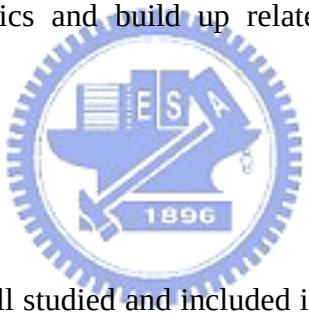
CHAPTER 1
INTRODUCTION

A return policy is one mechanism by which a retailer can prevent overstocking. In the process, the manufacturer's payoff converts from certain to uncertain. Early models of such return arrangements were characterized by an understanding that a retailer might request a manufacturer to buy back unsold goods. In turn, the manufacturer, to compensate for his or her increased costs, would charge higher wholesale prices. However, these studies have either focused on optimization from the retailer's perspective only, or ignored the fact that the manufacturer might have no incentive to accept returns. The dissertation will focus on three main topics and build up related models though game theoretic approach.



1.1 Motivations

Return polices have been well studied and included into many research streams, such as supply chain decentralized problem, manufacturer's returns-quantity discount strategy and integrated returns-quantity discount contract. However, these studies ignore the problem that a manufacturer might have no incentive to accept returns that will cause the model fail to implement in business deal. This study will extend the traditional return contracts with generalized scenario to overcome the drawback.

Decentralized problem is common in supply chain. The system serves an uncertain market demand that is the general experience in the competitive environment. That is, the actual demand at a specific due date is unpredictable. Therefore, the manufacturer's quantity setting at the outset of production is quite important. If the determined quantity is

too large, the deterioration cost might be enormous. However, shortage will occur if the determined quantity is insufficient. Differently, due to the benefit from the manufacturer's overproduction at no immediate cost, the retailer has the incentive to initially over forecast but eventually purchase smaller quantity. The manufacturer must in turn anticipate the outcome, particularly when a return policy is in place. If the manufacturer and the retailer make decisions independently, a rational manufacturer will determine the production quantity by maximizing his profit within both production cost and wholesale price. Thus, the market often suffers the shortage. If the manufacturing lead time is sufficiently short, the retailer can match the demand by employing backup but at an extra premium to compensate for overtime production cost. If the lead time fails to permit backup, then the retailer and manufacturer should absorb the market loss. In this study, the lead time is assumed to be insufficient for backup to occur. This results in an inefficient supply chain and is referred to as decentralized control (cf. Iyer and Bergen 1997, Lee 1999, and Tsay 1999). Tsay (1999) proposed an efficiency benchmark deemed central control, where the retailer and manufacturer are coordinated by a single entity and therefore the system is able to deliver the maximum expected profit. In this study, an option premium incentive will be proposed to resolve the dilemma of a decentralized supply chain.

Manufacturer's returns-quantity discount strategy is an interesting problem recently. Quantity discounts have been offered in industries for years and sellers, including manufacturers and wholesalers, use them to entice their customers to purchase more volume or as a response to competition. While the retailer generally has the right to return unsold inventory to the manufacturer within the wide category of products facing uncertain retail demands. Early research proposed a menu of alternative return policies since manufacturers might have difficulties implementing a particular return policy with a mix of retailers that differ in risk aversion, competitiveness, and skepticism. Although the menu

includes options with more generous return privileges coupled with higher wholesale prices, no analytic model is proposed to verify the alternatives. This study develops a two-stage game theoretic model that can fulfill the gap.

Integrated returns-quantity discount contract is implemented frequently in daily business. Early researches of return contract construct model were characterized by an understanding that a retailer might request a manufacturer to buy back unsold goods. In turn, the manufacturer, to compensate for his or her increased costs, would charge higher wholesale prices. However, they ignored the fact that the manufacturer might have no incentive to accept returns. Quantity discount is used as a tool by a manufacturer to induce a retailer to purchase a greater volume of goods to earn a reasonable profit, without increasing the buyer's cost. That is, the manufacturer might have an incentive to join a returns contract when a retailer agrees to purchase higher volume. Returns-quantity discount contract can thus satisfy the self-interest of both retailer and manufacturer, and be a self-enforcing scheme. Notably, when quantity discounts are proposed in the returns contact, the wholesale price should be determined by consideration of not only the buyback price but also the quantity discounts that can result from higher purchase volume. This study deals with a general situation in which both a retailer and a manufacturer can satisfy their interests in a business deal.

1.2 Objectives

The purpose of this study is to develop new schemes that can give the manufacturer incentive to accept return contract. The scheme should give a manufacturer benefit when accept returns while don't hurt the retailer at the same time. That is, "win-win" condition should be achieved in the business channel. This study will discuss three scenarios of return contracts and develop analytic models which give a manufacturer better

understanding when deal with the return contract. First, this study emphasizes the manufacturer's self-interest and optimizes the production quantity. Furthermore, we demonstrate that in comparison to centralized model, decentralized control causes an insufficient supply chain. That is, implementation of a centralized model results in extra profit and Pareto efficiency. However, in the centralized model, production quantity must be increased, which in turn decreases the manufacturer's profit. Hence, without compensation, a manufacturer will have no incentive to accept such a contract. As a result, we propose that a retailer should offer an option premium to induce a manufacturer to increase the production quantity. This, while not affecting the manufacturer, will increase the retailer's profit, and thus result in extra profit as a whole. This study also demonstrates that when the option premium incentive is applied to a decentralized supply chain, the Pareto efficiency obtained will equal that of a centralized model.

Second, this study addresses how manufacturers can design a quantity discount scheme and a return policy to achieve channel efficiency. When the supply chain includes return policies, owing to the right to return unsold goods, retailers are encouraged to increase ordering quantity. Therefore, traditional quantity discount schemes must be modified to maintain an efficient system. The whole scenario will be modeled by a two-stage game. At stage one, the manufacturer and retailer determine the inventory level cooperatively; therefore at this stage there is a Nash-Cournot equilibrium. The optimum inventory level is achieved by maximizing the joint profit. At stage two, the manufacturer bargains with the retailer for quantity discount and return schedules to maintain channel efficiency. The results of the second stage depend on the inventory level determined in the first stage and the solution concept for the whole game is subgame perfection.

Finally, the present study presents an integrated inventory model that incorporates contracts involving both returns and quantity discounts such that the retailer can return to secure risk, and also manufacturers has incentive to accept returns. We investigate each party's preferences with respect to the contract parameters, and define when system efficiency can be achieved according to a three-stage theoretical model. At the first stage, the retailer requests that unsold goods be returned, and the manufacturer then responds with a higher wholesale price to accept the returns. The relationship between returns price and quantity discounts will be identified in this stage. The lowest wholesale price comes with very strict feasibility on return, and a restocking fee for any returned goods. Otherwise, a higher wholesale price can result from the most liberal return policy. Based on the relationship of the returns price and quantity discounts made at the first stage, a manufacturer designs adequate incentive schemes to entice the buyer to change ordering decisions in the second stage. According to the proposed model, the retailer's optimal ordering quantity will increase, and channel coordination is attained. Finally, at stage three, the manufacturer and the retailer bargain to share the system gains that result from the channel corporation in the second stage.

1.3 Organization

The rest of this paper is organized as follows: Section 2 reviews the related research. Section 3 presents the problems of supply chain decentralized, an option premium incentive will be proposed to resolve the dilemma of a decentralized supply chain. In Section 4, we explore manufacturer's returns-quantity discount strategy, a menu of discount-return combinations will be proposed for the manufacturer to make inventory decisions. Section 5 discusses integrated returns-quantity discount contract, a three-stage

theoretic model will be developed to meet both retailer and manufacturer's interest. Section 6 contains a conclusion. The structure of the study can be illustrated in Figure 1-1.

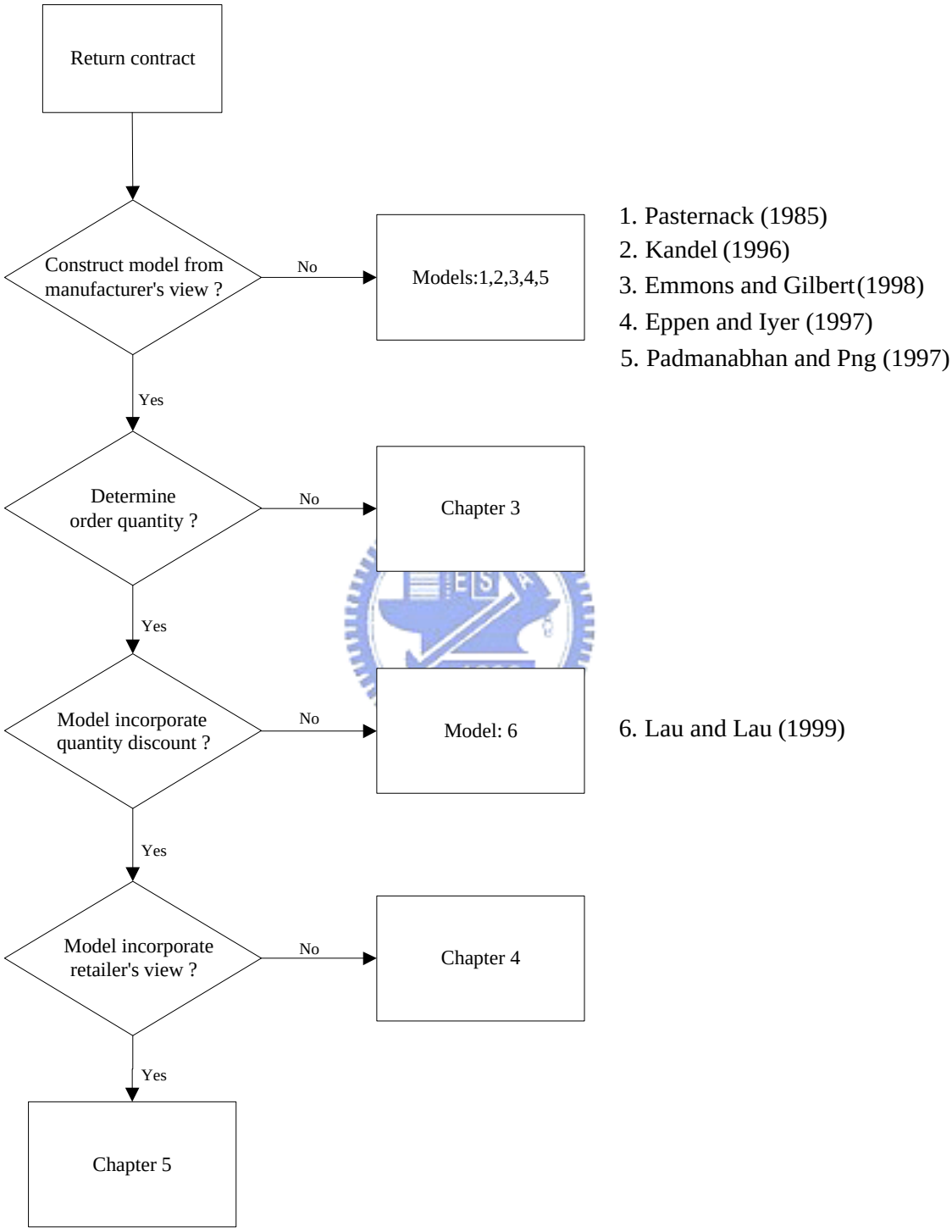


Figure 1-1: Structure of the study