EFFECTS OF SELF-ESTEEM ON SUPPLY CHAIN DECISIONS

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ABSTRACT

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Keywords: self-esteem, supply chain contracts, decision making

We study the effects of self-esteem on supply chain decisions and profits. To this end, the data obtained in computerized decision-making experiments in which human subjects participated as manufacturers (who offer a contract) and retailers (who either reject the contract, or accept and set the order quantity from the manufacturer) that engage in a long run relationship is used. Rosenberg scale survey data is used to categorize the manufacturers and retailers into high and low self-esteem classes. We find low self-esteem manufacturers to offer more attractive contracts to retailers, obtain lower profits themselves and cause higher supply chain total profit. Contrary to our expectations, we find high self-esteem retailers to end up accepting less favorable contracts compared to low self-esteem retailers, though the difference is not statistically significant. We explain this phenomena with the overordering tendency of the high self-esteem retailers: They overorder more frequently, and make larger overorders. We observe manufacturers to increase the attractiveness of their contract offer in the next period following a rejection. Finally, we develop a regression model to explain retailer order quantity decisions based on the retailer self-esteem score, lost demand in the previous period, number of contract rejections in the relationship, and the optimal order quantity. Our results indicate the importance of self-esteem as a significant factor in supply chain decisions and firms' profit performance.

ÖZET

ÖZSAYGININ TEDARİK ZİNCİRİ KARARLARINA ETKİSİ

ELİF KARUL

Yüksek Lisans Tezi, Ağustos 2019

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Anahtar kelimeler: özsaygı, tedarik zinciri kontratları, karar verme

Bu çalışmada, bir kişilik özelliği olan özsaygı'nın tedarik zinciri kararlarına ve firmaların kârlarına olan etkisini araştırdık. Bunun için, insan karar vericilerin üretici (sözleşme öneren) ve perakendeci (sözleşmeyi kabul ederse sipariş miktarını belirleyen) rollerini oynadıkları uzun etkileşimli bilgisayarlı karar verme deneylerinden elde edilmiş verileri kullandık. Katılımcıları, anket cevaplarına göre, Rosenberg Ölçeği ile yüksek veya düşük özsaygı sahibi olarak sınıflandırdık. Düşük özsaygı kategorisindeki üreticilerin perakendecilere daha cazip kontratlar önerdiğini ve bunun da kendilerinin kârlarına kötü etki ederken tedarik zincirinin toplam kârını arttırdığını gözlemledik. Beklentilerimizin aksine, yüksek özsaygılı perakendecilerin düşük özsaygılı perakendecilere kıyasla daha düşük kârlı sözleşmeleri kabul ettiklerini gözledik. Bunu, yüksek özsaygılı perakendecilerin optimal gazeteci çocuk miktarına kıyasla daha fazla miktarda sipariş verme ve bunu daha sık yapma yatkınlıkları ile açıkladık. Üreticilerin, bir sözleşme reddini takip eden turda perakendecilere daha cazip bir sözleşme önerdiklerini gösterdik. Son olarak, perakendecilerin belirli bir turdaki sipariş miktarı kararlarını özsaygı puanı, bir önceki tur kaçırılan satış, o tura kadar reddedilmiş sözleşme sayısı ve optimal sipariş miktarı faktörlerini kullanarak açıklayacak regresyon modelleri geliştirdik. Çalışmamız, özsaygının tedarik zinciri kararlarını ve tarafların kâr performanslarını etkileyen önemli bir faktör olduğunu gösterdi.

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1. INTRODUCTION

Supply chains consist of multiple firms whose relations are governed by a supply contract. These firms often have conflicting incentives. This incentive misalignment can be addressed by properly designed supply contracts (Narayanan and Raman, 2004). Supply chain contracts enable risk-sharing between parties and can allow a system-wide performance enhancement (Höhn, 2010). Accordingly, supply chain contracting has become a popular topic of research in the last decades (Cachon, 2003).

Supply chain contracting, by its nature, involves multiple decision makers. Modeling of supply chain decisions in the literature involves two sets of assumptions. First, there is the standard economic assumption that each party is a rational decision maker that aims to maximize expected utility. Second, it is often assumed that the interaction between the parties can be modeled using game theory (Hennet and Arda, 2007; Cai et al., 2008; Leng and Parlar, 2009; Zhao et al., 2010; Mazdeh and Karamouzian, 2014). These widely-used assumptions lead to nice theoretical results, and form the backbone of supply chain contracting research.

The validity of these assumptions with real human decision makers, however, has increasingly been questioned by recent research. For instance, in their experiments, Schweitzer and Cachon (2000) state that subject order decisions systematically deviate from optimal order quantities that maximize expected profits. Again, Katok and Wu (2009) observe that participants often act boundedly rational, and may have different utility functions than mere profit maximization. Katok and Pavlov's (2013) study shows fairness (inequity aversion) as an important behavioral factor in determining retailer response to offered contracts. Loch and Wu (2008) state that relationship preference increases cooperation and system efficiency while status seeking has a negative effect on those terms. Wu et al. (2013) studies effects of anxiety on social decision making. There is a wide literature on how to include risk-aversion into supply chain contracts (Agrawal

and Seshadri, 2000; Xu et al., 2014; Liu et al., 2016; Zhu et al., 2017). Such works, which belong to the behavioral operations management (BOM) domain, have been complementing the traditional analytical studies by explaining the possible causes of deviations from theoretical predictions.

In this thesis, we aim to understand the effects of an important behavioral factor, self-esteem, on operational decisions in a supply chain setting. Self-esteem is a term that is related with personal beliefs about oneself once a person contemplates the self (Heatherton and Wyland, 2003). Possible influences of self-esteem such as relationship and job satisfaction, physical and mental health, and occupational status have been widely studied in psychology literature (Orth et al., 2012). Few studies consider the effect of self-esteem on games between multiple decision makers. For instance, Paz et al. (2017) analyze the effects of self-esteem in a standard Ultimatum Game setting (Güth et al., 1982). To the best of our knowledge, no study considers the effects of self-esteem in supply chain contracting relations.

We use the data of an experimental study conducted by Akbay and Kaya (Reported in Akbay and Kaya, 2016). In these experiments, human subjects that play the roles of manufacturer and retailer for consecutive periods. The retailer faces the standard newsvendor problem. In each period, the manufacturer offers a contract, and the retailer either accepts the offer and determines her order (stock) quantity, or rejects the contract by ordering zero units. Both firms obtain zero profit in case of a contract rejection. We analyze the data to answer the following three research questions: First, how does self-esteem affect the profits of the contracting parties in the supply chain? Second, what is the effect of self-esteem on underorder-overorder behavior of the retailers? Third, what is the effect of self-esteem on retailer's contract rejections, and manufacturer's post-rejection behavior?

In Section 2, we review the relevant literature on behavioral experiments and the concept of self-esteem. Section 3 introduces our analytical model. The experimental procedure and self-esteem survey data are explained in Section 4. Section 5 presents our data analysis and results, and introduces a regression model that explains order quantity decisions. In Section 6, we provide an extension study that is based on the pairwise self-

esteem scores of the manufacturer and the retailer. In Section 7 we conclude and provide managerial discussions.

2. LITERATURE SURVEY

Our work is related mainly with two research streams: Literature on supply chain experiments and literature on the effects of self-esteem on human decisions.

2.1. Supply Chain Experiments

Behavioral operations researchers explain the effects of human decision factors on operational decisions, often by conducting experiments with human decision makers (Katok, 2011). Laboratory experiments is the major method used in BOM research; followed by surveys and case studies (Schorsch et al., 2017). Experiments are highly efficient in terms of both time and cost (Siemsen, 2011). The findings of behavioral experiments can lead to improved OM models by providing new information on how behavioral factors can be integrated into theoretical models (Boudreau, et al., 2003). With experiments, researchers have the power to manipulate treatment variables which may not be manageable in a real work environment (Deck and Smith, 2013).

Experimental approach is particularly useful for supply chain management research due to the existence of multiple human decision makers with conflicting incentives. Researchers have been using experiments to improve the understanding of behavioral factors in supply chain coordination (Croson and Donohue, 2002). Experiments can provide insights about long term relationships by enabling repeated interactions between parties (Wu, 2012). In our study, we make the subjects play a supply chain interaction game for consecutive periods with the same partner to observe their interaction in a long-term relationship.

Experiment data offers an advantage over survey data, since experiment data can indicate causality while survey data can only indicate correlation (Knemeyer and Naylor, 2011). In our study, we use both the subjects' decision data from experiments and survey data on their personality traits.

2.2. Effects of Self-Esteem on Decisions

Self-esteem has an influence on decisions by affecting cognitive, emotional and behavioral responses in varying circumstances (Rebellow and Patra, 2017). We discuss the effects of self-esteem on decisions in two categories; personal decisions which only affect the self, and strategic decisions which involve an interaction between multiple decision makers.

In settings that involve only personal decisions, such as the Allais Paradox experiments (Allais, 1953), low self-esteem people are observed to choose the safer option more frequently than high self-esteem people do (Petit et al., 2011). Choices of high self-esteem people tend to have more self-efficacy and are more vigilant (Filippello et al., 2013). There are studies considering long term effects of self-esteem as well. For instance, Trzesniewski et al. (2006) suggests that adolescents with low self-esteem tend to have worse psychical and mental health, poorer economic prospects and show higher criminal behavior during their adulthood compared to the adolescents with high self-esteem. However, pursuit of self-esteem may be costly. For instance, Crocker and Park (2004) argue that having self-validation goals may cause people to react to threats in a way that weaken capacity of learning, autonomy and self-regulation, which may adversely affect personal decisions.

In strategic decisions, the inherent uncertainty due to the other party's decision causes extra risk. Josephs et al. (1992) suggests that low self-esteem people may avoid risky decisions more often, because losing may be costlier for them than it is for high self-esteem people due to having less self-protective resources to face problems. Therefore, low self-esteem people try to act in a way which minimizes regret. Wray and Stone (2005) found a negative correlation between self-esteem and anxiety levels. They state that people with high self-esteem and low anxiety make more risky decisions for themselves than people with low self-esteem and high anxiety. People with high self-esteem are aware of their relational value and expect acceptance from a group (Anthony et al., 2006). Therefore, they make riskier decisions more easily compared to low self-esteem people. In our supply chain experiment context, this translates into high self-esteem retailers to overorder more than low self-esteem retailers.

Self-esteem is also known to be an important factor when one party has "veto power", that is, the power to reject the offer of the other party, leading to an undesirable outcome for both parties. This corresponds to retailer's contract rejection in our setting. Dunn et al. (2010) argue that individuals with high perceived self-worth believe that they are worth more than what is offered and therefore reject unfair offers. They further suggest that rejection behavior is a tool for self-esteem regulation and rejecting an unfair offer protects positive self-regard. Thus, in our experiments, we expect retailers with high self-esteem to reject unfair offers more often compared to retailers with low self-esteem. Another dimension of self-esteem is about how people react to rejections. People with low self-esteem have the fear of rejection more and they have difficulty with facing problems (Murray et al., 2002). Thus, in our setting, we expect low self-esteem manufacturers to offer contracts that are less likely to be rejected by their retailers.

3. ANALYTICAL MODEL

In the experiment, human decision makers play the roles of manufacturer (he) and retailer (she) that interact repeatedly for a number of periods, which simulates a long-run relationship. In each period, first the manufacturer offers a contract to the retailer by setting the contract parameters. Next, the retailer either rejects the contract, or accepts it and decides on the order quantity. The manufacturer then delivers the ordered quantity to the retailer prior to the sales season. Production cost at the manufacturer is \$3 per unit and the unit sales price at the retailer, p, is \$12. Consumer demand for the product at the retailer is probabilistic, having a discrete uniform distribution between 51 and 150.

We refer to this interaction in each period as a "game" between the two parties. Note that the outcome in each game, such as the sales quantity and the two parties' profits, depend on three factors: Manufacturer's contract parameters decision, retailer's quantity decision and the realization of the random demand. The theoretical solution of the interaction in each period is characterized by the subgame-perfect equilibrium of the respective multi-stage game.

The experimental data pools together the data obtained under three different contracts: wholesale price, buyback and revenue-sharing contracts. In the wholesale price contract (w), the manufacturer only sets one parameter which is the wholesale price, w. In the buyback contract (w, b), the manufacturer also sets the buyback price, b, which is the price at which the manufacturer buys back the unsold products from the retailer. In the revenue-sharing contract (w, r), the manufacturer sets both w and the revenue-share, r, which denotes the manufacturer's share of revenue for each product sold to consumers. Note that in this work, we do not study the differences in results under these three contract categories. We are interested in the effects of factors common to each contract type, such as under/overordering with respect to the optimal newsvendor quantity, and contract rejections.

For a given accepted contract offer of the manufacturer, theory predicts that the retailer will choose the newsvendor order quantity Q^* to maximize her expected profit. This quantity is expressed in Table 1 under the three contract categories.

Table 1 : Optimal order quantity for different contract categories

Wholesale Price Contract	Buyback Contract	Revenue Sharing Contract
$Q^*(w) = F^{-1}\left(\frac{p-w}{p}\right)$	$Q^*(w,b) = F^{-1}\left(\frac{p-w}{p-b}\right)$	$Q^*(w,r) = F^{-1}\left(\frac{p-w-r}{p-r}\right)$

Using the newsvendor order quantity, one can calculate the expected sales of the retailer and the expected profits of the manufacturer and the retailer. We refer to these values as the "predicted values" as they assume the newsvendor-model-predicted order quantity. In the experiments, retailer subjects often choose some other quantity than the newsvendor-predicted one. We refer to the expected outcome under this chosen quantity as the "expected values". In addition to the predicted and expected values, we also use the term "realized values" to refer to the observed sales and profit values, which depend on the demand realization. Table 2 provides the mathematical expressions for the realized profit based on different contract categories and subject roles.

Table 2 : Realized profit expressions for different contract categories and subject roles

Wholesale Price Contract	Retailer	$-wQ + 12\ min(Q,D)$
	Manufacturer	$(w-3)Q$
Buyback Contract	Retailer	$-wQ + 12\ min(Q,D) + b(Q - min(Q,D))$
	Manufacturer	$(w-3)Q - b(Q - min(Q,D))$
Revenue Sharing Contract	Retailer	$-wQ + (12-r)\ min(Q,D)$
	Manufacturer	$(w-3)Q + r\ min(Q,D)$

4. EXPERIMENT PROCEDURE AND SELF-ESTEEM DATA

This section explains the conduct of experiments, the self-esteem survey data and the associated subject classification, and the performance measures used in our analysis.

4.1. Experiment Procedure

The experiments were conducted at the CAFE (Center for Applied Finance Education) laboratory in Sabanci University campus. All 132 subjects were voluntary Sabanci University students. Subjects were provided with instruction sheets before coming to the lab. Upon their arrival to the lab, an experimenter went over the rules one more time and answered any questions that the subjects might have. Before the real experiment started, three pilot periods were conducted to ensure subjects' knowledge of the game and the computer interface. The results of these pilot periods were not recorded. Subjects were incentivized with real monetary payment proportional to the total profit they obtained during the real experiment periods.

Each subject was assigned the role of either retailer or manufacturer, and their roles were kept unchanged until the end of the experiment. All 66 retailer-manufacturer pairs (22 from each contract category) played the game for 40 consecutive periods. In accordance with the theoretical model, in each period, first the manufacturer set the contract parameters. These were transmitted to the retailer's screen by the server computer. Seeing the contract offer, the retailer decided on the order quantity which can be 0, which means rejection, or an integer quantity between 51-150. Finally, the demand was realized, and the profits were calculated. The outcome of each game was shared with both parties at the end of each period. The subjects had access to their historical results through a separate window on their screen. They were also provided with a decision support tool which allowed them to conduct what-if analysis before submitting their decisions.

4.2. Self-Esteem Survey Data and Subject Classification

In addition to making decisions in the experiment, each subject also in a survey that measures the self-esteem class. The survey was based on the Rosenberg Self-Esteem Scale (Rosenberg, 1965) which is popular among researchers (Baumeister et al., 2003). In this scale, the subject needs to answer the following 10 statements with one of the following responses; “Strongly Agree”, “Agree”, “Disagree” or “Strongly Disagree”.

1. I feel that I am a person of worth, at least on an equal plane with others.
2. I feel that I have a number of good qualities.
3. All in all, I am inclined to feel that I am a failure.
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I take a positive attitude toward myself.
7. On the whole, I am satisfied with myself.
8. I wish I could have more respect for myself.
9. I certainly feel useless at times.
10. At times I think I am no good at all.

For the positive statements (statements 1,2,4,6 and 7), “Strongly Agree” was scored as 3, “Agree” as 2, “Disagree” as 1 and “Strongly Disagree” as 0. For the negative statements (statements 3,5,8,9 and 10) the scoring is in the opposite direction, starting with “Strongly Agree” as 0, and ending with “Strongly Disagree” as 3. Subjects are classified over their total score over the ten questions.

To have sufficient separation between classes and sufficient number of data points under each class, we chose to label the subjects with the top 33% scores as “High Self-Esteem (HSE)” and the bottom 33% as “Low Self-Esteem (LSE)”. Accordingly, as summarized in Table 3, 44 subjects were classified as low self-esteem (score range 9-20) and 39 subjects as high self-esteem (score range 26-30). Subjects that fall into neither LSE nor HSE classes were labeled as “Medium Self-Esteem” and their data was not used in testing our self-esteem-related hypotheses. Note that some researchers that use the Rosenberg Scale may use different thresholds for low and high self-esteem.

Table 3 : Classification of self-esteem (SE) and sample sizes

Class	Self-Esteem Score Range	# of Manufacturers per category	# of Retailers per category
Low self-esteem (LSE)	9-20	26	18
High self-esteem (HSE)	26-30	19	20

4.3. Performance Measure: Profit Types

Here, we describe how we measure the profit types, which is the performance measure used in our analysis. We begin with the experimental data: Each row in our experimental data table corresponds to the results of one particular game (i.e., one period interaction) of a particular manufacturer-retailer pair. Columns indicate the manufacturer and retailer IDs, period number, contract category (wholesale, buyback or revenue-sharing), self-esteem class (low, medium or high) of the manufacturer and retailer, contract parameters (w, b, r) set by the manufacturer, order quantity (Q) decision of the retailer, predicted order quantity ($Q*$), demand realization and the realized profits of the retailer and the manufacturer.

The unit of analysis is the average value in each manufacturer-retailer pair over relevant periods in the subject-level data and all relevant periods' values separately in the pooled data. We pool the data of all contract types, leading to 66 manufacturer-retailer pairs. Originally, we had 2640 rows of data. Two rows, where the wholesale and buyback price both were set at 12 were eliminated because these values result in an error in $Q*$ calculation. One manufacturer-retailer pair that had 21 rejections out of 40 offers was considered as an outlier and all 40 rows of their data was excluded from the analysis. This left us with 65 manufacturer-retailer pairs and 2598 rows of data.

We compare subjects' performance based on profit at three types we define: predicted, expected and realized. Predicted profit is calculated based on the newsvendor-optimal order quantity ($Q*$). Being independent of the retailer's own quantity decision and demand realization, predicted retailer profit is a measure of contract attractiveness for the retailer. Expected retailer profit, on the other hand depends on the retailer's own quantity decision, but is independent of the demand realization. Realized profit depends on the

demand realization, and hence, can be quite variable. This profit type is what the subjects observe at the end of each period in the experiment, and what their payment is based on.

Rejected contracts result in zero profit for both parties. As such, one can arrive at different conclusions about a subject's profit performance depending on whether rejected contract data is considered or not. We use the term "data set" to indicate if the data of all games (ALL), only those with accepted contracts (AC), or only those with rejected contracts (RC) are considered. ALL set allows an overall comparison about performance. AC set allows studying the dynamics of retailer's order quantity decision. RC set is used for studying the factors affecting contract rejection or acceptance.

ALL set has 65 rows, each representing the average results over 40 periods for each of the 65 manufacturer-retailer pairs. The AC set contains for each pair the average values of periods in which the contract was accepted. Because all pairs have at least one accepted contract over the 40 periods, all pairs are represented in the AC set, leading to 65 rows. The RC set contains the average values of periods in which the contract was rejected. In nine out of 65 manufacturer-retailer pairs, no contract was ever rejected. Thus, the RC set contains only 56 pairs' data.

The number of manufacturer and retailer subjects falling under each self-esteem and data set combination is given in Table 4.

Table 4 : Sample sizes according to self-esteem class, data set and subject role

Self-esteem Class	Data Set	# of Manufacturers	# of Retailers
LSE	RC	24	15
HSE	RC	17	18
LSE	AC	26	18
HSE	AC	19	20

5. ANALYSIS

We develop our hypotheses based on the effect of self-esteem on the profits of the manufacturer and retailer. We tested our hypotheses with the Wilcoxon test, using R software. We label hypothesis testing results with $p<0.10$ as significant. The results of some hypothesis tests are reported at all three profit types of predicted, expected and realized. For some hypotheses, we provide comparisons at both the individual subject-level (for which we denote the p values as "s. p-values"), and the pooled level which contains the data of the all relevant games in all periods (for which we denote the p values as "p. p-values").

We first discuss the results of the effect of self-esteem on subject profits. Next, we analyze retailer's underorder-overorder behavior in detail. Then, we extend this analysis with an alternative underorder-overorder categorization. We continue with retailer's rejection behavior and finalize our analysis with manufacturer's behavior after contract rejections. Finally, we present a regression model to explain the retailers' order quantity decisions.

5.1. Effect of Self Esteem on Profits

First, we consider the data of all games (ALL). We expect low-self-esteem (LSE) manufacturers to offer contracts that have relatively higher retailer profit than the contracts that high-self-esteem (HSE) manufacturers offer. We propose two reasons to motivate this hypothesis. First, we believe LSE manufacturers to be more concerned about getting rejected. Second, we expect HSE manufacturers to trust in their ability to force the retailers to accept less attractive contracts.

Hypothesis 1: *Contract offers of LSE manufacturers will have higher retailer profit than the contract offers of HSE manufacturers.*

The two firms do not engage in a zero-sum game. Yet, offering more profitable contracts to the retailer often requires the manufacturer to forego his own profits. Thus, we expect:

Hypothesis 2: *Contract offers of LSE manufacturers will have lower manufacturer profit than the contract offers of HSE manufacturers.*

Table 5 compares the median profit at each profit type and the p-values of the self-esteem comparison. We observe Hypothesis 1 to be supported at all three profit types at both the subject-level and pooled data, indicating that contracts offered by LSE manufacturers have higher retailer profits. Hypothesis 2, on the other hand, is supported only at the expected and realized profit types at the subject-level data and supported at all profit types at the pooled data.

Table 5 : Manufacturer profit comparison (median values) in all contracts

All Games Data (ALL)	Predicted Retailer Profit	Predicted Mfg. Profit	Expected Retailer Profit	Expected Mfg. Profit	Realized Retailer Profit	Realized Mfg. Profit
LSE Mfg.	307	419	256	374	283.5	382
HSE Mfg.	246	433	202	425	211	423
s. p-values	*0.022*	*0.107*	*0.012*	*0.068*	*0.004*	*0.082*
p. p-values	$2.12e^{-21}$	$1.084e^{-10}$	$1.317e^{-19}$	$6.902e^{-14}$	$1.114e^{-10}$	$3.662e^{-09}$

Next, we constrain our attention to accepted contract offers only. We expect the contract offers of LSE manufacturers to be more attractive for retailers compared to those of the HSE manufacturers. Following the same logic with Hypothesis 2, we expect the profit of the LSE manufacturers to be lower than that of the HSE manufacturers.

Hypothesis 3: *Accepted contract offers of LSE manufacturers will have higher retailer profit than accepted contract offers of HSE manufacturers.*

Hypothesis 4: *Accepted contract offers of LSE manufacturers will have lower manufacturer profit than accepted contract offers of HSE manufacturers.*

Table 6 presents the comparison for accepted contracts. Hypothesis 3 is supported as LSE manufacturers offer contracts with higher retailer profits than HSE manufacturers at all

profit types at both the subject-level and the pooled data. Meanwhile, LSE manufacturers have lower manufacturer profits and this result is significant for all profit types for both the subject-level and the pooled data. Thus, Hypothesis 4 is supported.

Table 6 : Manufacturer profit comparison (median values) in accepted contracts

Accepted Contracts (AC)	Predicted Retailer Profit	Predicted Mfg. Profit	Expected Retailer Profit	Expected Mfg. Profit	Realized Retailer Profit	Realized Mfg. Profit
LSE Mfg.	319	407.5	299.5	403	323.5	408.5
HSE Mfg.	256	433	216	450	223	450
s. p-values	*0.013*	*0.068*	*0.007*	*0.034*	*0.002*	*0.062*
p. p-values	$2.17e^{-24}$	$1.40e^{-11}$	$4.85e^{-27}$	$3.50e^{-16}$	$3.97e^{-14}$	$2.66e^{-10}$

So far, we have seen that contracts offered by LSE manufacturers end up having lower manufacturer profits and higher retailer profits compared to the contracts offered by HSE manufacturers. However, there is another dimension of the negotiation; the total supply chain profit. For this purpose, the following hypothesis suggests if accepted contracts offered by LSE manufacturers also have higher total supply chain profit compared to contracts offered by HSE manufacturers.

Hypothesis 5: *Accepted contract offers of LSE manufacturers will have higher total supply chain profit than accepted contract offers of HSE manufacturers.*

Table 7 presents the results of the Hypothesis 5. It is supported at all three profit types at both the subject-level and pooled data. This shows that LSE manufacturers not only offering better contracts in terms of retailer profit but also overall supply chain profit.

Table 7: Manufacturer total supply chain profit comparison (median values) in accepted contracts

Accepted Contracts (AC)	Total Predicted Profit	Total Expected Profit	Total Realized Profit
Low_M	743	723	748
High_M	712	713	721
s. p-values	*0.016*	*0.065*	*0.004*
p. p-values	$5.06e^{-26}$	$5.00e^{-06}$	$7.77e^{-03}$

We now present results concerning the retailers' contract rejection and acceptance behavior. We expect self-esteem to be positively correlated with self-confidence, and this to be effective in the retailer's ability to push the manufacturer towards offering better contracts. Moreover, HSE retailers may think that they deserve a better contract than what is offered. These in turn would cause higher retailer profit in the rejected contracts of HSE retailers compared to those of LSE retailers.

Hypothesis 6: *Contracts rejected by HSE retailers will have higher predicted retailer profit than the contracts rejected by LSE retailers.*

Table 8 summarizes the results related to rejected contracts. Recall that by definition, rejected contract data has zero expected and realized profits for both parties. We observe the predicted profit difference between LSE and HSE retailers to be small and insignificant. Therefore, Hypothesis 6 is not supported.

Table 8 : Retailer profit comparison (median values) in rejected contracts

Rejected Contracts (RC)	Predicted Retailer Profit	Expected Retailer Profit	Realized Retailer Profit
LSE Retailers	174	0	0
HSE Retailers	185.5	0	0
s. p-values	*0.407*	-	-
p. p-values	*0.113*	-	-

With accepted contracts, we expect HSE retailers to have higher profit than LSE retailers. This is because HSE retailers are more likely to punish manufacturers when faced with unattractive contracts. They should end up accepting higher profited contracts because of their ego and belief in self-worth.

Hypothesis 7: *Contracts accepted by HSE retailers will have higher retailer profit than contracts accepted by LSE retailers.*

Table 9 compares the contracts accepted by LSE and HSE retailers. Contrary to what we expected in Hypothesis 7, HSE retailers have lower profits than LSE retailers for the contracts they accepted. Thus, Hypothesis 7 is rejected. Having high self-esteem does not

seem to benefit retailers. In Sections 5.2 and 5.3 we aim to understand the underlying reasons for this phenomenon by looking into retailer's underorder and overorder behavior in detail.

Table 9 : Retailer profit comparison (median values) in accepted contracts

Accepted Contracts (AC)	Predicted Retailer Profit	Expected Retailer Profit	Realized Retailer Profit
LSE Retailers	335	308	326
HSE Retailers	274	249	268.5
s. p-values	*0.840*	*0.896*	*0.860*
p. p-values	*1.000*	*1.000*	*0.999*

5.2. Retailer's Underorder and Overorder Behavior

Retailer's deviations from the newsvendor-predicted order quantity (Q^*) is a major determinant of both firms' profit values. In this section and in the following one, we analyze the relation between retailers' self-esteem class, and their underorder and overorder tendencies in detail. An underorder refers to an accepted contract with $Q < Q^*$, whereas an overorder refers to a contract with $Q > Q^*$. Table 10 summarizes the number of underorder and overorder instances for all retailers (including HSE, LSE as well as the Medium class), HSE and LSE retailers.

Table 10: Underorder and Overorder Quantities

	ALL	**HSE**	**LSE**
# of Underorders	976	274	324
# of Overorders	1279	431	292
# of Optimal Orders (Q^*)	383	21	34
# of Total Orders	2638	726	650
% of Underorder	37%	38%	50%
% of Overorder	48%	59%	45%
% of Optimal order	15%	3%	5%

We observe HSE retailers to overorder more frequently than they underorder, while the opposite is true for LSE retailers. Also, the difference between underorder and overorder percentages is much larger for HSE than for LSE.

Next, we analyze the magnitudes of overorders (Q- Q*) for each accepted contract. Note that this analysis also addresses underorder instances as negative values. We believe high self-esteem to be associated with higher risk taking, leading to higher overorders.

Hypothesis 8: *HSE retailers will make larger overorders (higher Q- Q*) compared to LSE retailers for the accepted contracts.*

Figure 1 presents the distribution of this metric for the HSE and LSE retailers. We clearly see that HSE retailers place overorders more frequently than LSE retailers. 59% of the HSE retailers overorder while this number is 45% for the LSE retailers. We also observe that HSE retailers have higher overorders in magnitude more. Approximately 24% of the HSE retailers overorder more than 25 while only 8% of the LSE retailers overorder in that scale. Hypothesis 8 is supported for both the pooled data and the subject-level data *(pooled; p: 3.317e^{-11}, m1:10, m2:0, n1:726, n2:650, subject-level; p: 0.056, m1: -0.29, m2: -3.81, n1:20, n2:18).* HSE retailers significantly order more in magnitude than LSE retailers.

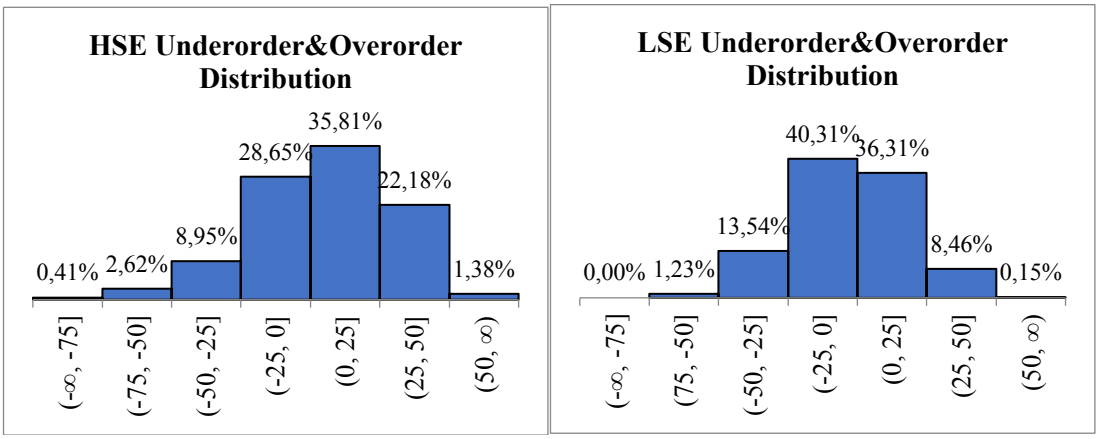

Figure 1: HSE and LSE Retailer Underorder&Overorder Distributions

An alternative way to compare the overordering behavior is using the metric Q/Q*.

Hypothesis 9: *HSE retailers will have higher Q/Q* values than LSE retailers for the accepted contracts.*

Hypothesis 9 is supported for both the pooled data and the subject-level data *(pooled; p: 4.976e^{-11}, m1:1.10, m2:1.00, n1:726, n2:650, subject-level; p: 0.059, m1:1.01, m2:0.96, n1:20, n2:18)*. Thus, this metric also supports the finding that HSE retailers tend to make larger overorders.

One potential explanation for why HSE retailers overorder more is that HSE retailers might be offered lower Q^* values in the first place, which leaves more room for overordering. We check this with the following hypothesis.

Hypothesis 10: *Accepted contract offers of HSE retailers will have lower Q^* values than the accepted contract offers of LSE retailers.*

Hypothesis 10 is not supported in neither pooled nor subject-level data *(pooled; p-value: 0.248, m1:93, m2:92, n1:726, n2:650, subject-level; p: 0.448, m1:97, m2:90, n1:20, n2:18).* This shows that there is not a statistically significant difference in terms of the accepted contract Q^* values between HSE and LSE retailers.

Finally, we compare the subject percentages of under and overorder between the two retailer types. Here, each data point is a retailer's ratio of overorder or underorder in accepted contracts. For example, if a retailer accepted 35 of the 40 contracts and has overordered in 30 of them, then her overorder ratio will be 30/35. Therefore, here, we can only present subject-level p-values. We expect to see HSE retailers to have a higher overorder ratio and a lower underorder ratio compared to LSE retailers.

Hypothesis 11: *HSE retailers have higher percentage of overorders than LSE retailers in the accepted contracts.*

Hypothesis 12: *HSE retailers will have lower percentage of underorders than LSE retailers in the accepted contracts.*

Both Hypothesis 11 *(p: 0.051, m1: 0.65, m2: 0.44, n1:20, n2:18)* and Hypothesis 12 *(p: 0.051, m1: 0.33, m2: 0.49, n1:20, n2:18)* are supported. This provides further support that HSE retailers are inclined to overorder more, compared to LSE retailers.

5.3. An Alternative Underorder-Overorder Categorization

Until now, we grouped all accepted contracts with $Q < Q^*$ as underorder and $Q > Q^*$ as overorder, where Q^* acts as a thin borderline between the two categories. Here, in Table 11, we present a different categorization in which we define a "nearly optimal" zone around the Q^*. We also differentiate between "regular" and "critical" versions of under and overorders as outlined in Table 12. We prefer adding and extracting numbers rather than percentages when defining the range of the categories to be able to treat different Q^* values equally. Since taking percentage would give different ranges for different amounts of Q^*.

Table 11: Alternative Underorder-Overorder Categorization

Categorization	Q-Q^*	
Critically Underorder	< -20	-
Underorder	< -10	≥ -20
Nearly Optimal	≥ -10	≤ 10
Overorder	> 10	≤ 20
Critically Overorder	> 20	-

Table 12: HSE and LSE Alternative Categorization

Total HSE Retailer Rows:	726	Ratios	Total LSE Retailer Rows:	650	Ratios
Critically Underorder	131	18%	Critically Underorder	122	19%
Underorder	75	10%	Underorder	91	14%
Nearly Optimal	171	24%	Nearly Optimal	271	42%
Overorder	133	18%	Overorder	79	12%
Critically Overorder	216	30%	Critically Overorder	87	13%

We observe the overall underorder percentage to be similar between HSE and LSE retailers. On the other hand, there is a stark difference in the overorder percentage: HSE retailers overorder in 48% of the cases, where 30% of this is of the "critical" type, whereas these numbers are only 25% and 13% respectively for LSE retailers. The difference is accounted for in the percentage of "nearly-optimal" orders which has a value of 24% for HSE and 42% for LSE retailers. Thus, LSE retailers seem to make more newsvendor-type ordering decisions, whereas HSE retailers take excessive risk more frequently. This

can lead LSE retailers to end up with more expected and realized retailer profits and profit shares than HSE retailers at the end of the game. We test these with the following hypotheses.

Hypothesis 13: *LSE retailers will have more expected retailer profit in accepted contracts than HSE retailers.*

Hypothesis 14: *LSE retailers will have more expected retailer profit share in accepted contracts than HSE retailers.*

Hypothesis 13 is only supported at the pooled data (pooled; p: $4.513e^{-11}$, m1:290, m2:241, n1:650, n2:726, subject-level; p: 0.110, m1: 308, m2:249, n1: 18, n2: 20) yet the difference between median values is high and p-value is almost significant at the subject-level as well. Hypothesis 14 is supported (pooled; p: $3.947e^{-14}$, m1: 0.43, m2: 0.35, n1: 650, n2:726, subject-level; p: 0.074, m1: 0.435, m2: 0.35, n1: 18, n2: 20). These results were based on the expected values. We have found parallel results with the realized profit values as well. From Hypothesis 10, we already know that there is not a difference in terms of $Q*$ values of the accepted contracts. Hence, the low expected and realized profit share values for the HSE retailers may be due to their orders being further away from the optimal order quantity compared to that of LSE retailers.

To summarize, our analysis so far shows that HSE retailers overorder more than LSE retailers. LSE retailers' order quantities closer to the optimal value, whereas HSE retailers suffer from an overordering bias. In the following subsection, we analyze the effect of self-esteem on contract rejection behavior.

5.4. Contract Rejections

A contract rejection causes both parties to receive zero profit in the period it occurred. Beyond that, a contract rejection can have further indirect effects. One is that, to make up for the lost profit, the retailer may be inclined to accept future contracts more frequently. Another is that the manufacturer can have a negative reaction to his contract being

rejected. We investigate these two effects respectively in this and the subsequent subsection.

As stated in the literature review, high self-esteem is positively correlated with high ego and hence, we expect HSE retailers to reject more contracts than LSE retailers. In what follows, we present a number of analyses that compare the rejection behavior of HSE and LSE retailers.

Hypothesis 15: *HSE retailers will reject more of the contracts they are offered than LSE retailers.*

In this analysis, each retailer's total number of rejections is a data point. Hypothesis 15 is not supported *(subject-level: p: 0.535, m1: 3, m2: 3, n1: 20, n2:18)*. Figure 2 provides the distribution of HSE and LSE retailers according to the number of contracts they rejected, out of 40 offers.

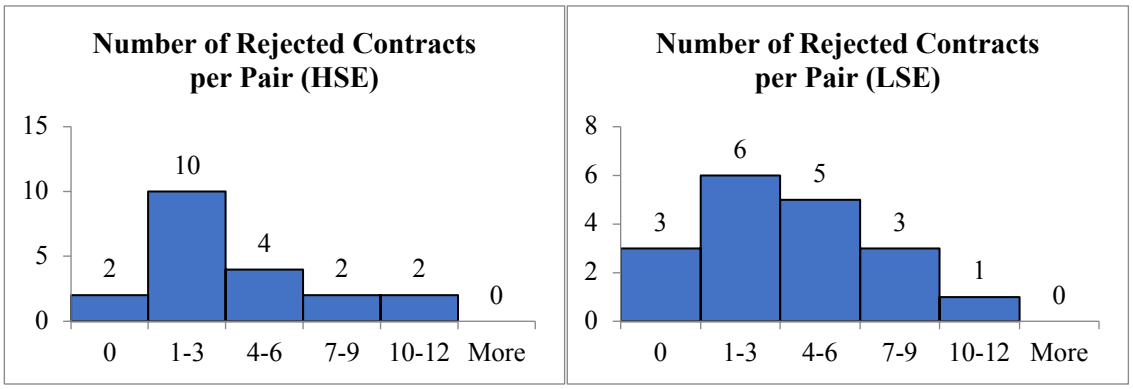

Figure 2: Number of Rejected Contracts

Note that rejection is not the only way for the retailer to protest the manufacturer. The retailer can also signal dissatisfaction by ordering the minimum quantity, which is 50, or by critically underordering with respect to the newsvendor quantity. From Section 5.3, we already know that there is not much difference in critical underorders between HSE and LSE retailers. We also wanted to check if a difference arises when the three ways of protest (rejection, ordering the minimum order quantity and making a critical underorder) are counted together. The numbers indicate no difference, though: HSE retailers exhibit these behaviors in 26% of the time while for the LSE retailers, this number is 27%.

Another potential difference is in how the number of contract rejections change over time. In initial periods, rejection has a value in that it can lead to better profits in future periods. However, a rejection in the latter periods of the relationship does not offer such a value. Hence, we compare the number of rejections in the first and the second halves of the experiment.

Figure 3 compares the average number of rejections per subject in each period. We observe the average number of rejections to decrease in the second half of the experiment in LSE retailers; whereas, there is no such reduction for HSE retailers (*Paired Wilcoxon Test, subject-level p-values of 0.019 and 0.220 respectively*). Given that contract rejection is a way to "protest" the other party, LSE retailers seem to settle down with what they have, whereas HSE retailers keep struggling for a longer period.

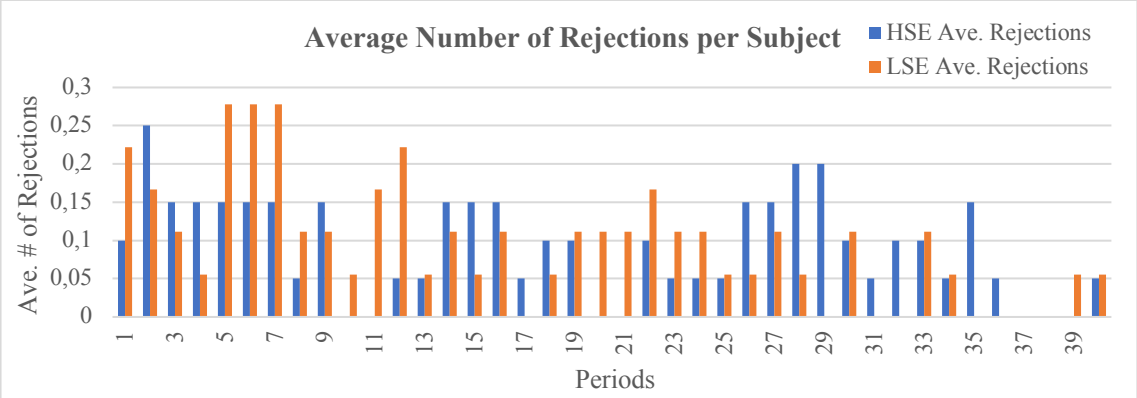

Figure 3: HSE and LSE Average Period Rejections

Next, we check the attractiveness of the contracts in the two halves of the experiment by comparing the predicted retailer profits (PRP) of contracts offered to each particular retailer in the two halves of the experiment, with a paired Wilcoxon Test.

Hypothesis 16: *For both HSE and LSE retailers, the predicted retailer profit (PRP) of the offered contracts will increase in the second half of the experiment compared to the first half.*

Hypothesis 16 is supported for both HSE and LSE retailers (*subject-level p-values of 0.082 and 0.088 respectively*), indicating that retailers are offered better contracts in the

second half of the experiment. Therefore, an alternative explanation to the smaller number of rejections in the second half is the increase in the attractiveness of the offered contracts. LSE retailers respond to this profit increase in the contracts by reducing the number of rejections significantly. On the other hand, HSE retailers do so on average but not on a statistically significant level.

In the following subsection, we study how these retailer rejections affect manufacturer behavior in the subsequent period.

5.5. Manufacturer Behavior After Rejections

Contract rejections can have an effect of the rest of the relationship between the manufacturer and the retailer. They may either deteriorate the relationship and cause the manufacturer to offer less attractive contracts, or they may work as a useful warning (or punishment) tool and cause the manufacturer to offer more attractive contracts.

Here, we analyze if a rejection positively affects the predicted retailer profit (PRP) in the subsequent period. Recall that PRP is the retailer's profit in case the retailer orders the newsvendor optimal order quantity (Q^*) for the offered contract. Since contract parameters are defined by the manufacturer, we compare the behavior of the manufacturer before and after a contract rejection.

Hypothesis 17: *An HSE manufacturer will increase the PRP of his contract offer in the next period following a rejection.*

Hypothesis 18: *An LSE manufacturer will increase the PRP of his contract offer in the next period following a rejection.*

Both hypotheses are supported at both the pooled and subject-level data *(Hypothesis 17; pooled, p: $1.583e^{-08}$, m:70, n:63, subject-level, p: 0.0004, m:80.33, n:17, Hypothesis 18; pooled, p: $1.019e^{-08}$, m:85, n:96, subject, p: $5.263e^{-05}$, m:77.64, n:24)*. Thus, both types of manufacturers respond to a contract rejection by offering a more attractive contract to the retailer.

Next, we compare the behavior of LSE and HSE manufacturers. For HSE manufacturers, after rejection, predicted retailer profit decreases in 11% of the contracts, does not change in 14% and increases in 75%. For LSE manufacturers; the respective figures are 13%, 17% and 70%. Next, we compare the magnitude of these changes.

Hypothesis 19: *LSE manufacturers will have higher PRP increase in their contract after rejection than HSE manufacturers.*

Hypothesis 19 is not supported *(pooled; p: 0.206, m1: 85, m2:70, n1:96, n2:63, subject-level; p: 0.401, m1:77.64, m2:80.33, n1:24, n2:17)*. On average, LSE has a change of 78.30 while HSE has a change of 69.24 for the pooled data and LSE has a change of 86.76 and HSE has a change of 83.77 for the subject-level data. So, this hypothesis is only supported in terms of average values.

When we look at the PRP change after rejection period, we ignore the effect of the rejection period's PRP. For example, if the PRP of the rejection period is relatively low, a higher PRP increase still means a low PRP. In that sense, we further analyze percentage changes between rejection and after rejection periods given in the below histograms for HSE and LSE manufacturers. According to Figure 4, we observe LSE manufacturers to offer higher percentage PRP change after rejection compared to HSE manufacturers (For instance, the share of more than 50% PRP increase for LSE is 38% and for HSE, it is 26%).

Hypothesis 20: *HSE manufacturers will have lower percentage PRP increase after rejections than LSE manufacturers.*

Hypothesis 20 is not supported *(pooled; p: 0.553, m1: 32%, m2:37%, n1: 57, n2:93)*. There is no significant difference between HSE and LSE manufacturers in terms of PRP percentage change after rejection.

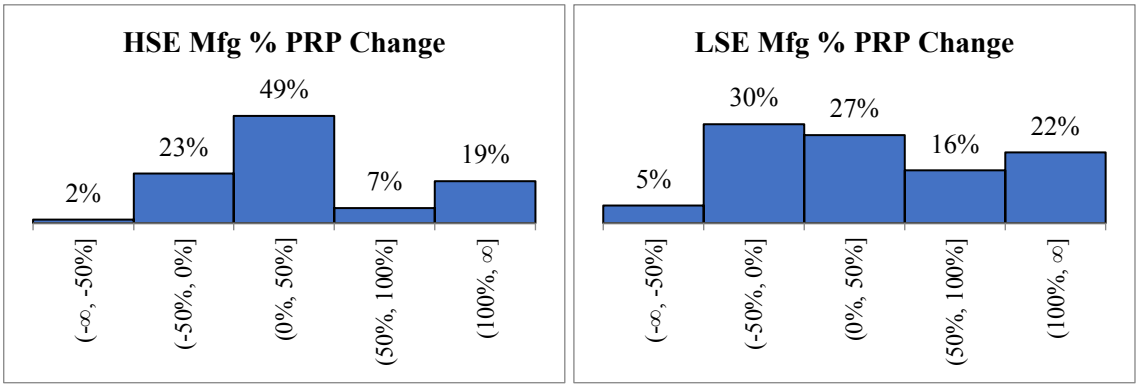

Figure 4: Manufacturer %PRP Change After Rejection

To summarize, even not statistically significant, LSE manufacturers have a higher PRP increase after rejection than HSE manufacturers on average. To make a better comparison, we need to know if the rejected contracts differ between LSE and HSE manufacturers. We expect LSE manufacturers to offer lower PRP in rejected contracts and that's why they might be offering a higher increase afterwards.

Hypothesis 21: *LSE manufacturers will offer lower PRPs in rejected contracts than HSE manufacturers.*

Hypothesis 21 is not supported *(pooled; p:0.546, m1:189, m2:200, n1:97, n2:63, subject-level, p:0.630, m1:189, m2:189, n1:24, n2:17).* In fact, LSE manufacturers offers of rejected contracts have a higher PRP on average (*pooled; 191.09 for LSE and 182.03 for HSE and subject-level; 187.42 for LSE and 171.06 for HSE*). Therefore, on average, LSE manufacturers increase PRP more after rejection even though they offer better contracts in the period of rejection.

5.6. Explaining Retailers Order Decisions: A Regression Model

Here, we present a number of multivariate linear regression models to explain the effect of self-esteem (SE) and a number of other variables on retailers' order quantity (Q) decisions. Accordingly, we use the data of the periods in which the retailer accepted the contract offer; that is, our accepted contract data, AC.

If decision makers were fully rational, we would expect the retailers to order the optimal order quantity. We know by now that this is not the case. Yet, we expect a positive correlation between Q and $Q*$ as $Q*$ is a proxy of the attractiveness of the contract offer for the retailer. It is logical for the retailer to order higher quantities if the contract offer is profitable for her. To see how $Q*$ alone can explain Q, we estimate the following basic linear regression model,

$$Q_{it} = \beta_0 + \beta_1 Q_{it}^* + \epsilon_t$$

Table 13: Results of the basic regression analysis

Variables	Estimate	Standard Error	t Value	p-value
β_0	31.550	2.835	11.13	$<2e^{-16}$
Q_{it}^*	0.692	0.029	23.51	$<2e^{-16}$

Table 13 presents the results of the model. As expected, $Q*$ is positively correlated with Q and its effect is significant. The model, however, has an adjusted R^2 of only 0.190, which shows how insufficient $Q*$ alone is in explaining the retailer's order quantity decisions in experiments.

Next, we expand the model with some additional independent variables. Because we observed HSE retailers to overorder more than LSE retailers, we expect the self-esteem score of the retailer (SE) to be positively correlated with Q. Another factor we consider is the contract rejection history. Previous rejections can increase Q as the retailer can think that she has already punished the manufacturer and now, it is time for her to make a profit. Alternatively, previous rejections can poison the long-run relationship between the firms, causing a reduction in Q. Finally, we consider the effect of unmet demand (UD) from the previous period, which occurs when demand is higher than the stock quantity. We conjecture that unmet demand in the previous period will positively affect the order quantity. We analyze unmet demand data in two different ways depending on how excess inventory (if any) is treated; as negative UD values versus as 0.

The order quantity of retailer i in period t is modeled as,

$$Q_{it} = \beta_0 + \beta_1 SE_i + \beta_2 Q_{it}^* + \beta_3 PR_{it} + \beta_4 UD_{it-1} + \epsilon_t$$

where β_0 is the intercept, SE_i refers to retailer i's self-esteem score, Q_{it}^* is the predicted newsvendor order quantity in period t, PR_{it} is the total number of rejections that the retailer made prior to period t, UD_{it-1} is the unmet demand in period $t-1$, and ϵ_t is the error term.

We checked against potential correlation between the predictor variables using Kendall's method as we do not assume normality. As observed from the correlation values that are reported in Table 14, the highest correlation is found to be between PR_{it} and Q_{it}^* , and its value is only 0.110. The Spearman method also yielded similar results.

Table 14: Correlation Matrix of the Variables

Variables	SE_i	Q_{it}^*	PR_{it}	UD_{it-1}
SE_i	1	-0.008	-0.064	-0.019
Q_{it}^*	-0.008	1	0.110	-0.062
PR_{it}	-0.064	0.110	1	0.027
UD_{it-1}	-0.019	-0.062	0.027	1

The results of this analysis with excess inventory being zero are provided in Table 15. The model has an adjusted R^2 of 0.214.

Table 15: Results of the regression analysis with 0 values for excess inventory

Variables	Estimate	Standard Error	t Value	p-value
β_0	21.986	4.090	5.376	$8.36e^{-08}$
SE_i	0.499	0.115	4.353	$1.40e^{-05}$
Q_{it}^*	0.704	0.030	23.758	$<2e^{-16}$
PR_{it}	-0.348	0.201	-1.729	0.084
UD_{it-1}	-0.094	0.014	-6.848	$9.52e^{-12}$

All of the explanatory variables are significant. As we expected, the order quantity Q_{it} is increasing in the self-esteem score of the retailer, SE_i, increasing in the predicted newsvendor quantity of the contract, Q_{it}^*, and decreasing in the number of rejected contracts in the relationship up to that period, PR_{it}. Contrary to our expectation, unmet demand in the previous period, UD_{it-1} is found to have a negative effect on the order quantity. This can potentially be explained by the Gambler's Fallacy behavior of the subjects, that is, they may erroneously be expecting a high demand realization (causing a

high unmet demand) to be followed by a low demand realization (causing a low order quantity decision).

Then, we analyze the same model with excess inventory cases represented as negative unmet demand. The results of this analysis are provided in Table 16. Variables UD_{it-1} and PR_{it} have more significance compared to previous model that represents excess inventory cases as "zero" unmet demand. We observe the adjusted R^2 of the model to increase slightly to 0.225.

Table 16: Results of the regression analysis with negative values for excess inventory

Variables	Estimate	Standard Error	t Value	p-value
β_0	23.408	4.067	5.756	$9.75e^{-09}$
SE_i	0.480	0.114	4.214	$2.60e^{-05}$
Q_{it}^*	0.681	0.030	22.974	$< 2e^{-16}$
PR_{it}	-0.530	0.199	-2.660	0.008
UD_{it-1}	-0.108	0.012	-8.872	$< 2e^{-16}$

In the final linear regression model, we treat self-esteem (SE) values as a factor (categorical) variable rather than a numeric variable. This data only includes LSE and HSE retailers while the numeric SE data also had medium self-esteem retailers. Excess inventory cases are treated as zero unmet demand. The adjusted R^2 value is found to be 0.219. As shown in Table 17, having low self-esteem (LSE variable) is found to have a negative impact on the order quantity, which is consistent with our earlier findings. Different from the other models, previous period's number of rejections becomes insignificant in this model.

Table 17: Results of the regression analysis with factor self-esteem

Variables	Estimate	Standard Error	t Value	p-value
β_0	41.342	3.622	11.413	$< 2e^{-16}$
LSE_i	-6.255	1.241	-5.039	$5.31e^{-07}$
Q_{it}^*	0.653	0.037	17.512	$< 2e^{-16}$
PR_{it}	-0.260	0.250	-1.039	0.299
UD_{it-1}	-0.117	0.018	-6.487	$1.22e^{-10}$

In summary, self-esteem score of the retailer, the contract's optimal order quantity, previous periods' total number of rejections and previous period's lost demand all have

significant effects in retailer's order quantity choice. Models have modest adjusted R^2 values; yet, when we consider other possible biases and factors that affect retailers, this result is not surprising.

We also checked what happens if Q_{it}^* is excluded from the model. In that case, in the model where excess inventory cases are represented as negative unmet demand, R^2 reduces to 0.051. Thus, Q_{it}^* is seen to have an important explanatory role in the model.

Next, we outline regression diagnostics results. Since it has the highest adjusted R^2, we again use the model where excess inventory cases are represented as negative unmet demand as an example. Figure 5 summarizes the results.

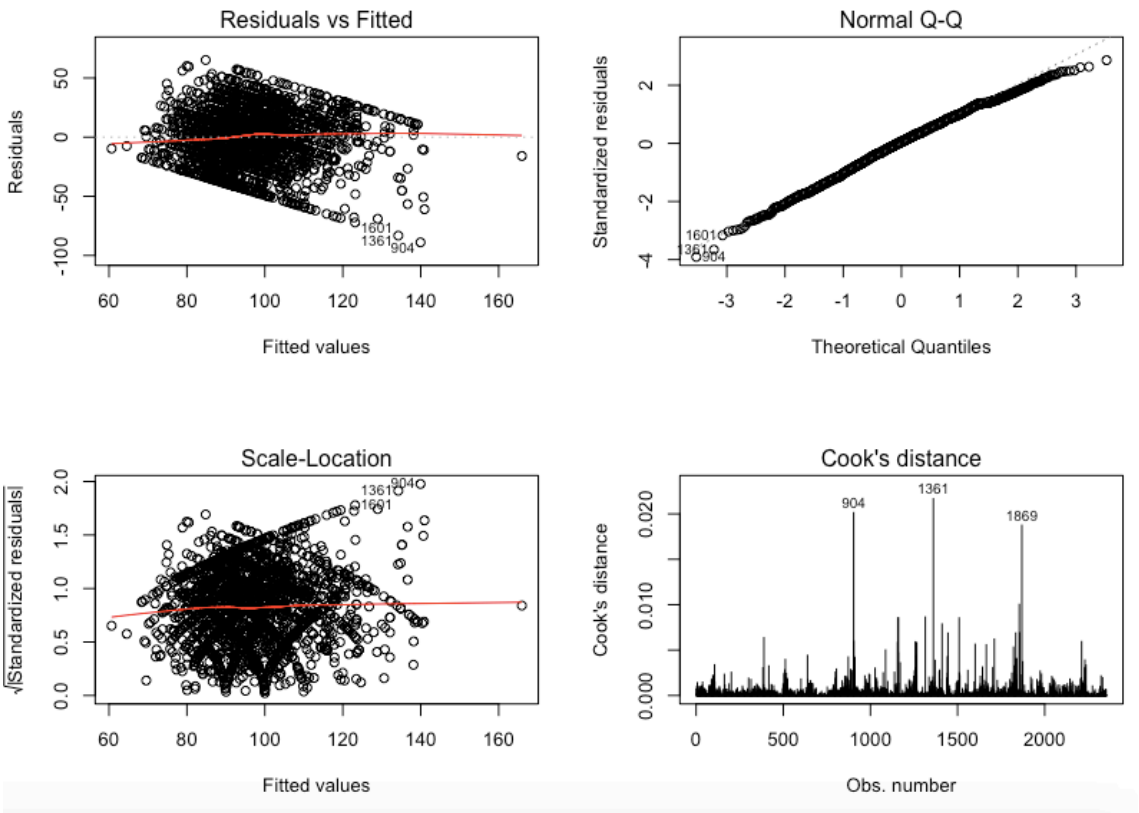

Figure 5: Model Diagnostics

Residuals vs Fitted plot shows that linearity assumption holds as the red line is almost horizontal; the relationship between stock given by the retailer and the model's predictors (self-esteem score of the retailer, previous periods' total number of rejections, previous

period's unmet demand and the optimal order quantity of the contract offered) is indeed linear.

From the Q-Q plot, we observe the residuals to mostly lie on the straight dashed line. Hence, the normality assumption also holds. Homoscedasticity is checked with the Scale-Location plot. The line is horizontal, and points are nearly equally spread which supports the homogeneity of the variance. Yet, a non-constant variance test in R yields a p-value lower than our significance level, which indicates some heteroscedasticity in data. To eliminate this, as a further study, a variable transformation such as Box-Cox can be applied to the order quantity values.

Influential value analysis is shown in the Cook's distance plot. Three data points are chosen as top extreme points. These correspond to the games with low order quantity and high optimal order quantities, which cause a high Cook's distance value. To check if these points have leverage on the regression analysis, we plot the Residuals vs Leverage graph in Figure 6. R software automatically alerts the user if there are points outside of the Cook's distance by adding zones of red dashed lines to the plot. Since the Residuals vs Leverage plot doesn't have such zones, we can say that all points are inside of the Cook's distance lines and our data don't have influential points.

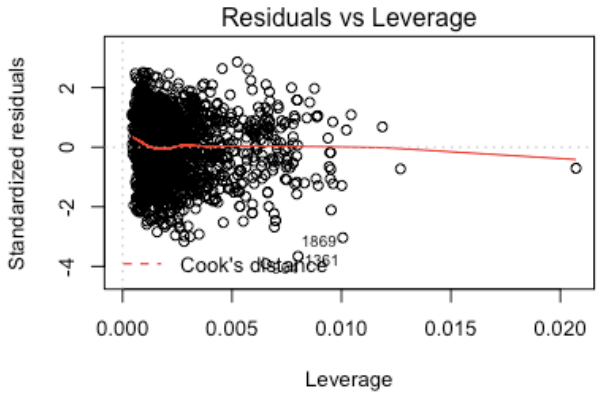

Figure 6: Residuals vs Leverage

From Table 14, we already know that the correlation coefficients of the predictors are low. Yet, we check the variance inflation factors (VIF) of the predictors in our model and we find values around 1. This result eliminates the risk of multicollinearity.

Finally, the residuals in the model should be independent of each other. To check this, we apply a Durbin Watson test and find a test statistic of 1.64. As a rule of thumb, values less than 1 or more than 3 are considered problematic (Field, 2009). Hence, we can assume that our model has independent residuals.

6. EXTENSION: PAIRWISE SELF-ESTEEM COMPARISONS

The hypotheses discussed far are concerned with the self-esteem class of one party only, the manufacturer or the retailer. Next, we consider the pairwise self-esteem class of the manufacturer-retailer pair. We use a four-letter acronym where the first letter (L or H) denotes the self-esteem class of the manufacturer and the second letter denotes that of the retailer, followed by "SE" for "self-esteem". For instance, HLSE corresponds to pairs with a high-self-esteem manufacturer and a low-self-esteem retailer.

Table 18 summarizes the number of pairs and total number of rejections for all four pairwise classes in the ALL data category.

Table 18 : Offered contract information and number of rejections by pairwise self-esteem classes

Pairwise Self-Esteem Class	# of Pairs	# of Rejections
HHSE	6	18
LLSE	7	24
HLSE	4	16
LHSE	10	37

We observe HSE retailers to reject more contracts on average than LSE retailers when the manufacturer has low self-esteem. We expect HSE manufacturers to offer less favorable contracts than LSE manufacturers when self-esteem category of the retailer is fixed at H or L based on the previous hypotheses we tested. Comparisons are based on predicted retailer profit as this profit type directly indicates the attractiveness of a contract for the retailer.

We expect higher manufacturer profit in accepted contracts when the manufacturer has high self-esteem. Thus,

Hypothesis 22: *Accepted contract offers in HHSE will have higher manufacturer profit than accepted contract offers in LHSE.*

Hypothesis 23: *Accepted contract offers in HLSE will have higher manufacturer profit than accepted contract offers in LLSE.*

Table 19 summarizes the comparisons on manufacturer's profit with the pairwise self-esteem classes. We observe Hypothesis 22 to be supported at the predicted profit for both the subject-level and the pooled data while at the expected and realized profits for only the pooled data. Hypothesis 23, on the other hand, is supported at the expected profit for both the subject-level and the pooled data while at the predicted and realized profits for only the pooled data.

Table 19 : Manufacturer profit comparison by pairwise self-esteem classes in accepted contracts

Accepted Contracts (AC)	Predicted Mfg. Profit	Expected Mfg. Profit	Realized Mfg. Profit
HHSE	488	443	442
LHSE	402	411.5	424
s. p-values	*0.022*	*0.110*	*0.157*
p. p-values	$5.50e^{-21}$	$7.33e^{-11}$	$1.09e^{-07}$
HLSE	427.5	449	450
LLSE	397	402	403
s. p-values	*0.115*	*0.082*	*0.158*
p. p-values	$5.39e^{-08}$	$8.48e^{-14}$	$2.55e^{-09}$

With the same logic in Hypothesis 6, we expect high self-esteem retailers to reject more attractive contracts. Thus,

Hypothesis 24: *Rejected contract offers in LHSE will have higher predicted retailer profit than rejected contract offers in LLSE.*

Hypothesis 25: *Rejected contract offers in HHSE will have higher predicted retailer profit than rejected contract offers in HLSE.*

Table 20 presents the comparison results about the attractiveness of the rejected contracts for the retailer. We observe neither Hypothesis 24 nor Hypothesis 25 to be supported.

Table 20 : Retailer profit comparison by joint self-esteem categories in rejected contracts

Rejected Contracts (RC)	Predicted Retailer Profit	Expected Retailer Profit	Realized Retailer Profit
LLSE	174	0	0
LHSE	182	0	0
s. p-values	*0.396*	-	-
p. p-values	*0.544*	-	-
HHSE	233	0	0
HLSE	242	0	0
s. p-values	0.793	-	-
p. p-values	0.648	-	-

Next, similar to the analysis in Section 5.3, we check the underordering & overordering tendency of the retailer with her manufacturer pair in Table 21. Remember that in this analysis, we ignore the data of pairs that have a medium self-esteem retailer or manufacturer. We observe low self-esteem retailers to place more nearly optimal orders independent of the manufacturer's self-esteem class. Yet, this percentage is higher when the manufacturer has low self-esteem. Moreover, high self-esteem retailers make more decisions in the critical category compared to low self-esteem retailers.

Table 21: Pairwise Categorization of the Orders

	LLSE	LHSE	HLSE	HHSE
Critically Underorder	16%	18%	9%	19%
Underorder	12%	10%	18%	11%
Nearly Optimal	46%	23%	37%	24%
Overorder	13%	17%	11%	18%
Critically Overorder	13%	32%	25%	28%

In summary, for the accepted contracts, we find partial support that HSE manufacturer has higher manufacturer profit than LSE manufacturer when the retailer's self-esteem is fixed at H or L. Results are significant at the pooled data and almost significant in the subject-level data. This supports our previous findings that self-esteem is beneficial for manufacturers. However, for the rejected contracts we couldn't find support for the hypotheses. We believe this may be due to small sample sizes as rejections occur less than acceptances and pairing subjects further decreases the sample size. Similar to our

previous analyses, we find LSE retailers to make more nearly optimal type decisions compared to the HSE retailers.

7. CONCLUSION

In this research, we study if and how the self-esteem of retailers and manufacturers affect their decisions and the resulting profits in a supply chain scenario where the retailer is faced with a newsvendor decision. We find manufacturers with high self-esteem to offer less attractive contracts to retailers and to enjoy higher profits, while this is detrimental to the retailer's and the total supply chain's profits. Thus, having high self-esteem seems to be beneficial for the manufacturer's own profit but detrimental to the other party.

The retailer's self-esteem, on the other hand may not turn out to be beneficial to her own performance. The average predicted profit of the contracts that high self-esteem retailers accept turned out to be lower than of those accepted by low self-esteemed retailers. To understand this unexpected result, we applied further analysis to observe under-overorder, rejection and after rejection behaviors in detail. It turns out that, HSE retailers overorder more in both percentage and magnitude than LSE retailers. Even though they are offered similar contracts in terms of the predicted newsvendor quantity, HSE retailers act more risk-taking than LSE retailers by ordering more. This might be one of the reasons why HSE retailers on average (albeit not at a statistically significant level) earn lower profits than LSE retailers. On the other hand, the expected profit share of HSE retailers is significantly less than that of the LSE retailers. This observation suggests studying "fairness" as a factor explaining subject decisions in an extension study.

We expected HSE retailers to reject more contracts than LSE retailers and in turn, cause a negative reaction in manufacturers leading to less attractive contract offers. However, we did not observe a significant difference between the number of rejected contracts between HSE and LSE retailers. On the other hand, we observe the average number of rejections to decrease in the second half of the experiment in LSE retailers, whereas there is no significant difference in HSE retailers. Hence, high self-esteem might cause the retailers to keep struggling with the manufacturers. We observe both LSE and HSE manufacturer types to offer more attractive contracts to retailers following rejections, as

measured by the predicted retailer profit. Thus, rejections seem to be useful in punishing the manufacturer and they work in retailer's advantage. On average, low self-esteem retailers exhibit this behavior more; however, the difference is not significant.

We applied a multivariate linear regression model to predict retailer's order quantity decision. It turns out that order quantity is positively correlated with self-esteem score and optimal order quantity of the contract. Whereas, it is negatively correlated with previous periods' total number of rejections and previous period's unmet demand.

We also study the effects of joint self-esteem categorization of the manufacturer-retailer pairs. In that study, although we have some directional observations, we could not arrive at significant results, especially for the subject-level data. This can be explained by the reduced number of data points due to pairwise categorization.

This study presents the very first results concerning the effect of an important behavioral factor, self-esteem, in supply chain relations. Our results have important managerial implications for contract and incentive design in firms. We have reported a number of interesting and significant results, yet, we believe more can be shown with increased number of experiments.

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