# Chapter 35
# Supply Chain Contracting with Linear Utility Function

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## ABSTRACT

*The supply chain contracting has traditionally been based on the profit maximization assumption. Recent research has shown that some behavior factors may influence the decision making of supply chain members. The authors utilize a linear utility function to depict such behavior factors and incorporate these into the newsvendor model. The linear utility function provides sufficient flexibility to better capture people's various behavior factors. By supposing the agents are concerned with behavior factors, the authors first investigate how the factors affect the supply chain under wholesale price contract, and find that they do not influence coordination condition, but can adjust the distribution of profits. Then they extend their study to other four common contracts with a similar method and systematically demonstrate that the behavior of agents in such a linear setting has no effect on the conditions of coordinating supply chain.*

## 1. INTRODUCTION

Supply chain contracting refers a cooperative strategy between the upstream and downstream enterprises in a supply chain. As an effective mechanism for improving supply chain performance, the supply chain contracting has received significant attention in business and academics. In previous studies, researchers have demonstrated that except wholesale price contract (Spengler, 1950; Lariviere & Porteus 2001;

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Gomez-Padilla 2009), other contracts which include buy back contract (Pasternack, 1985), quantity flexibility contract (Tsay & Lovejoy, 1999), revenue sharing contract (Cachon & Lariviere, 2005; Hou, Zeng, & Zhao, 2009; Wang, Li, & Du, 2014), quantity discount (Moorthy, 1987) and sales rebate (Taylor, 2002; Krishnan, Kapuscinski, & Butz, 2004) all can coordinate the supply chain when some conditions (mostly concerning economic factors) can be satisfied. Recently, some more complicated contracts, such as composite contracts (fusing the above simple contracts), option contract and insurance contract are also proposed to improve the channel performance (Tsay, 2002; Gan, Sethi, & Yan, 2005; Wang & Webster, 2007; Lin, Cai, & Xu, 2010; Zhao, Wang, Cheng, Yang, & Huang, 2010; Xiong, Chen, & Xie, 2011; Hematyar, Chahrsooghi, & Malekafzali, 2012; Ma, Zeng, & Dai, 2012). Among the supply chain contracting mentioned above, whether simple or complicated one, is based on maximizing the profit function.

However, recent work hypothesizes that some individual's behavior factors, which are distinct from economic factors, may influence the performance of supply chain transactions. To reflect and explore the decision maker's behavior factors, researchers investigate the effect of these factors using the utility function. In such case, the decision makers optimize their decision by maximizing their utility function instead of the traditional profit function. For example, based on the utility function, some researchers study the effect of fairness behavior on the supply chain coordination, and they obtain that fairness plays a significant role, particularly in maintaining and developing channel cooperation (Cui, Raju, & Zhang, 2007; Caliskan-Demirag, Chen, & Li, 2010; Ma et al., 2012). With the same method, Pavlov and Katok (2009) explore what reasons may lead to coordination failures, and they obtain that once fairness consideration is private information, agents may be inclined to reject cooperation even when they are entirely rational.

Note that among the various utility functions, there is a particular form, i.e., the linear utility function which can capture the majority of existing behavior factors. For example, by assuming that people are concerned about the opponent's type, Levine (1998) utilizes the linear utility function to model altruism and spitefulness. Based on Levine's model, many other various models are widely developed. For example, Rotemberg (2008) proposes a variation of Levine's model to depict minimally acceptable altruism, Gul and Pesendorfer (2010) develop a canonical model of interdependent preferences to study reciprocity. Still based on the linear form, Fehr and Schmidt (1999) focus their research on inequality aversion while Charness and Rabin (2002) and Chen and Li (2009) on social preferences. Apparently, among the most established linear utility functions (for simplicity, we only consider two individuals), the same characteristic is always held. That is the utility of one individual depends not only on his or her decision strategy, but also linearly on the decision strategy of others. Furthermore, the linear utility function has been proved by many experimental studies, which show that the model can capture most of the behavioral motives (Fehr & Schmidt, 2006; Ho, Lim, & Camerer, 2006). Although in certain games it has been documented that the linear utility model fails to capture behavior, the model indeed has the potential to explain a broad range of phenomena behavior in a large class of experimental games. And that is why we utilize a linear utility function to derive our behavior model.

Meanwhile, in studying decision maker's behavior factors, there also exists nonlinear utility function. Rabin (1993) proposes a model to incorporate fairness into a two-player game, but he also admits that when his model is extended to complete situation, it will deduce new issues. Then his model is extended by some researchers, such as Dufwenberg and Kirchsteiger (2004), and Falk and Fischbacher (2006), who try to study reciprocity in extensive games. In addition to these, Bolton and Ockenfels (2000) describe a model that is called ERC to capture three types of behavior including equity, reciprocity, and