Hosoda, T. and Disney, S.M., (2017), "On the dynamics of closed loop supply chains with auto- and cross-correlated demand and return processes", The 7th International Symposium on Operations Management and Strategy, 9th–11th June, Tokyo, Japan.

On the dynamics of closed loop supply chains with auto- and cross-correlated demand and return processes

Takamichi Hosoda

Graduate School of International Management, Aoyama Gakuin University, 4-4-25, Shibuya, Shibuya-ku, Tokyo, 150-8366, Japan

Tel: +81-3-3409-6922. Fax: +81-3-3409-4167

Email: hosoda@gsim.aoyama.ac.jp

Stephen M. Disney

Logistics Systems Dynamics Group, Cardiff Business School, Cardiff University, Aberconway Building, Colum Drive, Cardiff, CF10 3EU, UK

Tel: +44-29-2087-6310. Fax: +44-29-2087-4301

Email: disneysm@cardiff.ac.uk

We investigate the dynamics of a closed-loop supply chain with first-order auto-regressive (AR(1)) demand and return processes and establish an optimal linear policy in our CLSC setting to minimize inventory costs. We model a proportional random yield in the triage process of the auto- and cross-correlated returns. Our modelling setting is general enough to capture instances when the lead-time paradox exists, supporting van der Laan et al. (1999), Inderfurth and van der Laan (2001), and Hosoda et al. (2015), and when the lead-time paradox does not exist, supporting Zhou and Disney (2006) and Cannella et al. (2016). Our theoretical contribution effectively integrates the two schools of thought on the lead-time paradox, thus representing a unified theory for CLSCs. We reveal that the lead-time paradox can exist in the bullwhip effect, the capacity cost and the inventory cost. Our managerial recommendations for manufacturers in CLSCs are:

Rule 1: When the remanufacturing lead time is equal to or longer than the manufacturing lead time, shortening the manufacturing lead time reduces your capacity and inventory costs. Also in this setting, higher returns do not increase inventory costs. Shortening the remanufacturing lead time does not contribute to lower inventory costs but could generate some other benefits, such as lower capacity cost and in-transit inventory.

Rule 2: When the remanufacturing lead time is less than the manufacturing lead time, you should understand that: a) the lead-time paradox can emerge, and b) higher mean returns always increase your inventory cost. Point a) suggests that shortening the remanufacturing lead time may not have desirable consequences. Point b) highlights the conflicting incentives between company performance and societal needs. To avoid these consequences, first shorten the manufacturing lead time until both lead times are equal. Then your incentives are aligned and Rule 1 applies.