

Decision Making and Cognition in Multi-Echelon Supply Chains: An Experimental Study

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Supply chain performance often depends on the individual decisions of channel members who are members of a particular supply chain. Even when individuals have access to relevant information, order variation tends to increase when moving up the supply chain, giving rise to the well-known bullwhip effect. While prevalent in practice, this phenomenon has been demonstrated even in ideal laboratory conditions, such as when demands are known and stationary, and prior research has investigated efforts such as sharing inventory information to attenuate the bullwhip effect. While prior research has suggested that cognitive limitations in managing complex dynamic systems (and underweighting the supply line in particular) contribute to the bullwhip effect, the cognitive mechanisms and individual differences driving this behavior remain an open question.

Using a production and distribution decision-making simulation representing a four-stage serial supply chain, we apply theory from judgment and decision making and find that the cognitive profile of decision makers contributes to the bullwhip effect. Performance differs for entire supply chains and for particular echelons, including higher supply chain costs, larger order quantities and larger order quantity fluctuations. These results also hold under standard mitigation strategies and training. Furthermore, we compare individual ordering behavior against the optimal order-up-to decision policy that includes on-hand inventory, downstream demand and on-order inventory: Specifically, the tendency to underweight the supply line differs based on cognitive profile; individuals with low scores were twice as likely to ignore the incoming supply line when compared to those with higher scores. These findings have implications for supply chain design, education and industry, suggesting mechanisms by which the bullwhip effect can be reduced.