# Inventory Control by Using Speculative Strategies in Dual Channel Supply Chain

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**ABSTRACT**
This paper investigates how to control cost of inventory by analyzing the impact of speculation in a dual-supply chain. Manufacturers' exploit both traditional channel and direct channel independently to deliver goods. A four view Markov chain model was used to formulate total cost performance, with replenishment of inventory in accordance to Poisson process. Our numerical calculations divulge these findings, in the long run; (i) increasing speculation with increasing foreign search rate, rises warehouse lost sales (ii) increasing speculation, increasing local and foreign search rate with increasing total cost components results in holding cost diminishing aiding collapse of manufactures' product, (iii) as local, foreign or both search rate increase; (a) holding cost at warehouse and retailer remains constant but diminishes in its percentage contribution to total cost, (b) lost sales cost at warehouse keeps rising, and (c) our proposed two-echelon dual-supply chain may perform better than single supply chain, and (iv) increasing local and foreign search rate against increasing total cost components, escalate total cost. According to the authors, the issue at hand is: speculation impact on total cost not only creates opportunities for manufacturers to expand their products and gain profit but also produces a hazardous side-effect for it can collapse the product.

Keywords: Dual-supply Chain, Speculation, Inventory Cost, Markov Chain

## 1. Introduction

Friedman et al. defined a speculator as one who invests with the anticipation that an event or series of event will occur to increase the value of the investment [1]. For example, if the value of a product (stock, textiles, fashion goods, luxurious product, food stuffs etc.) has being appreciating rapidly in recent times, a speculator will purchase several units in anticipation that the appreciation of the value will continue. The motive behind financial speculation is to secure capital gain (arbitrage) simply by buying cheap, holding and then selling the product at higher price. The activities of speculators leads to several market sways like: (i) collapsing a product market, Pornchokchai & Perera, (ii) destabilizing market prices [2], Chang et al., (iii) exerting a stabilizing influence on markets [3], Friedman, (iv) have no impact on marker volatility [4], Radalj, Du and Kaufmann using different strategies, (v) devaluing a nations' currency and collapsing its exchange rate regime [5-7]. This paper researches on the speculation impact of total cost of inventory.

Some research have touch on financial constraint (firms having internal capital constraint: i.e. not having sufficient capital to install the ideal inventory level) on supply chain. Pires examines the impact of financial constraint on the choice of supply chain modes and constraint base on stackelber game [8]. Li studied multi-item IRP model with considering lateral transhipment and financial decisions is proposed as a business model in a distinct organization [9].

Buzacott and Zhang investigate a firms optimal production decision in multiple period with financial constraint and asset-based financing [10], Berman et al. studied on how operational decision of a firm manager depends on his/her own incentives, the capital structure, and financial decision in the context of the newsvendor framework [11] and Xu explained that facing bankruptcy risk due to demand uncertainty, a newsvendor-like firm will reduce inventory investment under capital constraint [12]. This paper differ from all these

paper in these areas; (i) it considers a two-echelon dual-channel supply chain under two different market segments, (ii) speculators' speculation on manufacturers products originates from foreign market, and (iii) no financial constraint.

There are several researches on dual supply chain: Chiang and Park examined a price-competition game in a dual channel supply chain [13-14], Yao considered a dual channel supply chain in which a retailer uses prices and services to attract customers [15], Lei et al. worked on return product after rework in a dual-channel supply chain [16], Huang et al. modeled a dual supply chain were manufactures action to operate direct channel is counteracted by retailers introducing their store brand products and others papers [17]. Zhao et al. proposed the commitment contracts for the drop shipping supply chain. In drop shipping supply chain, if the retailer's order quantity achieves decentralized level, the profit of the supply chain can be maximized [18].

To overcome these problems, Chaing & Monahan [19] proposed a two-echelon dual-channel inventory model in which stocks are kept in both manufacturer warehouses (upper echelon) and retail stores (lower echelon); furthermore, the product is available in two supply channels, namely a traditional retail store and an internet-enabled direct channel. According to their findings, the dual-channel strategy outperforms the other two channel strategies in most cases; additionally, the cost reductions realized by the flexibility of the dual-channel system may be significant in some cases. To further develop this model, Takahashi et al. [20] proposed a setup of production and delivery and created a new inventory control policy for the supply chain. In this paper, we intend to go beyond the proposals of Chaing & Monahan as well as the further developments of Takahashi et al. because we are aware that in times of stockout in either channel, customers search for options and cannot shift to the other channel, due to high direct channel demand of product coupled with speculation activities. Our goal is to create opportunities for manufacturers to expand their products and gain profit while preventing the hazardous side-effect of collapsing the product.

The rest of the paper is structured as follows. The subsequent section gives the model descriptions, assumptions and inventory control policy of two-echelon dual-channel supply chain. Next a Markov chain model and flow balance equation with its total cost performance measures are described and formulated. The following section presents the numerical calculated total performance under various conditions like speculators actions, demand variations, etc. the paper concludes with its findings.

## 2. Two-echelon Dual-channel Supply Chain Model

We discuss a two echelon dual-channel supply chain model (see figure 1) and its assumptions are:

1. Products are available to customer via two channels, a traditional and an internet direct channel; the traditional channel (serves local market) and the direct channel (serves foreign markets) is two different market segments;

2. The inventory at the retailer is used to satisfy the demand from traditional channel, and the inventory at the warehouse is used to satisfy the demand from the direct channel;

3. The product price is different for both channel and the system receives stochastic demand from two customers segment. Each customer segment has an independent demand arrival;

4. Demand through the retailer channel arrives in accordance with a Poisson process at constant rate $\lambda_r$ and is met with inventory at the retailer;

5. Demand through the direct channel arrives at the manufacturer directly in accordance with a Poisson process at constant rate $\lambda_d$ and is met through direct delivery with the inventory at the manufacturer. The inter-arrival time between successive demand follows an exponential distribution with mean 1/ λ;

6. The total demand arrival rate is λ (=$\lambda_r$ +$\lambda_d$), in a 1:2 ratio (i.e. $\lambda_r$ =1: $\lambda_d$ =2). The traditional channel preference is $\alpha$, so $\lambda_r$ = $\alpha\vartheta$ and that of direct channel is $\beta$, so $\lambda_d$ = $\beta v$; Backorders are not allowed, implying backorders equals zero;

7. The lead time from releasing an order to starting inventory replenishment to make up for

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