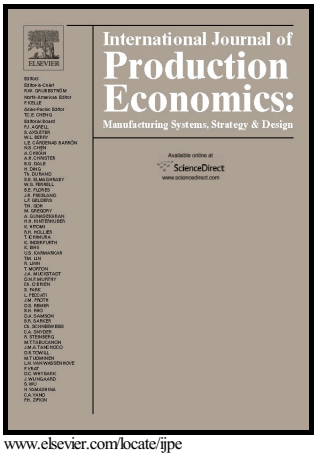

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E. Bazan, M.Y. Jaber, S. Zanoni

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Carbon emissions and energy effects on a two-level manufacturer-retailer closed-loop supply chain model with remanufacturing subject to different coordination mechanisms

E. Bazan[a], M.Y. Jaber[a*], S. Zanoni[b]

[a]Department of Mechanical and Industrial Engineering, Ryerson University, 350 Victoria Street, Toronto, ON M5B 2K3, Canada

[b]Department of Mechanical and Industrial Engineering, Università degli Studi di Brescia, Via Branze, 38, I-25123, Brescia, Italy

[*]Corresponding author: fax:416-979-5265. mjaber@ryerson.ca

Abstract

This paper presents two models (classical and VMI-CS coordination) for a two-level closed-loop supply chain with a manufacturer and a retailer with a facility to remanufacture used items. The paper considers three critical environmental issues, which are the energy used in production (manufacturing and remanufacturing) processes, GHG emissions from production and transportation activities (subject to a penalty tax), and the number of times to remanufacture (recover) a used item. Numerical results showed that the traditional optimization approach, which minimises the sum of inventory related costs, suggested less remanufacturing, fewer recovery times and more GHG emissions and energy usage; a result of operating at high production rates. The VMI-CS model was shown to be more economical than the classical model for a wide range of manufacturing rates, but not necessarily a more environmentally responsible choice. An extensive numerical analysis was conducted to enrich the discussion and to draw some managerial insights on how to make environmentally conscious decisions.

Keywords: Closed-loop supply chains, green supply chains, greenhouse gas emissions, carbon emissions, remanufacturing, energy