Chapter 2

Literature Review

2.1 Trade credit financing

Several interesting and relevant papers related to trade credit financing exist in the literature. The literature review of this section is related to chapters 3 to 6. Goyal [46] analyzed effects of trade credit on the optimal inventory policy. Chand and Ward [16] analyzed Goyal's [46] problem under assumptions of the classical economic order quantity model, obtained different results. Chung [23] developed an alternative approach to determine the economic order quantity under the condition of permissible delay in payments. Aggarwal and Jaggi [2] considered the inventory model with an exponential deterioration rate under the condition of permissible delay in payments . Chung et al. [25], Chu et al. [22] and Shinn et al. [101] extended GoyaPs [46] model to accommodate more real situations of deterioration of units in an inventory system. Jamal et al. [61] and Chang and Dye [17] further generalized the model with shortages. Chung [24] obtained an alternative method to modify Shah's [97] solution. Jaggi and Aggarwal [59] developed the trade credit financing in economic ordering policies of deteriorating items. Many related articles can be found in Hwang and Shinn [56], Jamal et al. [62], Arcelus et al. [6], Abad and Jaggi [1] and Chang [19], Chung et al. [30], Chung and Liao [29] and their references. Chung and Liao [28] developed the economic order quantity for exponential deteriorating items under permissible delay in payments depending on the ordering quantity. There were several interesting and relevant papers related to the delay of payments such as those by Arcelus and Srinivasan

[5], Chung and Huang [27], Ouyang et al. [82], Khouja and Mehrez [63], Kim et al. [64], Salameh et al. [92], Sarker et al. [93,94], Shinn [100], Salameh et al. [92], Song and Cai [103], Teng et al. [108], Jaber and Osman [58] and their references.

In all of the above models, researchers assumed that the supplier would offer the retailer a delay period but the retailer would not offer the trade credit period to his/her customers. But in two-level (two-echelon) trade credit financing, supplier offers a credit period to retailer and the retailer in turn offers credit period to his customers. Huang [53] extended Huang's [52] model to investigate the retailer's inventory policy under two levels of trade credit and limited storage space. Haung [54] incorporated Chung and Haung [26] to investigate the two-level trade credit policy in the EPQ frame work. Ho et al. [51] developed an integrated supplier-buyer inventory model with the assumption that demand is sensitive to retail price and the supplier adopts a two-part trade credit policy. Haung and Hsu [55] have developed an EOQ inventory model under two-level trade credit policy by incorporating partial trade credit option to the customers of the retailer. Liao [73] developed an EOQ model with non-instantaneous receipt and exponentially deteriorating items under two-level trade credit financing. Jaggi et al. [60] have developed a simple EOQ model in which the retailer's demand is linked to credit period. Tsao [111] developed an EOQ model under advance sales discount and two-echelon trade credits. Teng and Chang [109] extended the Haung's [54] model by relaxing the assumption $N < M$.

2.2 Delay product differentiation process

Delay product differentiation process is nothing but a customization process which can be delayed after ordering. It may also be called postponement. Many models have been developed to evaluate the cost effectiveness of postponement strategy [7,34,38,39,69,71,74,89, and 104]. They evaluated the benefits of applying postponement strategy in stochastic settings. Recent deterministic models with postponement strategy include those by Wan et al. [113, 114] and Li et al. [72]. The literature review of this section is related to chapter 7.

2.3 Logistics models under stochastic and fuzzy environments

The literature review of this section is related to chapters 8,9 and 10. One of the oldest papers in the field of continuous review multi-echelon inventory systems is a basic and famous one written by Sherbrooke [98] in 1968. He assumed $(S-1, S)$ policy (where S is reorder level) in a Depot- Base system for a repairable item in the American air force and approximated the average unit years of inventory and stockout in the bases. Continuous review models of multi-echelon inventory systems in 1980's concentrated more on repairable items in a Depot-Base system than on consumable items. For example Graves [43] worked on determining stocking levels in such a system, Moinzadeh and Lee [75] considered the issue of determining the optimal order batch size and stocking levels at the stocking locations by using a power approximation. Lee and Moinzadeh [66] generalized previous models on multi-echelon repairable inventory systems to cover the cases of batch ordering and batch shipment. Forsberg [35] developed the exact evaluation for (R, Q) policies in a two level inventory systems with Poisson demand. On consumable items, Deuermeyer and Schwarz [33] proposed a simple approximation for a complex multi-echelon system (one warehouse and multiple retailers) assuming backordering of unsatisfied demands in all installations with a batch ordering policy. Svoronos and Zipkin [105] proposed several refinements on the later paper by considering a second -moment information (standard deviation as well as mean) in their approximations.

In 1990s Axsäter [8] provided a simple recursive procedure for determining the holding and stockout costs of a system consisting of one central warehouse and multiple retailers with $(S-1, S)$ policy, independent Poisson demands in the retailers, backordered demand during stockouts in all installations and constant lead times. Axsäter [9] proposed exact and approximate methods for evaluating the previous system for the case of a general batch size in all installations but with identical retailers. For the case of non-identical retailers and a general batch size, Axsäter [10] proposed methods for the exact evaluation of two retailer's case and approximate evaluation for the case of more than two retailers. The common assumptions of the above papers are that demand during stockout in the retailers is backordered. However, on some conditions

demands may be lost. Anderson and Melchiors [4] have proposed an approximate method for the case of lost sales when inventory control policy is (5 — 1,5) in all installations (one warehouse and multiple retailers) and unsatisfied demands are lost in the retailers. Axsater [11] has developed an approximate method for a two-level distribution inventory system with normal approximations both for the retailer demand and the demand at the warehouse, i.e., the orders from the retailers. In 2005, Axsater [12] has developed a decentralized two echelon inventory control for the previous case. In 2006, Mehdi Seifbarghy and Akbari Jokar [96] have proposed an approximate method in the case of general batch ordering policy in all installations with lost sales in the retailers. Hill et al. [50] considered a two echelon inventory model with $(SQ,$ (5 — 1 $)Q)$ policy at the warehouse and continuous review (R,Q) policy with lost sales at the retailers. Olsson and Hill [80] developed an inventory model with number of retailers which operate under base stock policy and supplier functions as an $M/D/1$ queue.

Most research such as Cohen and Lee [31], Lee and Billington [67, 68], Newhart et al. [79], Thomas and Griffin [110], Vidal and Goetschalckx [112], Beamon [14], Graves and Willems [44], Goetschalckx et al. [42], Min and Zhou [76] and Chen and Paulraj [21] have modeled the supply chain uncertainty (e.g., uncertain demand) by probability distribution that is usually predicted from historical data. All these researches have developed under deterministic or stochastic environment. However, whenever statistical data is unreliable or even unavailable, stochastic models may not be the best choice. Fuzzy set theory (Klir and Yuan, [65]) may provide an alternative approach for dealing with the supply chain uncertainty. Little research such as those by Petrovic et al. [85, 86] and Giannoccaro et al. [41] have applied fuzzy set theory in the area of supply chain management.

2.4 Literature gaps

To the best of our knowledge, we found some of the gaps in the literature as below.

1. There is no inventory model for a supply chain system which incorporates both EPQ model and partial trade credit financing at the retailer under two-echelon

trade credit scenario.

2. There is no supply chain model with partial trade credit financing at the retailer under the following conditions:

   (a) the demand is sensitive to selling price as pricing is an obvious strategy to influence demand.

   (b) the retailer can have two-warehouse facility in order to store more purchased items;

   (c) the selling items are perishable such as fruits, fresh fishes, gasoline, photographic films, etc;

3. No inventory model, in the literature, dealt with both the Advance Payment (AP) scheme and two-echelon trade credit option in a supply chain with perishable items.

4. There exists no logistic model, with perishable items, in which demand depends on both selling price and credit period (between retailer and customers) under two-echelon trade credit financing.

5. No research work exists for studying the interaction between inventory and delayed product differentiation process in a supply chain with the flow of non-instantaneous deteriorating items and partially backlogged shortages.

6. There is no two-echelon supply chain model with stochastic lead times for the supplier's orders at the warehouse under (R, Q) replenishment policy and Poisson demand.

7. There is no two-echelon supply chain model with partial backordering of shortages and Poisson demand.

8. There is no continuous review supply chain model in a fuzzy environment.

The above said literature gaps 1,2, ... ,7 and 8 are carried out in chapters 3,4, ..., 9 and 10 respectively.