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Supply Contract Intelligence : The Impact of Stockout and Overstock Experiences Using System Dynamics Simulation Model

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The purpose of this study is to investigate the influence of behavioral factors (buyer's tendency to reflect stockout and overstock experiences in ordering decision) on the supply chain performance. This study employs system dynamics to examine the influence of these behavioral factors derived from the interview with several representatives of retailers in South Korea. The results show that different contract can bring different performance (total profit, seller's profit, buyer's profit, order quantity, sales quantity, overstock, and stockout). The results also suggest that these behavioral factors play a significantly influential role in the performance of supply contract. These results imply that supply contract should be established based on the analysis of behavioral factors of supply chain participants.

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1. Introduction

In recent years, supply chain management has become more important due to increased business complexity has raised environmental uncertainty. Along with increased complexity in business environment, buying firms have been outsourcing more functions to their suppliers. Thus, coordination between buyers and suppliers has become one of the key success factors in the competition between suppliers. The disruption between buyer and supplier not only causes excessive operating cost, but also decreases stock value, finally causing the harmful effects on the capital structure of a firm (Hendricks and Singhal, 2005). Therefore, in order to have coordination

among supply chain members, many researchers have studied various features of supply contract over the years (Cachon and Lariviere, 2005; Dejonckheere et al., 2003; Granot and Yin, 2005; Gonçalves et al., 2005; Kim et al., 2012; Lee et al., 2012; Pasternack, 1985; Suh et al., 2012; Tsay, 1999). However, there is a paucity of research on the impact of a firm's experiences of stockout and overstock of its inventory on the next ordering decision. Since decision makers make decision with bounded rationality, they cannot order optimized quantity based on all the information. Decision makers are mostly influenced from their previous experience (Simon, 1991). This experience can cause significant impacts on the total value of the whole supply chain as well as the profits of individual firm in the long run.

Therefore, focusing on the impact of stockout and overstock experiences of the supply chain participants, this study tries to find which type of contracts has positive impact on performance of the firm according to different situation. We model the newsvendor model for simulation and compared this base model with buyback contract model and revenue sharing model to investigate the effect of each contract. Comparing the results, we first quantify the value of being able to contract on quality to the buyer. This value, which is obtained from interview, provides an upper bound on the value of activities that the supplier can produce. Buyback and revenue sharing contract are employed, because they are one of the most frequently used contracts as the alternative models to improve the performance of supply chain and known to increase the total value of whole supply chain (Pasternack, 1985; Cachon and Lariviere, 2005). The purpose of this study is to investigate how stockout and overstock experiences affect the profit of market participants and performance variables in supply chain for both short term and long term. To do this, system dynamics program, Vensim DSS 5.6 is used. We compared buyback and revenue sharing model with no contract model.

This paper is organized as follows: in the next section, review of relevant literature is presented. Then, the research model and methodology to identify the effect of stockout and overstock experiences are shown. In the following section, the results of the simulation using system dynamics are presented based on each contract model and period of time. Finally, this paper concludes the results of simulation with implication of the results, limitation of this study, and future research needs.

2. Review of Relevant Literature

2.1 Coordinating Supply Chain with Contract

Appropriate supply contracts are significant to maintain and improve the utilization of an organization to achieve superior performance (Farrell and Shapiro, 1989; Scott, 1987). Especially under today's dynamic business environment, efficiency in relationship between suppliers and buying firm, locked in competitive prices and quantities for particular contractual terms, can create indispensable competitive advantages in a company's supply chain (Nellore and Motwani,

1999). In this vein, a variety of issues in supply contract have been studied so far. The issues of previous studies regarding supply contracts can be classified into six categories: specification of decision rights, pricing, buyback, quantity flexibility, minimum purchase commitments, and allocation (Tsay et al., 1998).

Among these categories, the first analytical research about buyback policy was performed by Pasternack (1985). He stated that the return policy to buy back a particular ratio of an original transaction without the limitation of the buyback quantity can influence the total value of supply chain (Pasternack, 1985). From the perspective, Kandel (1996) expanded Pasternack's (1995) study and insisted that only the return policy without autonomous price control among supply chain partners cannot properly coordinate the supply chain. In addition, he stated that the impact of other variables such as retailer's efforts for promotion, information asymmetry, and elasticity of market demand should be considered in terms of the degree of risk aversion of supply chain partners (Kandel, 1996).

The studies about quantity flexibility have focused on how much power to control order quantity should be given to purchasers. By increasing order quantity flexibility, sellers can predict minimum level of order quantity and buyers can evade the uncertainty of customers' demands. As a result, the total profits of whole supply chain can be increased by quantity flexibility (Tsay, 1999). Also, by minimum purchase agreement, suppliers can get the insight about the minimum purchase amount with lower price for products. This contract can also increase total performance of whole supply chain network (Bassok and Anupindi, 1997).

2.2 Types of Supply Contracts

A few alternative contracts have been studied to improve the performance of whole supply chain given the standard newsvendor model such as buyback contract (Pasternack, 1985), quantity flexibility contract (Tsay, 1999), sales rebate contract (Taylor, 2002), and revenue sharing contract (Cachon et al., 2005). This study starts with the standard newsvendor model in which a manufacturer sells products to independent purchasers facing uncertain demands and extends it by applying the characteristics of buyback contract and revenue sharing contract, assuming stockout and overstock experiences.

Under buyback contract, suppliers accept returns of unsold products for full or partial credits by the negotiation with purchasers who face random demand. In North America, a variety of products such as newspapers, CDs, dairy products, costume jewelry, books, fashion wear, computer products, recordings, and peripherals are usually permitted to buyback to their source for full or partial credits (Granot and Yin, 2005). Buyback contract can coordinate the basic newsvendor model in which a supplier provides products to a buyer for a fixed wholesale price and a fixed buyback ratio, and a buyer faces a fixed retail price, stochastic demand (Pasternack, 1985).

Under revenue sharing contract, purchasers pay suppliers discounted prices for the products purchased, plus a certain level of revenue the purchasers gain. This contract has become more popular in the video cassette rental industry relative to the conventional wholesale price contracts (Cachon and Lariviere, 2005). The estimated increase of total profits in this industry by revenue sharing contracts were up to 7% (Mortimer, 2008). The revenue sharing model was also able to coordinate the standard newsvendor model (Cachon and Lariviere, 2005).

2.3 Supply Chain Instability

As supply chain is getting more complex and more various members are involved, most organizations are seeking healthful supply chain. In this regard, many literatures investigate activities on supply chain and critical factors to acquire organization's competitive advantages. Although strategies and behaviors in supply chain have ameliorated, many firms still have difficulties in controlling their inventories accurately and effectively, bringing supply chain instability (Gonçalves et al., 2005). The bullwhip effect in supply chain, sometimes called whiplash effect, occurs due to distorted communications between suppliers and demanders, the communications including demand forecast updating, order batching, price fluctuation, and rationing and shortage gaming (Lee et al., 1997. Especially, in the bullwhip effect larger variance of suppliers than sales to the demanders may make inventories of both suppliers and demanders out of control (Lee et al., 2004).

Fisher et al. (1997) suggests that organizations need to take into account supply chain disruptions, the mismatches between suppliers and demanders, in terms of economic effect. Supply chain management, in many cases, often place the low cost first rather than stable supply chain (Kilgore, 2003). Dejonckheere et al. (2003) suggest that since the instability is fate, firms have to focus on forecasting unstable demand and relevant environment. Especially supply chain disruptions can reduce shareholder values and increase the equity risk in that organizations do not get over the disruptions immediately (Hendricks and Singhal, 2005). In terms of stocks, supply chain instability has an effect on inventory levels including overstock and stockout (Gonçalves et al., 2005). To solve the instability, suppliers and demanders need to consider coordination such as information sharing, channel alignment, and operational efficiency (Lee et al., 1997). Narayanan and Raman (2004) indicate that a supply chain is not functioning unless the risks, costs, and rewards of sales are unfair across the chain and that this misalignment lead to excess inventory, stock-outs, incorrect forecasts, inadequate sales efforts, and poor customer service. However, according to Cachon (2004), channel alignment like coordinating contract is not a panacea since this alignment definitely costs more to manage than a single wholesale price contract costs to implement, monitor and supervise.

2.4 System Dynamics Approach

The system dynamics approach is designed

by Forrester (1961). By using the structure and dynamics feedback sequence in heterogeneous field many social behaviors can be systematically analyzed (Forrester, 1961). In addition, Forrester (1961) points out that system dynamics focus on the multi-loop, multistate, nonlinear features in complex world. System dynamics modeling is composed of feedback loops, accumulation processes, and delays between cause and effect (Sterman, 2000). Especially, system dynamics approach is able to play an important role to investigate supply chain because system dynamics define its components as many SC activities includeing the reverse logistics, the distorted information flow, the initiating inventories, the effect of bottle necks, and the hipment delays (Grßler et al., 2008). Mass (1980) and Sterman (2000) illustrate that as far as stocks concern, system dynamics is critical approach because stocks reflect the state of the system and when making decision, managers often use accumulated data from stocks information as a criterion. Also they suggest that system dynamics characterize the source of delay and the differences between inflow and out flow.

3. Research Model

To discuss important issues in setting parameters, we interviewed representatives of three firms in different industries. Each reprehensive reviewed our basis assumptions and agreed with model. Since system dynamics is a useful approach to understand feedback from complex decision making process in the supply chain, we selected system dynamics as a simulation method and VENSIM DSS 5.6 was used. The model has three basic assumptions: (1) Supply chain in our model is operated by one seller and one buyer. (2) A buyer places an order with a seller by analyzing an end customer's demand. (3) A seller supplies its products to fulfill order from a buyer.

3.1 Exogenous Variables

To build up the simulation model, we set up exogenous variables: actual demand, seller's cost, wholesale price, price, and salvage cost. We use the random normal function to reflect distribution of the demand in newsvendor model. We assume that demand is independent of whether or not the consumer would like to buy the good. We generated random normal varieties with Minimum 1000, Maximum 5000, Average 3000, and Standard Deviation 1000 based on interviews.

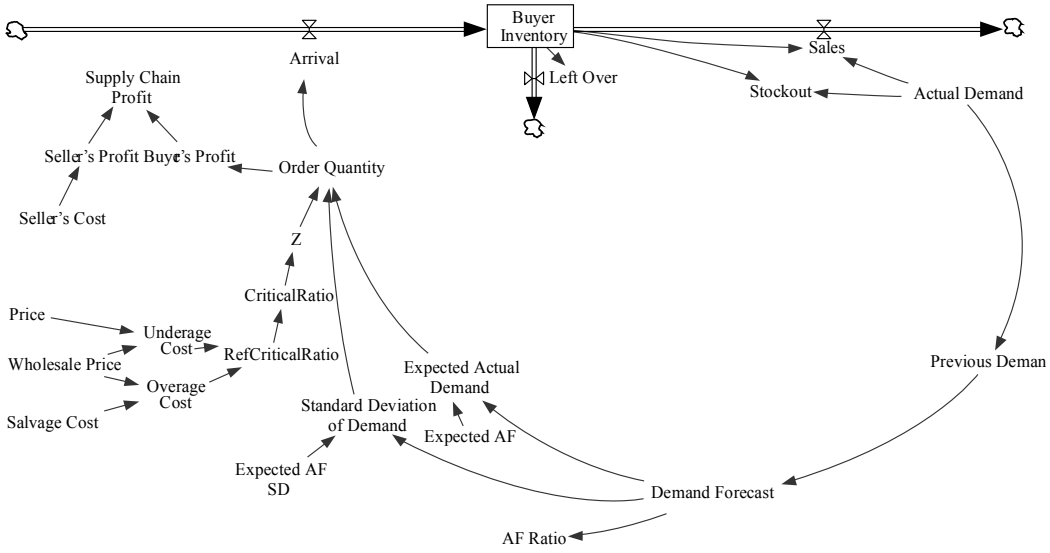
Actual Demand = RANDOM NORMAL (1000, 5000, 3000, 1000, seed)

Values of the rest exogenous variables were adopted based on the interview with representative retailers in their industries.

Seller's Cost = $35
Wholesale Price = $75
Price = $125
Salvage Cost = $25

3.2 Basic Newsvendor Model

Since the demand in news vendor model



<Figure 1> Basic Newsvendor Model

has uncertain characteristic, we take a random normal function to reflect the uncertain demand. Suppliers forecast demand using data from the past. We adopted the moving average method as the approach to forecasting demand and the demand is based on the past actual demand for a week. Basic newsvendor model is shown in <Figure 1>.

Suppliers take into account not only differences between actual and forecasting demand (A/F ratio) but also economic costs to determine their order quantity.

Order Quantity = Expected Actual Demand + Z × Standard Deviation of Demand

In the newsvendor model, left inventory will be transformed into savage cost. Thus, in the model, buyer's profit is calculated as:

Buyer's Profit = MIN (Buyer Inventory, Actual Demand) × Price-Wholesale Price × Order Quantity + Salvage Cost × Left Over

We estimated supplier's profit using three parameters:

Supplier's Profit = Wholesale Price × Order Quantity – Supplier's Cost × Order quantity

Buyer's Profit added to seller's profit makes supply chain profit.

3.3 Newsvendor Model with Stock-out and Overstock

There has been minimal research regarding the functional relation of the effect of left over and stock out experience on order quantity. So, we draw permissible adjustment rate by carrying

out simulation on the assumption that each members on supply chain behave in an effort to maximize their profit.

We assumed that permissible rate of leftover adjustment is a constant, which determines, when buyers adjust their order quantity in terms of left over experience, certain order rates comparing with left over experience. Likewise, in case that buyer adjusts order quantity in terms of stock out experience, permissible rate of stock-out adjustment is a constant value that determines certain order rates comparing with stock-out experience. Newsvendor model with stockout and overstock is shown in <Figure 2>.

Left over adjustment on order quantity is determined by comparing previous order quantity with permissible rate of leftover adjustment.

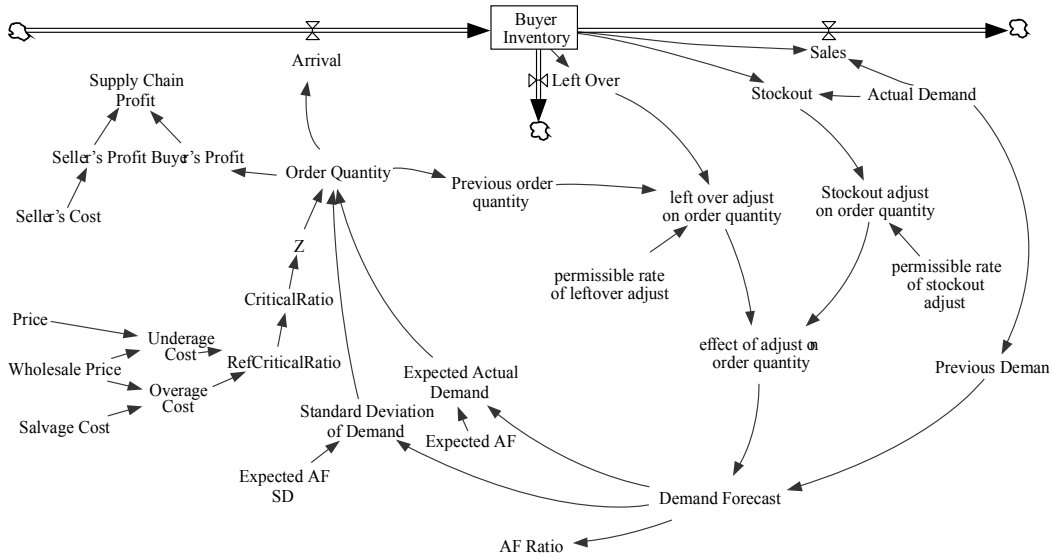
Left over adjustment on order quantity = IF THEN ELSE (Left Over >= (Previous Order Quantity × Permissible rate of leftover adjustment), Left Over – (Previous Order Quantity × permissible rate of leftover adjustment), 0)

Like left over adjustment, stock-out adjustment is calculated by comparing two parameters, previous order quantity and permissible rate of stock-out adjustment.

Stock-out adjustment on order quantity = IF THEN ELSE (Stock Out >= (Previous Order Quantity × Permissible rate of Stock Out adjustment), Stock Out – (Previous Order Quantity × permissible rate of Stock Out adjustment), 0)

In this regard, effect of adjust on order quantity can be expressed:

Effect of Adjustment on Order Quantity =



<Figure 2> Newsvendor Model with Stockout and Overstock

- left over adjustment on Order Quantity + Stock Out adjustment on Order Quantity

As shown in <Table 1>, by using scenario method we calculated the permissible rate, which maximizes buyer's profit. We put five permissible rates, 30%, 40%, 50%, 60%, 70%, into each supply contract model and simulated 10 times.

<Table 1> Permissible Rate Maximizing Buyer's Profit

	Permissible Rate of Stockout	Permissible Rate of Overstock
Price Only	70%	40%
Buyback	30%	60%
Revenue Sharing	30%	60%

3.4 Buyback Model

Under buyback contracts, the buyer pays the wholesale price and repayment from seller, which is for any unsold items, is guaranteed. Buyback model is presented in <Figure 3>. In buyback contract, we calculated buyback profit, buyer's profit, and seller's profit as:

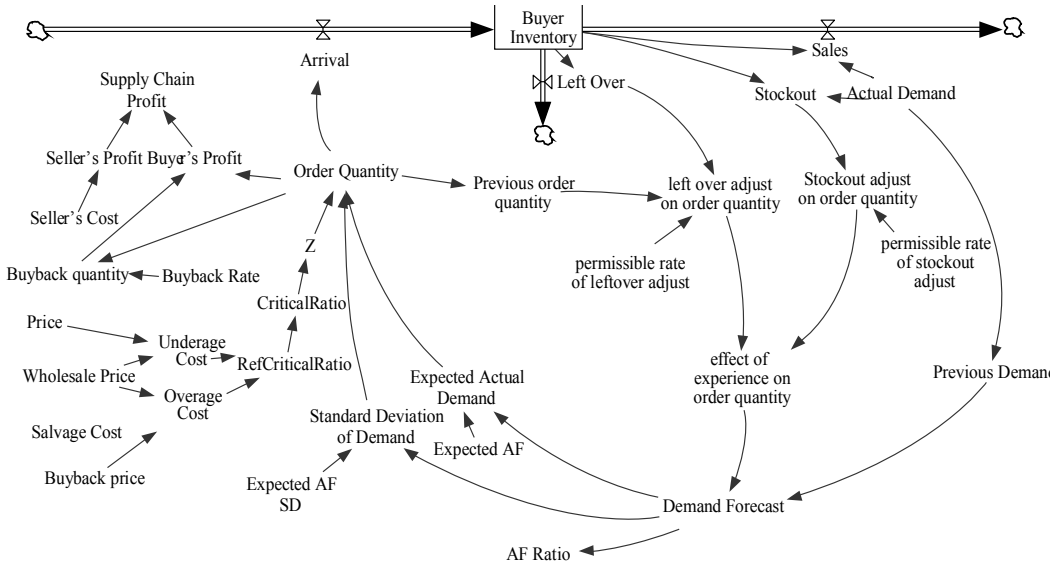
Buyback Price = Price – (Price – Wholesale Price) / ((Price-Salvage Cost) / (Price – Seller's Cost))

Buyer's Profit = MIN (Buyer Inventory, Actual Demand) × Price – Wholesale Price × Order Quantity + Buyback Price×Buyback Quantity

Seller's Profit = Wholesale Price × Arrival – Seller's Cost × Arrival – Buyback Quantity × Buyback Price + Buyback Quantity × Salvage Cost

3.5 Revenue Sharing Model

A revenue sharing contract indicates that a buyer pays a supplier both a wholesale price and



<Figure 3> Buyback Model with Stockout and Overstock

<Table 2> Supply Chain Performance of Each Contract Model with Stockout and Overstock

		Total Profit	Seller's Profit	Buyer's Profit	Order Quantity	Sales Quantity	Overstock	Stockout
Price Only	Mean SD	20.802 0.7716	12.403 0.3945	8.371 0.4196	310,887 9,872	265,769 9,603	31,895 3,027	44,961 2,846
Buyback	Mean SD	22.079 0.7933	12.680 0.4308	9.399 0.4346	414,826 12,345	291,830 10,110	5,835 1,574	121,725 4,115
Revenue Sharing	Mean SD	21.177 0.8172	12.397 0.4724	8.780 0.3854	345,544 14,010	273,832 10,440	23,832 2,498	71,430 6,718

surplus of a rate of the revenue that the buyer makes.

Revenue sharing model is presented in <Figure 4>. Wholesale price, buyer's profit, and seller's profit can be expressed:

Wholesale Price = Existing Wholesale Price – Wholesale Price Discount

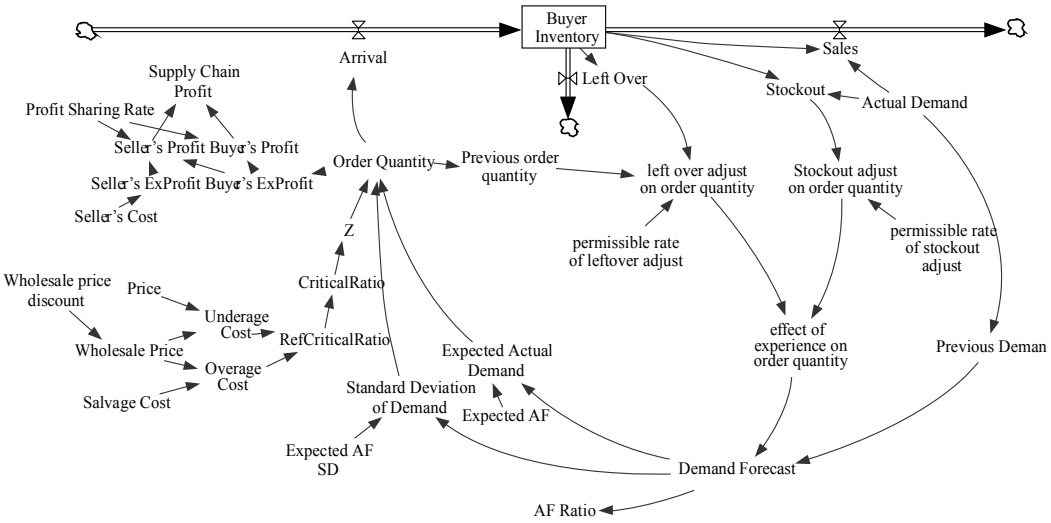
Buyer's Profit = (MIN (Buyer Inventory, Actual Demand) × Price – Wholesale Price × Order Quantity + Salvage Cost × Left Over) × (1 – Profit Sharing Rate)

Seller's Profit = Wholesale Price × Order Quantity – Seller's Cost × Order Quantity + Profit Sharing Rate × Buyer's Exprofit

4. Result of the Study

4.1 Results of Supply Chain Performance with Stockout and Overstock

In our research, there are three contract models: price only, buyback, and revenue sharing model considering stock out and over stock. We



<Figure 4> Revenue Sharing Model with Stock-out and Overstock

simulated contract models reflecting stock out and over stock in order to check performance parameters (supply chain profit, seller profit, buyer profit, order quantity, sales, stockout, and overstock). Each contract models was simulated 200 times independently. The results are presented in <Table 2>.

In buyback model shown in <Table 3>, reflecting stock out and over stock, three profit parameters including supply chain profit, seller's profit, and buyer's profit are significantly bigger than those in price only contract model reflecting stock out and over stock.

<Table 3> Comparison of Price Only with Buyback Contract

	Mean Difference	t-value	Df	Sig. (2-tailed)
Total Profit	-1.277	-9.519	199	0.00000
Seller's Profit	-0.250	-15.983	199	0.00306
Buyer's Profit	-1.029	-3.232	199	0.00000
Order Quantity	-103.940	-50.847	199	0.00000
Sales Quantity	-26.060	-15.220	199	0.00000
Overstock	26.060	54.597	199	0.00000
Stockout	-76.763	-127.337	199	0.00000

According to <Table 4>, in revenue sharing model reflecting stock out and over stock, seller profit significantly increased, but buyer profit and supply chain profit did not change.

Comparing with price only model considering stock out and over stock, both buyback and revenue sharing model reflecting stock out and over stock have more stock out, order quantity, and sales but less overstock. The results are shown in <Table 5>.

<Table 4> Comparison of Price Only with Revenue Sharing Contract

	Mean Difference	t-value	Df	Sig. (2-tailed)
Total Profit	-0.375	-2.085	199	0.04595
Seller's Profit	0.033	0.346	199	0.73221
Buyer's Profit	-0.410	-0.410	199	0.00015
Order Quantity	-34.657	-13.115	199	0.00000
Sales Quantity	-8.063	-3.560	199	0.00130
Overstock	8.063	14.760	199	0.00000
Stockout	-26.469	-22.775	199	0.00000

<Table 5> Changes in Performance

	Total Profit	Seller's Profit	Buyer's Profit	Order Quantity	Sales Quantity	Overstock	Stockout
Buyback	+	+	+	+	+	-	+
Revenue Sharing	No change	No change	+	+	+	-	+

<Table 6> Comparison of Buyback with Revenue Sharing Contract

	Mean Difference	t-value	Df	Sig. (2-tailed)
Total Profit	0.903	3.866	199	0.00057
Seller's Profit	0.619	5.294	199	0.00001
Buyer's Profit	0.283	2.154	199	0.03972
Order Quantity	69.283	18.785	199	0.00000
Sales Quantity	17.297	6.048	199	0.00000
Overstock	-17.997	-41.401	199	0.00000
Stockout	50.295	34.622	199	0.00000

As presented in <Table 6>, buyback model made more seller profit and supply chain profit, in comparison to revenue sharing model. Also buyback increased order quantity, sales, and stockout more than revenue sharing. There is no difference of buyer profit between two models.

4.2 Comparison with Supply Chain Performance without Stockout and Overstock

We compared the performance of supply contract without stockout and overstock experiences with that of supply contract with those experiences. The results are presented in <Table 7>, <Table 8>, and <Table 9>.

With these results, we employed t-test to examine the significance of the influence which the stockout and overstock experiences have on the supply chain performance. For this analysis, we simulated each model for 200 times. As presented in <Table 10>, in price only contract (basic newsvendor model), significant difference was found in buyer's profit, which means that the buyer's behavior to maximize its profit leads to substantial increase in profit. In contrast, reflecting the stockout and overstock experiences decreased seller's profit and the profit of whole supply chain. As a whole, the experiences have a negative impact on the whole supply chain performance. The stockout and overstock experiences also decreased the order quantity of buyer, leading to the decrease of sales quantity and overstock, and the increase of stockout.

<Table 7> Performance Comparison in Price Only Contract

		Total Profit	Seller's Profit	Buyer's Profit	Order Quantity	Sales Quantity	Overstock	Stockout
Without Experience	Mean	20.889	12.559	8.3295	314,118	267,120	46,797	30,545
	SD	0.7796	0.4014	0.4392	10,021	9,688	3,436	3,014
With Experience	Mean	20.802	12.430	8.371	310,887	265,769	44,961	31,895
	SD	0.7716	0.3945	0.4196	9,872	9,603	2,846	3,027

<Table 8> Performance Comparison in Buyback Contract

		Total Profit	Seller's Profit	Buyer's Profit	Order Quantity	Sales Quantity	Overstock	Stockout
Without Experience	Mean	22.058	11.103	10.95	418,773	292,046	125,383	5,619
	SD	0.7966	0.3973	0.4010	12,735	10,141	5,082	1,760
With Experience	Mean	22.079	12.680	9.399	414,826	291,830	121,725	5,835
	SD	0.7933	0.4308	0.4346	12,345	10,110	4,115	1,574

<Table 9> Performance Comparison in Revenue Sharing Contract

		Total Profit	Seller's Profit	Buyer's Profit	Order Quantity	Sales Quantity	Overstock	Stockout
Without Experience	Mean	22.071	13.241	8.830	418,151	292,094	124,793	5,573
	SD	0.8684	0.5224	0.3473	13,709	11,035	5,860	2,021
With Experience	Mean	21.177	12.397	8.780	345,544	273,832	71,430	23,832
	SD	0.8170	0.4724	0.3854	14,010	10,440	6,718	2,498

<Table 10> Results of t-test for Performance Variable in Price Only Contract

	Mean Difference	t-value	Df	Sig. (2-tailed)
Total Profit	-0.087	-7	199	0.00352
Seller's Profit	-0.129	-20.10941	199	0.00000
Buyer's Profit	0.040	3.17739	199	0.00000
Order Quantity	-3,231	-21	199	0.00000
Sales Quantity	-1,351	-10	199	0.00000
Overstock	-1,836	-10.4937	199	0.00000
Stockout	1,351	9.6939	199	0.00000

In case of buyback contract shown in <Table 11>, buyer's profit significantly decreased after reflecting the stockout and overstock experiences, while seller's profit increased. The increase of seller's profit might result from the decrease of buyback risk. The profit of whole supply chain does not significantly change and it might be because the decrease of buyer's profit is almost same as the increase of seller's profit. The stockout and overstock experiences does not significantly affect the order quantity, sales quantity, and stockout, while overstock decreased.

<Table 11> Results of t-test for Performance Variable in Buyback Contract

	Mean Difference	t-value	Df	Sig. (2-tailed)
Total Profit	0.021	0.15892	199	0.87483
Seller's Profit	1.577	19.7174	199	0.00000
Buyer's Profit	-1.550	-23.38014	199	0.00000
Order Quantity	-3,947	-1.740598	199	0.09236
Sales Quantity	-216	-0.124174	199	0.90203
Overstock	-3,658	-5.273242	199	0.00001
Stockout	216	1.3029	199	0.20286

The results for revenue sharing contract are presented in <Table 12>. In revenue sharing contract model, reflecting the stockout and overstock experience results in the significant decrease in seller's profit and whole supply chain's profit. Conversely, buyer's profit was not affected significantly. These experiences caused the order quantity, sales quantity, and overstock to decrease, while they increased the stockout.

<Table 12> Results of t-test for Performance Variable in Revenue Sharing Model

	Mean Difference	t-value	Df	Sig. (2-tailed)
Total Profit	-0.894	-3.441	199	0.00178
Seller's Profit	-0.843	-5.548	199	0.00001
Buyer's Profit	-0.050	-0.442	199	0.66165
Order Quantity	-72,607	-18.047	199	0.00000
Sales Quantity	-18.262	-5.541	199	0.00001
Overstock	-53,363	-30.450	199	0.00000
Stockout	18,260	30.382	199	0.00000

4.3 Summary of the Results

The results of t-test for performance variables in each contract model are summarized in <Table 13>. The stockout and overstock experiences decreases the total profit of price only and revenue sharing contract, while they do not affect the performance of buyback contract. In price only contract, the buyer's efforts to maximize its profits (efforts to reflect the stockout and overstock experiences) lead to not only the decrease of seller's profit but also the decrease of total profits of supply chain, although buyer obtains additional profit. In buyback contract, the experiences have no impact

on total profit, positive impact on seller's profit, and negative impact on buyer's profit. In revenue sharing contract, total profit and seller's profit are affected negatively, while buyer's profit does not change.

<Table 13> Results of t-test for Performance Variable in Revenue Sharing Model

	Price Only	Buyback	Revenue Sharing
Total Profit	-	No change	-
Seller's Profit	-	+	-
Buyer's Profit	+	-	No change
Order Quantity	-	No change	-
Sales Quantity	-	No change	-
Overstock	-	-	-
Stockout	+	No change	+

As a whole, the performance of supply chain deteriorates after reflecting the experiences of stockout and overstock. From the literature, we know that buyback contract can coordinate the price only model (Pasternack, 1985), and revenue sharing contract also coordinate the profits of whole supply chain (Cachon and Lariviere, 2005). However, the results of this study show that the performance of supply contract can be negatively affected by buyer's behavioral factors in buyback and revenue sharing contract. These results imply that behavioral factors of supply chain participants should be considered in establishing new supply contract.

5. Conclusion

This study delineates the influence of behavioral factors (buyer's tendency to reflect stockout and overstock experiences in supply contract) in price only, buyback, and revenue sharing contract. The results show that the performance variables (total profit, seller's profit, buyer's profit, order quantity, sales quantity, overstock, and stockout) were affected differently according to the supply contract models.

The results suggest that the use of buyback and revenue sharing contracts can negatively influence the performance of supply chain considering buyer's tendency to reflect stockout and overstock experiences in supply contract. In other words, supply contract which does not properly reflect behavioral characteristics of supply chain participants might decrease the performance of whole supply chain as well as individual participants' profits. These results imply that behavioral factors of supply chain participants should be considered in supply contract, because they play an influential role in the success of applying new types of supply contracts such as buyback and revenue sharing model. This distinguishing feature of our study allows us to capture the effects of behavioral factors that are difficult to capture with analytical model. For example, the analytical model assumes that the decision makers are rational, and their objective is to maximize expected utility. Human decision makers are known to violate such behavioral assumptions, which might affect their decision in actual situations. From our research model, we could find that reflecting behavioral factors can improve prediction of the contract performance when the various parameters change.

This study has practical implications. First, firm managers can apply behavioral factors to their supply contracts based on this study. Through the simulation reflecting stockout and overstock experiences, they can improve their supply contract performance. Second, this study provides a useful tool to evaluate operating performance of the firm. Third, this study can help firm managers to decide the level of price discount or revenue sharing when they make supply contracts. Fourth, based on the results of this study, supply chain members can cooperate to improve the overall performance of the whole supply chain.

This study has a limitation in terms of external validity because the behavioral factors were derived from the interview with only a few retailers in South Korea. However, the results of this study can be generalized due to the fact that the interviewed retailers were the representative companies with high market share in their industries. In addition, this study employs only the stockout and overstock experiences as behavioral factors, even though there might be a variety of other behavioral factors which influence the performance of supply contract.

Despite these limitations, this study presents some contributions in terms of the fact that it shows the importance of behavioral factors in supply contract performance. If more supply contract models other than buyback and revenue sharing models are analyzed, it can shed more light on the influence of these factors. Also, further study on the other behavioral factors affecting supply contract performance might give some additional insight for developing appropriate supply contract.

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Abstract

공급사슬지능 : 시스템 다이나믹스를 이용한 재고 과부족 경험이 공급사슬에 미치는 영향 분석

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본 연구는 재고 과부족 경험을 주문에 반영하고자 하는 구매자의 행동적 경향이 공급사슬의 성과에 미치는 영향에 대해 고찰하였다. 이를 위해 한국의 대표적인 소매점 몇 곳의 경영자와의 인터뷰 결과를 토대로 시스템 다이나믹스 시뮬레이션 기법을 사용하여 분석을 수행하였다. 공급사슬 전체 이익, 판매자 이익, 구매자 이익, 주문량, 판매량, 재고초과, 재고부족 등 다양한 공급사슬 성과 변수에 대한 분석 결과 서로 다른 공급 계약은 서로 다른 공급사슬의 성과를 가져왔다. 또한, 구매자의 행동적 요소는 공급계약의 성과에 중요한 영향을 미치고 있었다. 본 연구의 결과를 토대로 공급계약은 공급사슬 참여자들의 행동적 특성을 충분히 반영하여 수립되어야 함을 알 수 있다.

Keywords : 공급계약, 재고부족, 재고초과, 바이백, 수익공유, 시뮬레이션, 시스템 다이나믹스

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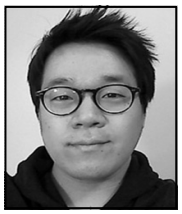

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