Chapter V

The Effect of Different Payment Terms on Order Variability in a Supply Chain

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Abstract

Literature on supply chain management has acknowledged the effects of forecasting techniques, lot sizing rules, centralising information system, vendor managed inventory, and various biases and noises on order variability or bullwhip effect. We will show in this chapter that order variability from a buyer is also affected by the payment terms offered by the supplier. We develop mathematical models to accommodate different payment terms into the lot sizing techniques. The models are then simulated under uncertain demand situations over a range of parameter values. The results suggest that payment terms have substantial impacts on order variability passed by a supply chain channel onto its upstream channel.

**Introduction**

The difficulty in managing supply chain operations is much attributable to the degree of variability of orders or demands flowing from a downstream to the upstream channels in the supply chain. It is believed that order variability could be disruptive to achieving efficient supply chain operations: it results in higher inventories, lower service levels, and more difficulties in managing capacities. Authors on supply chain management have discovered that order variability could be a result of various processes in a supply chain such as forecasting, rationing and gaming, order batching, quantity discount policy, etc. (see, for example, Lee et al., 1997; Fransoo and Wouter, 2000; Disney and Towill, 2003). Several of those processes are rational responses for dealing with uncertainty while others, such as order batching and quantity discount, are processes to exploit economies of scale in a supply chain. Mason-Jones and Towill (2000) asserted that at each supply chain channel, order information is subject to delay, bias, and noise before it is transferred to the immediate supplier. In other words, the demand information from a downstream channel is distorted, and as a result, the further away a channel is from the end customer, the larger is the distortion of the demand of the end customer he or she receives. Such a phenomenon creates difficulty in managing a supply chain and is disruptive to achieving effective and efficient supply chain operations.

Amplification of order variability in a supply chain has been a subject of interest for academics. Forrester (1960) is probably the first scholar to present the amplification of demand from a downstream to an upstream channel in a supply chain. More recent literature has termed this phenomenon as a Bullwhip Effect (Lee et al., 1997; Dejonckheere et al., 2002; Pujawan, 2004; Disney and Towill, 2003; Zhang, 2004). Various issues have been addressed in relation to the bullwhip effect in the recent literature. Metters (1997) presented experimental results that show the impact of the bullwhip effect on supply chain profitability. Chen et al. (1998) provided quantitative models that measure the impact of forecasting techniques and information centralisation policy on the bullwhip effect. With respect to the forecasting techniques, for example, the authors showed that the exponential smoothing technique led to a higher bullwhip effect compared to the moving average. Disney and Towill (2003) evaluated the effect of using a Vendor Managed Inventory system on the bullwhip effect. They showed that VMI could reduce demand amplification up the supply chain and, hence, provides better supply chain stability. Zhang (2004) modeled and evaluated the impact of forecasting methods on the
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