北京大学中国经济研究中心
China Center for Economic Research

讨论稿系列
Working Paper Series

NO.E2005008 2005-12

Discount Store

Hao Wang*

NO. E2005008 December 2005

- Hao Wang thanks the financial supports from the "211 project" of Peking University.
- Mail Address: China Center for Economic Research, Peking University, Beijing 100871, P. R.China.
- Telephone: 86-10-6275-8934. Fax: 86-10-6275-1474. Email: hwang@ccer.edu.cn

Discount Store

Hao Wang*

NO. E2005008   December 2005

Abstract: A retail store can profitably commit to the lowest prices because that allows it to take significantly greater market share. If a discount store acquires a competing convenience store, the average retail price tends to go up. When the upstream market is oligopolistic, the discounter can exert buyer power in the upstream market and thus earn even more profits. That also allows the discounter to lower its competitors' profit margins and sales. The average retail price goes down because the buyer power leads to more sales through the discounter. However, the consumers as a whole may not better off, and the social welfare decreases.

Keywords: Buyer power, Channel fees, Countervailing power, Discount store

JEL Classification: L1, L4, M2, M3

- Hao Wang thanks the financial supports from the "211 project" of Peking University.
- Mail Address: China Center for Economic Research, Peking University, Beijing 100871, P. R.China.
- Telephone: 86-10-6275-8934. Fax: 86-10-6275-1474. Email: hwang@ccer.edu.cn

1. Introduction

An important development in retailing industries in the last few decades is the polarization of store sizes. Large-scale discounters and small convenience or specialty stores were squeezing traditional mid-sized general retailers out of the marketplace (Griffith and Krampf (1997)). Particularly, the "big-box" retailers, like Wal-Mart, Carrefour, Home Depot and Tesco, are taking increasing market shares in the industries. A usual economic measure of market power is the Lerner Index: firms with greater Lerner Index are often viewed having greater market power. But in retail industries, the biggest players often offer lower prices, or even lower profit margins than their competitors. According to Yahoo! Finance (June, 2005), the gross profit margins of four competing supermarket companies are: Kroger 24.12%, Albertson's 28.03%, Safeway 29.36%, and Wal-Mart 22.99%. Wal-Mart, which is the largest retailer on earth, actually has the lowest gross profit margin. From this perspective, Lerner index does not appear to be a good measure of retailer market power.

Then how exactly the large retailers exert their market power? If exerting retailer market power leads to lower market prices, maybe the accumulation of retailer market power is desirable, particularly for consumers. Indeed, Galbraith (1952) suggests that the market power on one side of a market "*create an incentive to the organization of another position of power that neutralizes it*" (page 119). A demonstration of countervailing power suggested by Galbraith is the large retail organizations such as the major chain stores. By exerting the countervailing power, these retailers are able to obtain lower wholesale prices from the manufacturers and then pass the savings to consumers. The notion of "countervailing power" has been criticized by several economists (Whitney (1953), Stigler (1954), and Hunter 1958)), who argue that the powerful retailers do not have incentive to pass their cost savings to consumers. Hence the so-called countervailing power may not really exist. Probably influenced by the countervailing power theory, the competition authorities of the United Kingdom are largely impassive toward the increase in concentration in retail industry. However, the United States tends to be hostile to the mergers and acquisitions of large retailers. They take the view that the buyer power of large retailers allows them to obtain lower wholesale prices from suppliers, which constitutes a type of price discrimination that is illegal under Robinson-Patman Act of 1936 (Dobson and Waterson (1997)).

There was considerable interest in discount stores back to 1950s and 1960s, following the emergence of "discount house" during that period. For examples, Gilchrist (1953) finds "*some form of discount selling is inevitable so long as manufacturers follow resale price maintenance polices*," based on his interviews with 550 consumers, 20 discounters, numerous dealers, department stores, and distributors in Los Angeles; DeLoach (1962) discusses the principal factors causing the spread of discount pricing and the practical limitations on a continuous increase in the number of discount stores; Minichiello (1967) surveys the operation of discount food stores, based on the practices of three non-competing companies active both in food discounting and in conventional supermarket operations. Those studies are either conceptual or empirical discussion, but not theoretic analysis. The operation mechanism of discount stores is not rigorously analyzed in this stream of literature.

There are also substantial studies on "Every Day Low Price" or promotional strategies. For examples, Chakravarthi (1988) explores the equilibrium pricing strategies of branded products that enjoy a monopoly market protected from other firms and a common market in which every one competes. It is shown that a mixed-strategy equilibrium exists with the firms' prices randomizing over an interval, which constitutes a promotional strategy; Lal and Rao (1997) study the competition between two supermarkets to investigate the phenomenon of "Every Day Low Pricing" (EDLP). The two stores compete for two types of customers, time-constrained consumers and "cherry pickers," through their choices of advertising, price, and service. Consumers buy a basket of two products. It is shown that under certain conditions, one firm adopting a promotional strategy and the other adopting an EDLP strategy is an equilibrium, even when the EDLP store does not have a cost advantage. Nevertheless, those studies focus on strategic behaviors of individual retail stores, but not particularly on discount stores. They cannot explain the polarization of store sizes in modern retail industries either.

Studies of retailer market power in vertically separated industries often use monopoly-oligopoly models. In those models, manufacturer firsts negotiate wholesale contracts with retailers, and then retailers compete for consumers. The studies often relate to the "countervailing power" hypothesis. In von Ungern-Sternberg (1996), a supplier (Nash) bargains with several retailers who engage in Cournot competition. It is found that a decrease in the number of retailers leads to an increase in equilibrium consumer price. But if the downstream is perfectly competitive, the reverse is true because the average costs of the firms decrease with the number of firms. Dobson and Waterson (1997) consider a model with Nash bargaining in upstream market and price competition in downstream market. They show that when retailer services are regarded as very close substitutes, consumer price fall close to the competitive level and social welfare increase with the decline in the number of retailers in the market. This result is viewed as an evidence of countervailing power. But as commented by Chen (2003), this conclusion crucially depends on the assumption of linear pricing in wholesale. It is also pointed out that the model does not capture the feature of store size polarization in retail industries. Chen (2003) considers a monopoly-oligopoly where the downstream market has a price-setting dominant retailer and *n* price-taking fringe retailers. The supplier makes a take-it-or-leave offer to each of the fringe retailers, but negotiates with the dominant retailer over the transaction contract through two-person Nash bargaining. It is found that when the dominant retailer has stronger bargaining power, the supplier's share of the joint profits decreases. As a result, the supplier lowers the wholesale price to the fringe retailers in order to boost the sales through them. The fall in wholesale price results in lower retail price. Hence a stronger dominant retailer leads to lower retail price. This is exactly what the countervailing power theory suggests. Chen (2003) exogenously models a dominant retailer in order to capture the feature of store size polarization in retail market. But the model may not be able to represent the retail competition very well because of the assumption of price-taking fringe retailers.

In a monopoly-oligopoly model, since the upstream monopolist simultaneously bargains with all downstream retailers, it can maximize the industry profit first and then decides how to share the profit with the retailers. Otherwise the transaction contracts in the upstream market can be Pareto improved. The maximization of industry profit is often possible with two-part tariffs or more sophisticated schemes.[1] Hence in monopoly-oligopoly models, the

[1] For example, Winter (1993) considers a monopoly-duopoly model where the retailers can provide demand-enhancing services. In order to maximize the industry profit, the manufacturer needs to induce the optimal retail prices and service levels. It is shown that two-part tariffs and resale price maintenance can be jointly used to achieve the first best outcome for the manufacturer.

retail prices may often be the monopoly prices, which are independent to the retailers' market power. From this perspective, monopoly-oligopoly models may not be suitable for studying the effect of retailer market power on retail prices. It is thus desirable to use bilateral oligopoly models for this purpose.

This paper offers a theory to understand retailer market power. It explains the polarization of store sizes in retail industries. The theory also casts new insight into the countervail power hypothesis. In the model, manufacturers produce substitute products that are sold through downstream retail stores. Consumers, who have unit demands, are living in different residential areas. They incur some transportation costs when they move between two areas. There is a store located in each area. Among them there is a store that is able to commit to offering the lowest price in the market. This store, which is called discount store, describes the role of Wal-Mart, Carrefour or Tesco in the real world. The retail stores engage in price competition with spatial differentiation.

In Section 2 of the paper, I consider the case with competitive upstream manufacturers and oligopolistic downstream retailers. In this case, all retailers face the same wholesale price, which equals to the marginal production cost of the good. It is shown that the discount store takes significantly greater market share and earns more profits than the other stores. Intuitively, because the discounter offers the lowest price, all consumers who have low enough transportation costs would buy from the discounter. The discounter can thus sell much more than the other stores. From another perspective, the discount store competes with many convenience stores, while each convenience store only directly competes with the discounter. It is also shown that if the discounter acquires a competing convenience store, the average retail price tends to go up. Hence the accumulation of retailer market power is unlikely to be good to consumers. An interesting implication is that the store that offers the lowest prices may be exactly the one that drives retail prices up.

In Section 3, I consider the case where the upstream market is duopolistic rather than competitive. The configurations of consumers and store locations are the same as those in the previous model. I define "channel fees" as the fees that manufacturers pay retailers in order to encourage them carrying their products. Banning the use of channel fees, the retail prices reflect the "sum" of the degree of product differentiation and the degree of store location differentiation. That means greater retailer market power brought by greater degree of store location differentiation necessarily leads to higher retail prices. This result does not support the "countervailing power" hypothesis. If demanding channel fees are allowed, the discount retailer can exert buyer power in the upstream market through the fees.[2] The discounter is particularly interested in demanding channel fees that are positive related to sale volumes, because that allows it to raise the wholesale prices faced by the other stores and thus lower their profit margins and market shares. The discounter, on the contrary, achieves greater profit margins and market shares. Hence the channel fees of the discounter have exclusionary effect against the other retailers. This paper thus partially endorses the insight of Dobson (2005): "*…smaller retailers face increased price differentials from what might amount to a 'waterbed' effect in which low purchase prices for the major retailers force suppliers to*

[2] Based primarily on the grocery business in the United Kingdom, Dobson (2005) studies the buyer power of large retailers in grocery trade. Dobson finds that buying power in retailing arises from three roles played by retailers in relationship to suppliers: as the suppliers' customer (when purchasing and re-selling the suppliers' goods); as the suppliers' competitor (when developing own-brand substitutes); and as a supplier to their suppliers (in providing shelf and advertising space). Those roles may give a large retailer great buyer power in the upstream market.

charge higher prices to smaller retailers in order to cover fixed costs."[3]

The linear channel fees in the model raise the prices of the convenience stores but lower the prices of the discount store. The average retail prices decrease because more consumers buy from the discounter now. In this sense, we can say that the accumulation of retailer market power leads to an effect that is consistent with the "countervailing power" hypothesis—a discounter store passes the savings from lower wholesale prices to consumers. Notice that the critical circumstance for the "countervailing power" to arise is that the large retailer is a discounter and it faces competition from other stores. However, we cannot easily conclude that the consumers are better off with the channel fees. Since the low prices are available only in the discount store, the consumers as a whole have to pay higher transportation costs. The extra transportation costs may cancel out the consumers' savings from the lower average retail prices. Also because of the increased transportation costs, the social welfare decreases when the discounter exerts buyer power in the upstream market.

The "channel fee" defined in this paper has some similarity with the term of "slotting allowance", which has been substantially discussed in the literature. I use this new term because "slotting allowances" are typically recognized as lump sum fees only, particularly the one-time fees charged for introducing new products to retailers' stores.[4] The "channel fees" defined here need not be lump sum. Since slotting allowances are typically privately

[3] However, this paper shows that the suppliers would charge higher prices to smaller retailers even if their fixed costs were zero. Smaller profit margins from selling to large retailers actually push the suppliers to extract more out of small retailers. This mechanism works even without fixed costs.

[4] In the literature, a school of researchers argues that slotting fees help to improve the distribution efficiency of retailing industry (Kelly (1991), Chu (1992), Lariviere and Padmanabhan (1997) and Sullivan (1997)). It is argued that slotting fees can be used by manufacturers to signal the quality of newly introduced products, or by retailers to screen the products that are suitable for them to stock. Another school of researchers finds that requiring slotting allowances is an exercise of market powers by large retailers (Shaffer (1991)) or powerful manufacturers (MacAvoy (1997)).

negotiated, empirical data on those fees are scarce. It is actually difficult to tell whether the allowances are lump sum or not in practice. According to a survey by the National Food and Agriculture Policy Project (NFAPP), 74 percent of produce shippers indicated that the demand for various fees and services has increased in recent years. Volume incentives, promotional allowances, and other forms of rebates topped the list of fees demanded by retailers. All of these allowances are tied to the volume of sales and have been a customary form of business for many years (NFAPP #01-04). This survey implies that the fees paid to marketing channels are often positively related to the volume of sales.

2. The Model with a Competitive Upstream Market

Consider the market for a product in a city. The manufacturers of the product are perfectly competitive, which means all downstream retailers face the same wholesale prices equaling to the marginal production cost of the good. The city has n ($n \geq 2$) residential areas. Each area has one continuum of consumers. The consumers incur no cost moving within an area. A consumer's transportation costs of moving between any two areas are the same.[5] The consumers' inter-area transportation costs are evenly distributed on interval $[0,T]$. The consumers have unit demands with "high enough" reservation prices. Each area has a single store. Store j has constant marginal costs of s_j, where $s_1 \leq s_2 \leq ... \leq s_n$.[6] Denote the retail

[5] This assumption significantly simplifies the analyses. But it looks restrictive from geographic perspective. It can also be shown that the results of this paper hold when the assumption is significantly relaxed. As long as each consumer's transportation costs from his/her home to different other areas are comparable, the results still hold. I omit the details here. On the other hand, the assumption can be roughly satisfied if the consumers' transportation costs are less than proportional to geographic distances and the number of areas is not too large (say $n \leq 10$).

[6] The marginal costs include the wholesale prices and the store's marginal retailing costs. The wholesale prices are the same across the stores, but the retailing costs may not.

prices of the stores as $p_1,\ldots,p_n$. When there are only two stores, we have following equilibrium.

Proposition 1 *If n=2, there is a unique equilibrium with prices*

$$p_1^* = \frac{2s_1 + s_2}{3} + T \quad \textit{and} \quad p_2^* = \frac{2s_2 + s_1}{3} + T\,. \tag{1}$$

Proof: Given p_1 and p_2, $\frac{p_2 - p_1}{T}$ consumers of area 2 will shop at store 1. Hence the stores' profit functions are

$$(p_1 - s_1)(1 + \frac{p_2 - p_1}{T}) \text{ and } (p_2 - s_2)(1 - \frac{p_2 - p_1}{T})\,. \tag{2}$$

The first order conditions of the stores' problems are

$$p_1 = \frac{p_2 + s_1 + T}{2} \text{ and } p_2 = \frac{p_1 + s_2 + T}{2}\,. \tag{3}$$

Solve this equation system with respect to p_1 and p_2, we immediately obtain the equilibrium prices at stated in (1). *Q.E.D.*

We see that when n=2, the low cost store's price is $\frac{s_2 - s_1}{3}$ lower than the other store. It can be shown that the low cost store also earns more profit. The equilibrium of the market is structurally symmetric with respect to the marginal costs of the stores. However, this symmetry disappears when there are three or more stores.

From now on we consider the case where $n \geq 3$. Assume that the marginal costs satisfy $s_1 \leq s_2 = \ldots = s_n \equiv s$ in order to simplify the exposition. I also assume that store 1, who has the lowest marginal retailing cost, is able to commit to the lowest price. Due to this assumption, an immediate implication of the modeling is that stores $2,\ldots,j$ (directly) compete with store

1, but not with each other. Particularly, in area j, $j \in \{2,\ldots,n\}$, there are $\frac{p_j - p_1}{T}$ consumers who buy the product from store 1 rather than store j.

Proposition 2 *When $n \geq 3$, pricing strategy profile*

$$p_1^* = \frac{2s_1 + s}{3} + \frac{n+1}{3n-3}T \quad \textit{and} \quad p_j^* = \frac{2s + s_1}{3} + \frac{2n-1}{3n-3}T, \qquad j \in \{2,\ldots,n\}, \tag{4}$$

is the unique equilibrium strategy profile of the stores.

Proof: Since $p_1 < p_j$, $\forall j \in \{2,\ldots,n\}$, store 1 chooses p_1 to solve problem

$$\underset{p_1}{Max}\ (p_1 - s_1)(1 + \sum_{j=2}^{n} \frac{p_j - p_1}{T}). \tag{5}$$

Each store $j \in \{2,\ldots,n\}$ chooses p_j to solve problem

$$\underset{p_j}{Max}\ (p_j - s)(1 + \frac{p_1 - p_j}{T}). \tag{6}$$

The first order conditions of the stores' problems are

$$p_1 = \frac{T + \sum_{i=2}^{n} p_i}{2n-2} + \frac{s_1}{2} \quad \text{and} \quad p_j = \frac{T + p_1}{2} + \frac{s}{2}, \text{ for } j \in \{2,\ldots,n\}. \tag{7}$$

Solving this equation system, we have

$$p_1^* = \frac{2s_1 + s}{3} + \frac{n+1}{3n-3}T \quad \text{and} \quad p_j^* = \frac{2s + s_1}{3} + \frac{2n-1}{3n-3}T, \text{ for } j \in \{2,\ldots,n\},$$

which is exactly (4). It is easy to check that $p_j^* - p_1^* = \frac{s - s_1}{3} + \frac{n-2}{3n-3}T > 0$, for any $j \in \{2,\ldots,n\}$. This is consistent with the assumption that store 1 commits to the lowest price. Hence (4) describes the unique equilibrium pricing strategy profile of the stores. *Q.E.D.*

Corollary 1 *When $n \geq 3$, the retailers' equilibrium quantities of sale satisfy*

$$q_1^* \geq q_1^o \equiv \frac{n+1}{3} > \frac{2n-1}{3n-3} \equiv q_j^o \geq q_j^*, \ \ j \in \{2, \cdots, n\}. \tag{8}$$

The equilibrium profits satisfy:

$$\pi_1^* \geq \pi_1^o \equiv \frac{(n+1)^2}{9(n-1)} T > (\frac{2n-1}{3n-3})^2 T \equiv \pi_j^o \geq \pi_j^*, \ \ j \in \{2, \cdots, n\}. \tag{9}$$

Quantities q_j^o *and profits* π_j^o, $j \in \{1, 2, \cdots, n\}$, *are respectively the equilibrium quantities and profits when* $s_1 = s_2 = ... = s_n$. *All the inequalities hold strictly if* $s_1 < s$.

Proof: (See Appendix).

Proposition 2 shows that store 1 offers significant lower price than all the other stores. It thus attracts consumers from all those areas. This is a structurally asymmetric equilibrium. It is not difficult to prove that this model does not have a symmetric equilibrium even when all stores have the same marginal costs (I skip the details here). From Corollary 1 we can see that the equilibrium market share of the discount store is more than $\frac{1}{3}$, which is significantly greater than that of each other store. It is interesting that though the discount store offers significantly lower price, it earns more profit than the convenience stores. Hence committing to the lowest price is a profitable strategy of a retailer, even when all stores have the same marginal costs. However, there is only one store that can use this strategy in a certain region. This simple model explains why discount stores like Wal-Mart are so profitable. It also explains why other retailers can hardly duplicate Wal-Mart's strategy unless they are strong enough to credibly undercut Wal-Mart's low prices. Since stores 2, 3, …, n only serve their local customers, I call them convenience stores.

At mentioned in the last section, the antitrust authorities hold rather different views regarding the mergers and acquisitions in retail industries. It might be of interest to see what will happen if the discount store acquires a nearby convenience store. Now suppose that the discount store 1 acquires convenience store 2 and becomes a new store 1. The merged store is assumed to have the lowest marginal cost of s_1. We have following proposition and corollary. The proofs are put in Appendix.

Proposition 3 *If discount store 1 acquires convenience store 2, the equilibrium prices become*

$$p_1^{**} = \frac{2s_1 + s}{3} + \frac{n+2}{3(n-2)}T \quad \textit{and} \quad p_j^{**} = \frac{2s + s_1}{3} + \frac{2n-2}{3(n-2)}T, \ \textit{for} \ \ j \in \{3, \ldots, n\}. \tag{10}$$

And the equilibrium quantities of sales at the stores satisfy

$$q_1^{**} \geq \frac{n+2}{3} \quad \textit{and} \quad q_j^{**} \leq \frac{2(n-1)}{3(n-2)}, \ \ j \in \{3, \ldots, n\}. \tag{11}$$

The equilibrium profits satisfy:

$$\pi_1^{**} \geq \frac{(n+2)^2}{9(n-2)}T \quad \textit{and} \quad \pi_j^{**} \leq \left[\frac{2(n-1)}{3(n-2)}\right]^2 T, \ \ j \in \{3, \ldots, n\}. \tag{12}$$

The inequalities hold strictly if $s_1 < s$.

Corollary 2 *When* $s_1 = \ldots = s_n = s$, *we have*

(1) *The average market price increases with the merger;*

(2) *If* $n \leq 10$, *the merger is profitable in the sense that the post-merger profit of the merged firm is higher than the sum of the merging firms' premerger profits;*

(3) *The post-merger sale of the merged firm is less than the sum of the merging firms' premerger sales;*

(4) *The sale volumes of the non-merging stores increase.*

Proposition 3 implies that the retail prices satisfy $p_1^{**} > p_1^*$ and $p_j^{**} > p_j^*$, $j \in \{3, \ldots, n\}$. Hence the acquisition of a convenience store by the discounter increases the retail prices of all stores, though it may lower the price available in area 2. Corollary 2 shows that the merger allows the non-merging convenience stores to sell more at higher prices. The average retail price goes up conditional on all stores having the same marginal costs. In this sense, market concentration in retail industry is unlikely to be good to consumers. However, the change in average price also depends on the degree of cost saving caused by the merger. Indeed, if s_1 is much lower than s, it is possible that the merger leads to lower average price. Finally, recall that our model is more relevant when the number of areas is not too large. This is consistent with the result that the merger is profitable only when $n \leq 10$.

3. The Model with a Duopolistic Upstream Market

Based on the model of Section 2, in this section I assume that there are only two upstream manufacturers that produce substitute products. Denote the two manufacturers (as well as the two brands of the products) as *a* and *b*. Their marginal production costs are *m*. The consumers have unit demands with high enough reservation prices. Half of the consumers prefer each brand. If a consumer chooses her less preferred brand, her utility from the consumption decreases by *x*. The values of *x* across the consumers are evenly distributed on interval [0, *J*], where *J* is a positive parameter. The retailers cannot directly observe the consumers' preferences. The consumers' preferences over the two brands are independent to their location and transportation costs. The products are sold through n downstream stores 1, 2,…, n, which have marginal retailing costs of $s_1, s_2, ..., s_n$ respectively, with $s_1 \le s_2 \le ... \le s_n$. Suppose store 1 is a discount store that can commit to the lowest price in the market. In order to simplify the exposition, I assume $s_1 = s_2 = ... = s_n \equiv s$. It can be shown that the main results still hold if the discounter has strictly lower marginal cost than the other stores.

We initially discuss a benchmark game: *First, the manufacturers announce their wholesale prices, denoted as w_a and w_b respectively. Second, the stores order products from the manufacturers and determine their retail profit margins α_j, $j \in \{1,\ldots,n\}$.*[7] *Finally, the consumers enter the market and determine which store to go and which brand to buy.*

A feature of the model is that the equilibria of the upstream and downstream markets can be solved separately. In the downstream market, it is easy to see that if the wholesale prices satisfy $w_a - w_b \ge J$, the stores only carry product *b*; If $w_b - w_a \ge J$, the stores only carry product *a*; If $J < w_a - w_b < J$, the stores carry both products. I omit the discussion of the first two cases since it can be shown that they never occur in equilibrium. Following proposition describes the equilibrium of the retail market.

Proposition 4 *The equilibrium retail prices of the benchmark game are*

$$r_{a1}^* = w_a + s + \frac{n+1}{3n-3}T, \quad r_{b1}^* = w_b + s + \frac{n+1}{3n-3}T, \tag{13}$$

$$r_{aj}^* = w_a + s + \frac{2n-1}{3n-3}T, \text{ and } r_{bj}^* = w_b + s + \frac{2n-1}{3n-3}T, \; j = 2, ..., n. \tag{14}$$

---

[7] Thus the retail prices in store *j* are $r_{ja} = w_a + s + \alpha_j$ and $r_{jb} = w_b + s + \alpha_j$ respectively. Generally, each store should be able to choose two strategic variables α_{ja} and α_{jb} for the two products. I assume the stores use a simple rule with $\alpha_{ja} = \alpha_{jb} = \alpha_j$ in order to make the model tractable. This treatment is appropriate if the consumers can only perceive the overall price levels of the stores before they decide which store to go. In that case the stores do not have incentive to choose different profit margins for the two products.

Proof: The modeling implies that for each manufacturer's product, its prices in store i and j is differentiated by $\alpha_i - \alpha_j$. Given the profit margins α_j, $j = 1,...,n$, if the discount store 1 offers the lowest profit margin (or price), we would have $\frac{\alpha_j - \alpha_1}{T}$ consumers of area j, $j = 2,...,n$, buying from the discount store 1, no matter which brand the consumers prefer. Hence the profit function of the discount store is

$$\pi_1(\alpha_1) = \alpha_1(1 + \sum_{j=2}^{n} \frac{\alpha_j - \alpha_1}{T}). \tag{15}$$

And the other stores have profit functions of

$$\pi_j(\alpha_j) = \alpha_j(1 - \frac{\alpha_j - \alpha_1}{T}), \quad j = 2,...,n. \tag{16}$$

The first order conditions of the stores' maximization problems are

$$\alpha_1 = \frac{1}{2n-2}(T + \sum_{j=2}^{n} \alpha_j) \text{ and } \alpha_j = \frac{1}{2}(T + \alpha_1), \quad j = 2,...,n. \tag{17}$$

In equilibrium we have

$$\alpha_1^* = \frac{n+1}{3n-3}T \text{ and } \alpha_j^* = \frac{2n-1}{3n-3}T, \quad j = 2,...,n. \tag{18}$$

Obviously we have $\alpha_j^* > \alpha_1^*$, $j = 2,...,n$, which is consistent with the assumption that store 1 is the discounter. Hence (18) represents the unique equilibrium of the market, conditional on $\alpha_j > \alpha_1$, $j = 2,...,n$. *Q.E.D.*

In the upstream market, since the retail prices in store j are $r_{ja} = w_a + s + \alpha_j$ and $r_{jb} = w_b + s + \alpha_j$, for $j \in \{1, \ldots, n\}$, the price differentials of the two manufacturers' products are $w_a - w_b$ in all stores. Bearing this in mind, we can obtain the following proposition about the equilibrium wholesale prices. The proof is left in Appendix

Proposition 5 *The manufacturers' equilibrium wholesale prices are* $w_a^* = w_b^* = c + J$.

From Proposition 4 and 5, one can easily calculate the manufacturers' profits, which are $\pi_a^* = \pi_b^* = \frac{nJ}{2}$. One can also compute the retail prices as:

$$r_{a1}^* = r_{b1}^* = c + J + s + \frac{n+1}{3n-3}T \quad \text{and} \quad r_{aj}^* = r_{bj}^* = c + J + s + \frac{2n-1}{3n-3}T \ , \ \ j = 2,...,n \, . \tag{19}$$

This result shows that the overall competitiveness of the market depends on the degree of product differentiation as well as the degree of spatial differentiation of the stores. The configuration of the downstream sales and profits are similar to that in the last section. The sales of the stores are $q_1^* = \frac{n+1}{3}$ and $q_j^* = \frac{2n-1}{3n-3}$, $j = 2,...,n$, respectively, and the profits are $\pi_1^* = \frac{(n+1)^2}{9(n-1)}T$ and $\pi_i^* = (\frac{2n-1}{3n-3})^2 T$, $j = 2,...,n$, respectively. It can also be shown that the discount store would drive the market prices upward if it acquires a convenience store.

However, in the game discussed above, the discount store is not allowed to exert its "buyer power" in the wholesale market. This may be unreasonable since the discounter has rather significant market share (greater than a third in this model) in the wholesale market. To measure the buyer power of the discounter, it is helpful to consult the definition provided by Secretariat of OECD:

(A) retailer is defined to have buyer power if, in relation to at least one supplier, it can credibly threaten to impose a long term opportunity cost (i.e., harmful or withheld benefit) which, were the threat carried out, would be significantly disproportionate to any resulting long term opportunity cost to itself. (Supra note 8, OECD, 1998).

In our model, delisting a manufacturer's product causes the same percentage loss to all stores, which is between 0-50%, depending on the degree of product substitutability. However, given all other stores carrying a manufacturer's product, the discount store can bring significant percentage loss to the manufacturer if it delists the manufacturer's product, because it has substantial market share in the upstream market. But the convenience stores are unable to do that. Hence according to the definition of buyer power above, the discount store has much greater buyer power than the convenience stores in the upstream market.

There are many different ways for a discount store to capitalize its buyer power (Dobson (2005)). One of the important ones is requiring "channel fees" from manufacturers. Since the convenience stores have much weaker buyer power, I assume the convenience stores are unable to demand channel fees without loss of generality. Channel fees are often positively related to transaction volumes, but can be lump sum fees too. I will focus on the fees that are linear to transaction volumes.[8]

The game with channel fees is defined as: *First, the manufacturers announce their wholesale prices. As the same time, the manufacturers and the discount store negotiate over the terms of channel fees. Second, the stores order products from the manufacturers and determine their retail profit margins. At the same time, the manufacturers pay the channel fees to the discounter. Finally, the consumers enter the market and determine which store to go and which brand to buy.*

Suppose that the discount store demands δ per unit of channel fee for both products. Given the wholesale prices w_a and w_b , the retail prices of the two products are

[8] The linear channel fees can be viewed as one type of price discrimination. Under the Robinson-Patman Act of 1936, price discrimination can be illegal in the United States. But this Act can hardly be enforced in many situations. Channel fees are often demanded under the name of slotting allowances, which are viewed as legal in the United States so far.

$w_a - \delta + s + \alpha_1$ and $w_b - \delta + s + \alpha_1$ respectively in the discount store, and they are $w_a + s + \alpha_j$ and $w_b + s + \alpha_j$, $j = 2,...,n$, in the convenience stores. Note that the price differentials of the two products are $w_b - w_a$ within each store, and the price differentials between store 1 and store j are $\alpha_j - \alpha_1 + \delta$ for both products. These features make it easy to obtain following results. The proof of Corollary 3 is skipped since it is straightforward.

Proposition 6 *If the discount store is able to extract linear channel fee of δ per product unit from the manufacturers, the equilibrium profit margins of the stores are*

$$\alpha_1^{**} = \frac{n+1}{3n-3}T + \frac{\delta}{3} \quad \textit{and} \quad \alpha_j^{**} = \frac{2n-1}{3n-3}T - \frac{\delta}{3}, \quad j = 2,...,n. \tag{20}$$

The equilibrium volumes of sales are

$$q_1^{**} = \frac{n+1}{3} + \frac{n-1}{3T}\delta, \ \textit{and} \ \ q_j^{**} = \frac{2n-1}{3n-3} - \frac{\delta}{3T}, \quad j = 2,...,n. \tag{21}$$

The market share of the discounter in equilibrium is

$$k \equiv \frac{n+1}{3n} + \frac{n-1}{3n}\frac{\delta}{T}. \tag{22}$$

Proof: The profit function of the discounter is

$$\pi_1(\alpha_1) = \alpha_1(1 + \sum_{j=2}^{n} \frac{\alpha_j - \alpha_1 + \delta}{T}), \tag{23}$$

while those of the convenience stores are

$$\pi_j(\alpha_j) = \alpha_j(1 - \frac{\alpha_j - \alpha_1 + \delta}{T}), \quad j = 2,...,n. \tag{24}$$

The first order conditions of the profit maximization problems are

$$\alpha_1 = \frac{1}{2n-2}[T + \sum_{j=2}^{n}\alpha_j + (n-1)\delta] \quad \text{and} \quad \alpha_j = \frac{1}{2}(T + \alpha_1 - \delta), \quad j = 2,...,n, \tag{25}$$

respectively. Hence in equilibrium we have

$$\alpha_1^{**} = \frac{n+1}{3n-3}T + \frac{\delta}{3} \quad \text{and} \quad \alpha_j^{**} = \frac{2n-1}{3n-3}T - \frac{\delta}{3}, \quad j = 2,...,n.$$

The other parts of the proof are easy. I omit the details. *Q.E.D.*

Corollary 3 *The linear channel fees of the discount store raise the discount store's profit margin, market share and profit. On the contrary, the fees lower the convenience stores' profit margins, market shares and profits. The channel fees of the discount store have exclusionary effects against the convenience stores since they raise those stores' stock costs.*

Proposition 7 *If the discount store is able to extract linear channel fee of δ per product unit from the manufacturers, the equilibrium wholesale prices become*

$$w_a^* = w_b^* = J + c + k\delta, \tag{26}$$

where k is the market share of the discount store. The manufacturers' profits are unaffected by the linear channel fees.

Proof: There are nk consumers buy from the discounter. Among them, $nk(\frac{1}{2} + \frac{1}{2}\frac{w_b - w_a}{J})$ buy product a and the others buy product b. Manufacturer a's profit is

$$\pi_a(w_a) = nk(w_a - \delta - c)(\frac{1}{2} + \frac{1}{2}\frac{w_b - w_a}{J}) + n(1-k)(w_a - c)(\frac{1}{2} + \frac{1}{2}\frac{w_b - w_a}{J}). \tag{27}$$

The first order condition of the maximization problem is

$$w_a = \frac{1}{2}(J + w_b + c + k\delta). \tag{28}$$

Similarly, the first order condition of manufacturer b's problem is

$$w_b = \frac{1}{2}(J + w_a + c + k\delta). \tag{29}$$

We can solve the equilibrium wholesale prices from (28) and (29), which are

$$w_a^* = w_b^* = J + c + k\delta \ .$$

Each manufacturer's profit is

$$\frac{n}{2}\,[k(J + k\delta - \delta) + (1-k)(J + k\delta)] = \frac{nJ}{2}, \tag{30}$$

which is unaffected by the linear channel fees. *Q.E.D.*

If the discount store exerts its buyer power through requiring linear channel fees, the real wholesale prices faced by the discount store become $J + c + k\delta - \delta$ for both products, but the convenience stores face wholesale prices of $J + c + k\delta$. Compared to the wholesale prices in Proposition 5, we see that the channel fees actually raise the stock costs of the convenience stores. It is the convenience stores and their consumers that in fact bear the burden of the fees. Hence linear channel fees of large discount store have exclusionary effects against other stores. The consequence is similar to the "raising rivals' costs" effect suggested by Salop and Scheffman (1983). Finally, we can derive following result from Proposition 6 and 7.

Proposition 8 *Given the market structure, the linear channel fee lowers the average retail price, as long as the rate of the fee,* δ *, is not too large.*

Proof: The discount store's retail prices are

$$r_{a1}^{**} = r_{b1}^{**} = J + c + k\delta - \delta + s + \frac{n+1}{3n-3}T + \frac{\delta}{3} \ = J + c + s + \frac{n+1}{3n-3}T + (k - \frac{2}{3})\delta \ .$$

And those of the convenience stores are:

$$r_{aj}^{**} = r_{bj}^{**} = J + c + k\delta + s + \frac{2n-1}{3n-3}T - \frac{\delta}{3}$$
$$= J + c + s + \frac{2n-1}{3n-3}T + (k - \frac{1}{3})\delta > J + c + s + \frac{2n-1}{3n-3}T = r_{aj}^* = r_{bj}^* ,\ \ j = 2,...,n \ .$$

We have $k = \frac{n+1}{3n} + \frac{n-1}{3n}\frac{\delta}{T} > \frac{1}{3}$. And if $\delta < T$, we have $k - \frac{2}{3} = \frac{n-1}{3n}(\frac{\delta}{T} - 1) < 0$. Hence, if $0 < \delta < T$, we have

$$r_{a1}^{**} = r_{b1}^{**} = J + c + s + \frac{n+1}{3n-3}T + (k - \frac{2}{3})\delta < J + c + s + \frac{n+1}{3n-3}T = r_{a1}^{*} = r_{b1}^{*}.$$

The average retail prices without channel fee is

$$\overline{r^*} = \frac{n+1}{3n} r_{a1}^* + (1 - \frac{n+1}{3n}) r_{aj}^* = \frac{n+1}{3n}[J + c + s + \frac{n+1}{3n-3}T] + (\frac{2n-1}{3n})[J + c + s + \frac{2n-1}{3n-3}T]$$
$$= J + c + s + \frac{(n+1)^2 + (2n-1)^2}{9n(n-1)}T.$$

The average retail prices with the channel fee is

$$\overline{r^{**}} = k r_{a1}^{**} + (1-k) r_{aj}^{**}$$
$$= k[J + c + s + \frac{n+1}{3n-3}T + (k - \frac{2}{3})\delta] + (1-k)[J + c + s + \frac{2n-1}{3n-3}T + (k - \frac{1}{3})\delta]$$
$$= J + c + s + (\frac{n+1}{3n} + \frac{n-1}{3n}\frac{\delta}{T})[\frac{n+1}{3n-3}T + (k - \frac{2}{3})\delta] + (\frac{2n-1}{3n} - \frac{n-1}{3n}\frac{\delta}{T})[\frac{2n-1}{3n-3}T + (k - \frac{1}{3})\delta]$$
$$= J + c + s + \frac{(n+1)^2 + (2n-1)^2}{9n(n-1)}T + \frac{2n-2}{9n}\frac{\delta^2}{T} - \frac{2n-4}{9n}\delta. \text{ Hence}$$

$$\overline{r^{**}} - \overline{r^*} = \frac{2n-2}{9n}\frac{\delta^2}{T} - \frac{2n-4}{9n}\delta = \frac{2\delta}{9n}[(n-1)\frac{\delta}{T} - (n-2)],$$

which is negative if and only if $\frac{\delta}{T} < \frac{n-2}{n-1}$. Hence the average retail price goes down when δ is not too large. *Q.E.D.*

Linear channel fees divert some sales from the high-price convenience stores to the discount store. Hence allowing the discounter store to exert buyer power in the upstream market tends to lower the average retail price. This result is consistent with Galbraith (1952)'s "countervailing power" argument. My model suggests that countervailing power arises not because of retailer concentration, but the buyer power of discount retailers in wholesale market. Furthermore, the "countervailing power" found in this paper may not benefit the consumers as a whole. Channel fees increase the price gaps between the discount store and the convenience stores, which means the consumers have to pay more transportation costs. The extra transportation costs may cancel out the consumers' savings from the lower average retail prices. Also because of the increased transportation costs, the social welfare decreases when the discounter exerts buyer power in the upstream market.

Dynamically, channel fees lead to greater market share for the discount store, which would enhance the discounter's buyer power in the upstream. And greater buyer power allows it to obtain greater rate of channel fees. And that would again raise its market share and profit. This is what Dobson (2005) called *virtuous* circle for the discount retailers and the *vicious* circle for the convenience stores. The exclusionary effect of the channel fees is also enhanced in the circle. The market would eventually reach an equilibrium at the limit.

4. Concluding Remarks

A striking feature of modern retail industries is the polarization of store sizes. Most of the powerful retailers are discount stores. This is paradox because economists typically believe that powerful firms in an industry should enjoy greater profit margins, but that is not the case in retail industries. Theoretic study about discount stores is scarce in the literature. The major contributions of this paper are to demonstrate why a discount store is profitable and how it exerts market power. In the first model of this paper, I show why a powerful retailer may find it profitable to undercut their competitors' prices. Intuitively, because a discount store offers the lowest price, all consumers who have low enough transportation costs would buy from the discounter rather than any other stores. The discounter can thus sell much more and earn more profit than the other stores. The model also suggests that the overall market price may go up when a discount store acquires a competing convenience store.

The second model of this paper considers a bilateral oligopoly where a discount store can exert buying power in the upstream market. I show that the discounter actually uses linear “channel fees” as a tool to capitalize its buying power. The burden of the linear channel fees is in fact on the shoulders of the convenience stores and their customers, but not the upstream manufacturers. Interestingly, given the market structure, linear channel fees tend to lower the average retail price in the market. This result partially supports the “countervailing power” argument of Galbraith (1952). Particularly, the model suggests that the “countervailing power” arises not because of retailer concentration, but the buyer power of the discount retailer in wholesale market. However, the “countervailing power” only benefits the discounter and some of the consumers. Its overall impact on the social welfare is negative because it increases the consumers’ transportation costs. On the other hand, linear channel fees lower the discounter’s stock costs but raise those of the convenience stores. Hence the channel fees raise the discounters’ profits and market share while lower those of the other stores. In this sense, requiring channel fees may be regarded as an exclusionary strategy of the discount store. Regarding antitrust practice, this paper prefers the position of the United States to that of the United Kingdom. It suggests that the concentration in retail industries tends to hurts the economies.

References

Chen, Zhiqi, (2003), "Dominant Retailers and the Countervailing-Power Hypothesis," *The Rand Journal of Economics*, Vol. 34, No. 4, pp. 612-625.

Chu, Wujin (1992), "Demand Signaling and Screening in Channels of Distribution," *Marketing Science*, Vol. 11, No. 4, pp. 327-347.

DeLoach, D. B. (1962), "Marketing through Discount Stores," Journal of Farm Economics, Vol. 44, No. 1, pp. 169-177.

Dobson, Paul, (2005), "Exploiting Buyer Power: Lessons From the British Grocery Trade," Antitrust Law Journal, No.2, pp. 529-562.

Dobson, Paul W. and Michael Waterson, (1997). 'Countervailing power and consumer prices.' *The Economic Journal*, Vol. 107, No. 441, pp. 418-430.

Galbraith, John Kenneth, (1952), "American Capitalism: The Concept of Countervailing Power." Boston: Houghton Mifflin.

Gilchrist, F. W., (1952), "The Discount House," Journal of Marketing, Vol. 17, No. 3, pp. 267-272.

Griffith, D.A. and R.F. Krampf (1997), "Emerging trends in US retailing," *Long Range Planning*, Vol. 30, No. 6, pp. 847-852.

Gundlach, Gregory T. and Paul, N. Bloom, (1998), "Slotting Allowances and the Retail Sale of Alcohol Beverages," *Journal of Public & Marketing*, Vol. 17, No. 2, pp. 173-184.

Hunter, Alex, (1958), "Notes on Countervailing Power," *The Economic Journal*, Vol. 68, No. 269, pp. 89-103.

Kelly, Kenneth H. (1991), "The Antitrust Analysis of Grocery Slotting Allowances, The

Procompetitive Case," *Journal of Public Policy & Marketing*, Vol. 17, No. 2, pp. 173-184.

Kreps, David M. and Jose A. Scheinkman, (1983), "Quantity Precommitment and Bertrand Competition Yield Cournot Outcomes," *Bell Journal of Economics*, Vol.14, No. 2, pp. 326-337.

Lal, Rajiv and Ram Rao, (1997), "Supermarket Competition: The case of Every Day Low Pricing," Marketing Science, Vol. 16, No. 1, pp. 60-80.

Lariviere, Martin A. and V. Padmanabhan (1997), "Slotting Allowances and New Product Introductions," *Marketing Science*, Vol. 6, No. 2, pp. 112-128.

MacAvoy, Christopher J. (1997), "Antitrust Treatment of Slotting Allowances," ABA Section of Antitrust Law, 45th Annual Spring Meeting, April 9-11, Washington, D.C.

Minichiello, Robert J., (1967), "The Real Challenge of Food Discounters," Journal of Marketing, Vol. 31, No. 2, pp. 37-42.

Narasimhan, Chakravarthi, (1988), "Competitive Promotional Strategies," Journal of Business, Vol. 61, No. 4, pp. 427-449.

NFAPP #01-04, (2001), "Slotting Fees: Symptom of a More Fundamental Problem?" *National Food and Agricultural Policy Project Policy (NFAPP) Briefing Paper*, March.

O'Brien, Daniel P. and Greg Shaffer (1992), "Vertical Control with Bilateral Contracts," The *RAND Journal of Economics*, Vol. 23, No. 3, pp. 299-308.

Salop, Steven and David T. Scheffman, (1983), "Raising Rival's Costs," *American Economic Review*, Vol. 73, No. 2, pp. 267-271.

Shaffer, Greg, (1991), "Slotting Allowances and Retail Price Maintenance: A Comparison of Facilitating Practices," *The RAND Journal of Economics*, Vol. 22, No. 1, pp. 120-135.

Stigler, G. J., (1954), “The Economist Plays with Blocs.” *American Economic Review*, Vol. 44, No. 2, pp. 7-14.

Sullivan, Mary W. (1997), “Slotting Allowances and the Market for New Products,” *Journal of Law & Economics*, Vol. 40, No. 2, pp. 461-493.

Whitney, Simon N., (1953), “Errors in the Concept of Countervailing Power,” *The journal of Business of the University of Chicago*, Vol. 26, No. 4, pp. 238-253.

Winter, R.A. (1993), “Vertical Control and Price versus Nonprice Competition.” *Quarterly Journal of Economics*, Vol. 108, No. 1, pp. 61-76.

von Ungern-Sternberg, 1996. "Countervailing Power Revisited," *International Journal of Industrial Organization*, Vol. 14, No. 4, pp. 507-519.

Appendix

Proof of Corollary 1: Since $s_1 \le s$ the equilibrium quantities sold by the stores are:

$$q_1^* = 1 + \sum_{j=2}^{n} \frac{p_j^* - p_1^*}{T} = \frac{n+1}{3} + \frac{(n-1)(s-s_1)}{3T} \ge \frac{n+1}{3},$$

$$q_j^* = 1 - \frac{p_j^* - p_1^*}{T} = \frac{2n-1}{3n-3} - \frac{s-s_1}{3T} \le \frac{2n-1}{3n-3}, \quad j = 2,\ldots,n.$$

And the profits are:

$$\pi_1^* = (p_1^* - s_1)q_1^* = (\frac{s-s_1}{3} + \frac{n+1}{3n-3}T)[\frac{n+1}{3} + \frac{(n-1)(s-s_1)}{3T}] \ge \frac{(n+1)^2}{9(n-1)}T$$

$$\pi_j^* = (p_j^* - s)q_j^* = (-\frac{s-s_1}{3} + \frac{2n-1}{3n-3}T)[\frac{2n-1}{3n-3} - \frac{s-s_1}{3T}] \le (\frac{2n-1}{3n-3})^2 T, \quad j = 2,\ldots,n.$$

Apparently, the inequalities hold strictly if $s_1 < s$. *Q.E.D.*

Proof of Proposition 3: The new store 1 chooses p_1'' to solve problem

$$\underset{p_1''}{Max}\ (p_1'' - s_1)(2 + \sum_{j=3}^{n} \frac{p_j - p_1''}{T}).$$

Each store $j \in \{3,\cdots,n\}$ chooses p_j'' to solve problem

$$\underset{p_j}{Max}\ (p_j'' - s)(1 + \frac{p_1'' - p_j''}{T}).$$

The first order conditions of the stores' problems are

$$p_1'' = \frac{2T + \sum_{j=3}^{n} p_j''}{2n-4} + \frac{s_1}{2} \quad \text{and} \quad p_j'' = \frac{T + p_1''}{2} + \frac{s}{2}, \text{ for } j = 3,\ldots,n.$$

Solving the equilibrium prices from this equation system, we have

$$p_1^{**} = \frac{2s_1 + s}{3} + \frac{n+2}{3(n-2)}T \quad \text{and} \quad p_j^{**} = \frac{2s + s_1}{3} + \frac{2n-2}{3(n-2)}T, \text{ for } j = 3,\ldots,n.$$

The equilibrium sale quantities and profits of the stores are:

$$q_1^{**}=2+\sum_{j=3}^{n}\frac{p_j^{**}-p_1^{**}}{T}=2+\frac{(n-2)}{T}[\frac{s-s_1}{3}+\frac{n-4}{3(n-2)}T]=\frac{n+2}{3}+(n-2)\frac{s-s_1}{3T}\geq\frac{n+2}{3},$$

$$q_j^{**}=1-\frac{p_j^{**}-p_1^{**}}{T}=1-\frac{1}{T}[\frac{s-s_1}{3}+\frac{n-4}{3(n-2)}T]=\frac{2(n-1)}{3(n-2)}-\frac{s-s_1}{3T}\leq\frac{2(n-1)}{3(n-2)},\quad j=3,\ldots,n,$$

$$\pi_1^{**}=(p_1^{**}-s_1)q_1^{**}=(\frac{s-s_1}{3}+\frac{n+2}{3(n-2)}T)[\frac{n+2}{3}+(n-2)\frac{s-s_1}{3T}]\geq\frac{(n+2)^2}{9(n-2)}T,$$

$$\pi_j^{**}=(p_j^{**}-s)q_j^{**}=(\frac{s_1-s}{3}+\frac{2n-2}{3(n-2)}T)[-\frac{s-s_1}{3T}+\frac{2(n-1)}{3(n-2)}]\leq[\frac{2(n-1)}{3(n-2)}]^2T,\quad j=3,\ldots,n.$$

And if $s_1<s$, the inequalities hold strictly. *Q.E.D.*

Proof of Corollary 2: If $s_1=s$, before the merger we have

prices: $p_1^*=s+\frac{n+1}{3n-3}T$, $p_j^*=s+\frac{2n-1}{3n-3}T$, $j=2,\ldots,n$,
sales: $q_1^*=\frac{n+1}{3}$, $q_j^*=\frac{2n-1}{3n-3}$, $j=2,\ldots,n$, and

profits: $\pi_1^*=\frac{(n+1)^2}{9(n-1)}T$, $\pi_j^*=(\frac{2n-1}{3n-3})^2T$, $j=2,\ldots,n$.

After the merger we have

Prices: $p_1^{**}=s+\frac{n+2}{3(n-2)}T$, $p_j^{**}=s+\frac{2n-2}{3(n-2)}T$, $j=3,\ldots,n$,

Sales: $q_1^{**}=\frac{n+2}{3}$, $q_j^{**}=\frac{2(n-1)}{3(n-2)}$, $j=3,\ldots,n$, and

Profits: $\pi_1^{**}=\frac{(n+2)^2}{9(n-2)}T$, $\pi_j^{**}=[\frac{2(n-1)}{3(n-2)}]^2T$, $j=3,\ldots,n$.

(1). The average retail price before the merger is

$$\overline{p*}=\frac{p_1^*\cdot q_1^*+(n-1)p_2^*\cdot q_2^*}{n}=\frac{[s+\frac{n+1}{3n-3}T][\frac{n+1}{3}]+(n-1)[s+\frac{2n-1}{3n-3}T][\frac{2n-1}{3n-3}]}{n}$$

$$=\frac{ns+\frac{(n+1)^2}{9(n-1)}T+\frac{(2n-1)^2}{9(n-1)}T}{n}=s+\frac{(n+1)^2+(2n-1)^2}{9n(n-1)}T=s+\frac{5n^2-2n+2}{9n(n-1)}T.$$

The average retail price after the merger is

$$\overline{p**} = \frac{p_1^{**}\cdot q_1^{**} + (n-2)p_3^{**}\cdot q_3^{**}}{n} = \frac{[s+\frac{n+2}{3(n-2)}T][\frac{n+2}{3}] + (n-2)[s+\frac{2n-2}{3(n-2)}T][\frac{2(n-1)}{3(n-2)}]}{n}$$

$$= \frac{ns + \frac{(n+2)^2}{9(n-2)}T + \frac{(2n-2)^2}{9(n-2)}T}{n} = s + \frac{(n+2)^2 + (2n-2)^2}{9n(n-2)}T = s + \frac{5n^2-4n+8}{9n(n-2)}T\,.$$

Since $\frac{5n^2-4n+8}{9n(n-2)} > \frac{5n^2-2n+2}{9n(n-1)}$, we have $\overline{p**} > \overline{p*}$.

(2). Since $\pi_1^* + \pi_2^* = \frac{(n+1)^2}{9(n-1)}T + (\frac{2n-1}{3n-3})^2 T = \frac{n(n^2+5n-5)}{9(n-1)^2}T$ and $\pi_1^{**} = \frac{(n+2)^2}{9(n-2)}T$, we have $\pi_1^{**} > \pi_1^* + \pi_2^*$ if and only if $n \le 10$.

(3). Inequality $q_1^{**} = \frac{n+2}{3} < q_1^* + q_2^* = \frac{n+1}{3} + \frac{2n-1}{3n-3} = \frac{n^2+2n-2}{3n-3}$ holds for any $n \ge 1$.

(4). (Straightforward). *Q.E.D.*

Proof of Proposition 5: The retail price differentials of the two products are the same in all stores, because the stores put the same profit margins on the two products. As long as $-J \le w_b - w_a \le J$, price differential $w_b - w_a$ would attract $\frac{n}{2}(\frac{w_b - w_a}{J})$ consumers who prefer brand *b* to buy brand *a* product. Hence the profit functions of the manufacturers are

$$\pi_a(w_a) = (w_a - c)[\frac{n}{2} + \frac{n}{2}(\frac{w_b - w_a}{J})] \quad \text{and} \quad \pi_b(w_b) = (w_b - c)[\frac{n}{2} - \frac{n}{2}(\frac{w_b - w_a}{J})]$$

respectively. The first order conditions of the manufacturers' maximization problems are

$$w_a = \frac{1}{2}(J + w_b + c) \quad \text{and} \quad w_b = \frac{1}{2}(J + w_a + c)$$

respectively. Hence in equilibrium we have $w_a^* = w_b^* = c + J$. *Q.E.D.*