



# Optimal pricing for group buying with network effects<sup>☆</sup>



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## ABSTRACT

In this paper, we analyze online group-pricing mechanisms for sellers and compare them with the option of selling only to individuals. We formulate the demand for group buying and individual buying (GB and IB, respectively) based on the utility a consumer attains from each environment considering two specific types of externalities unique to our problem. First, we assume that consumers receive positive “network effects” from GB, i.e., they obtain utility from shopping with others because of information exchange and collective support. Second, they encounter a negative externality of group buying because of inconvenience costs and delays in receiving the products. The two types of externalities lead to distorted demand, which in turn affects prices and profits. We analyze the optimal and equilibrium strategies for a seller operating in monopoly, duopoly, and multiple-firm competition. We derive the equilibrium strategies and show the existence of a Nash Equilibrium under competition of multiple firms. In addition, we show that positive network effects from group buying often outweigh the negative externalities arising from costs.

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## 1. Introduction

*Social buying* or *group buying* (GB) is a form of selling that allows consumers to pool their purchasing power to buy goods at lower prices. GB is not a new concept; in fact, consumers have gathered to bargain over quantity discounts for a long time going back in history. Originating from the idea of a consumer cooperative [29], group buying re-emerged with advancements in electronic commerce and online networks. However, online platforms specifically dedicated to selling goods of multiple sellers to individuals seeking bargains have become popular within the past decade. Some financiers regard GB as one of the Internet's most innovative consumption opportunities [13], and examples of companies operating with GB format are increasing in the U.S.; well-known examples include Groupon, Eversave, Living Social, Amazon Local, and Tippr. Groupon, the most well-known example of GB, had more than 142.87 million subscribers in 2014 (<http://www.statista.com/topics/824/groupon/>), with \$2.573 billion (2013) in revenue. Given the growing pace, an increasing number of scholars have started taking interest in studying how and when group-buying mechanisms work.

GB differs from individual buying (IB) in several ways. First, a positive “network effect” arises in GB environments when buying with friends and family because of information exchange, affirmation of choice, and lower cognitive load when deciding what to buy. The presence of other buyers in shopping instances is known to enhance utility of a consumer [22]. Second, there is some inconvenience inherent in buying with others, such as delays in manufacturing or limited product selection. Groupon, for instance, often announces restrictions on which items and how many units of them can be purchased, in addition to setting an expiration date when goods or services purchased can be claimed. The extent to which such inconveniences exist may rise proportionally to the popularity of a product and demand. Third, the existence of a minimum order threshold separates GB from IB. Sellers may set a minimum purchase threshold to activate a sale, which is also known as the packet (group) size. When demand is lower than the packet size, consumers cannot activate the channel of purchasing via GB.

This study focuses on group and individual selling options of a seller and identifies (i) the optimal selling strategy for a monopolist and (ii) the equilibrium selling strategies for competing sellers. We investigate whether sellers find it optimal to offer products via GB or IB and how offering a GB option influences the pricing and profits of firms. In particular, this study addresses the following questions: What is the impact of positive network effects and cost of inconvenience of buying through the GB

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mechanism? What is the optimal strategy for a monopolistic seller and for competing sellers when deciding to go either the GB or the IB route? What are the conditions under which a pure GB, a pure IB, or a mixed strategy is the most appropriate?

Our goal in the current study is to advance the understanding and application of group-buying mechanisms by explicitly accounting for the utility from shopping with one's social circle. In line with this goal, we consider the distinguishing features of this study to be the two externalities that arise in a GB environment, i.e., network effects and cost of inconvenience, which are often not present when consumers buy on their own. Our model explicitly incorporates how firms, considering the network effects in group-buying environments, should make pricing and selling strategy decisions. Group buying has been cited as a tool facilitating price and quantity discounts [2]. However, this aspect is little understood and modeled by existing studies. We develop a stylized model to capture the consumer's utility from shopping with others and price discounts, as well as the seller's benefit from selling to an extended consumer base.

We find that indeed the network effects play a significant role in determining the optimal strategy in a group environment. In particular, when the positive network effects from participation are higher relative to the cost externality, a firm is more likely to favor the GB strategy over the IB strategy. In some cases, the negative impact of inconvenience in buying within a group may surpass the positive network effect of buying with a social circle. Under such circumstances, the seller may be forced to sell only to individuals. In addition, when selling under IB is less advantageous because of procurement cost or spot-selling operation cost, firms may prefer a pure GB strategy. We extend the analysis to identify the best strategy under competition and show that a pure-strategy equilibrium exists when multiple firms compete.

While exploring a new price-discounting mechanism is the main intention of this study, the wide commercial applications of group buying provide a second motivation for our undertaking. The emergence of e-commerce has triggered many new and thought-provoking Internet-based sales models (e.g., eBay.com and Amazon.com), differential pricing, and price discrimination applications. GB embraces price discrimination characterized by quantity and time [1,26]. On the one hand, it allows consumers to aggregate demand and pool together buying power to bargain for lower prices. On the other hand, it allows firms to steer customer demand away from a competitor, save on costs per consumer, expand market share, and speed up their capital turnover.

The rest of the paper is organized as follows. In Section 2, we provide a detailed summary of the literature relevant to our study. Section 3 defines the utility function and derives the demand function and optimal pricing schedule for IB, GB, and a mix of both (MIX) strategies. We also compare the three strategies for a monopolist. In Section 4, we extend the base model to address competition and to determine the equilibrium strategy that allows pure and mixed strategies to be adopted. Section 5 conducts a computational study to verify the insights derived in this research. The concluding remarks are given in Section 6.

## 2. Literature review

This study contributes to three streams of literature: group buying, price discrimination and quantity discounts in sales, and social influence of others in shopping environments. We discuss the relevant literature in each of these areas next.

### 2.1. Group buying

Motivated by the growing attention on group-buying platforms, such as Groupon, Living Social, and Amazon Local, an increasing number of researchers have shown interest in understanding what motivates sellers and buyers to participate on these platforms. A number of demand and supply side reasons have been cited for the emergence of GB platforms. First, on the supply side, it is widely acknowledged that selling to a large number of consumers allows for flexible pricing [23,32], which facilitates the clearing of excess inventory [11,30]. Second, quantity discounts facilitate transaction efficiencies when larger orders are processed and shape the incentives of a seller in a vertical channel [2,19,28].

Third, GB allows for managing uncertainty in demand. The heterogeneity of buyers' purchasing power and willingness to pay may limit a seller's market share, and the well-promoted temporary price discounts may benefit sellers. For instance, the seller may be motivated to sell off-season items at a discounted price. When such temporal fluctuations in price are anticipated by the consumers, it is well-known that a post-promotional price dip may follow the event, resulting in lowered sales. More innovative and less anticipated mechanisms for conducting price and quantity discrimination are welcome from the seller's perspective. Group buying offers one such alternative, and in fact, Anand and Aron [2] find that group selling, despite production delays, is a better strategy than the posted-price mechanism under scale economies of production. Wang, Zhao and Li [30] also provide an extensive discussion of why consumers and sellers engage in group buying and highlight the benefits to the sellers as building awareness and enhancing customer acquisition.

### 2.2. Price discrimination and price discount

Chen and Roma [10] focus on the price discounts facilitated by GB within a single channel. They model the customer gains from price discounts and develop the conditions under which a retailer might prefer to follow GB or IB strategy. Kauffman and Wang [17] provide an econometric model to study changes in the number of orders for MobShop-listed products. They find that the number of existing orders has a significant positive effect on the number of new orders, indicating the presence of a positive *participation externality effect*, which provides a basis for our model. Unlike our study, which provides a theoretical comparison of GB and IB, they empirically analyze the strategy of a single retailer. Then again, Kauffman, Wang [18] examine the characteristics and competitiveness of a variety of Internet-based selling strategies, including GB, from the perspectives of customer behavior, dynamic pricing, and sustainability.

Similarly, a growing number of scholars have focused on the demand-side reasons for group buying and investigated what motivates consumers to purchase in groups.<sup>1</sup> Anand and Aron [2] emphasize that there are several economic and theoretical underpinnings of group-buying mechanisms, such as quantity discounts and augmented buyer bargaining power.

### 2.3. Social influence

More recent research extends the benefits of group buying to include the psychological effects and cite the presence of others in shopping occasions as providing utility (e.g., [24,9,7,15,6]). Shopping with others and the influences of peers, family, and friends have been well documented in consumer psychology literature,

<sup>1</sup> Anand and Aron [2] provide a survey of the existing mechanism on group buying. Readers are referred to this paper for a comprehensive review.

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