Loss Leaders: An Indirect Empirical Test

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Abstract

We apply an *indirect* method to test for the extent of loss leader pricing. Specifically, the extent of loss leader pricing should increase with the profit from other regularly-priced items ("loss leader scope"). Bookstores customarily use bestsellers as loss leaders. Among conventional bookstores, we found that the bestseller discount systematically increased with the store area, selection of titles, and presence of other product categories. A one standard deviation increase in store area was associated with a 3.7 (± 1.8) higher bestseller percentage discount. Among online stores, we found that the bestseller discount systematically increased with the selection of titles and number of product categories. A one standard deviation increase in selection was associated with a 9.5 (± 2.2) higher bestseller percentage discount.

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1. Introduction

When and how retailers should use loss-leaders has been the subject of considerable theoretical research. Considerations that have been identified include the distinction between "shopping goods" and "impulse goods" (Hess and Gerstner 1987), price advertising as a commitment to assure buyers of surplus (Lal and Matutes 1994), differences in buyer loyalties (Simester 1997), and differences in the buyers' intended basket of purchases (DeGraba 2003).

However, owing to the lack of information on retail costs, there has been little empirical research into the use and extent of loss leaders (Chevalier et al. 2003). From weekly price promotions at two supermarkets, Walters and McKenzie (1988) concluded that loss leaders do not affect store profit and have little impact on store traffic. Chevalier et al. (2003) found that a Chicago-area supermarket systematically reduced margins at seasonal demand peaks, which behavior was consistent with the use of loss leaders but not other explanations of counter-cyclical pricing.

In this paper, we apply an *indirect* method to test for the use and extent of loss leaders. Specifically, a retailer's return from a loss leader is the profit contribution from customers' expected purchases of regular-priced items. The expected purchases depend on characteristics of the customers and store-level factors that we call the "loss leader scope". Accordingly, the extent of loss leader pricing should increase with the loss leader scope.

We applied this indirect method to the pricing of books in both conventional and online stores. For conventional stores, we measured loss leader scope by the area of the store, selection of titles, and presence of other product categories such as music and videos. With all three measures, we found strong support for the hypothesis that the extent of loss leader pricing increased with the loss leader scope.

For online stores, we measured the loss leader scope by the selection of titles and number of other product categories. We found strong support for the hypothesis with loss leader scope measured by selection of titles and marginal support with the scope measured by the number of other product categories.

2. Model

Suppose that all consumers are identical and have demand for at most one unit each of a broad class of items. For simplicity, the consumer's reservation value for each of the items is v. Consider a retailer selling one loss-leader item and a selection s of other items under conditions of monopolistic competition. Following Hess and Gerstner (1988) and Lal and Matutes (1994), we suppose that the retailer sets price $p < v$ for the loss-leader item and prices the other s items at the consumer's reservation value v. Let $mQ(p)$ represent the number of consumers at price p, where m represents idiosyncratic factors specific to the retail location. Further, let the retailer incur a fixed cost F of retailing and a constant marginal cost c for all items.

The sequence of decisions is that the retailer first chooses the selection s to offer, then, given s, chooses the price p. At the pricing stage, the retailer's profit is

$$\Pi = [p + vs]\ mQ(p) + [1 + s]\ cmQ(p) - F\,. \qquad (1)$$

Differentiating with respect to p, the first-order condition is

$$\frac{d}{dp}[p + vs]\ Q(p) = \frac{d}{dp}[1 + s]\ cQ(p)\,,$$

or

$$\frac{d}{dp}\,pQ(p) = c\frac{d}{dp}Q(p) - [v - c]s\frac{d}{dp}Q(p)\,, \qquad (2)$$

which characterizes the price, $p(s)$.

Condition (2) is the textbook profit-maximization condition under conditions of monopolist competition with the adjustment

$$-[v - c]s\frac{d}{dp}Q(p) \qquad (3)$$

for the impact of the loss leader on the profit from selling the other items. If s is higher, this adjustment factor will be more negative, and hence, by (2), the profit-maximizing price p will be *lower*. Describing s as the "loss leader scope", we have the theoretical proposition that the price of the loss leader is decreasing in the loss leader scope.

3. Hypotheses and Data

We test our theoretical proposition with data from the retailing of books. Books differ from many other goods in that they are marked with a list price at the point of manufacture. Bookstores set prices not in absolute dollar terms, but rather in terms of discounts from list price. In common with other retailers, bookstores engage in a variety of pricing strategies, including loyalty programs, coupons, and clearance sales.

Bookstores stand out from other retailers in one respect. They systematically charge lower prices for their most popular items. Specifically, bookstores offer larger discounts on current bestsellers than titles not on the bestseller list. For instance, Barnes & Noble sets a 30% discount on all hardcover and paperback titles on its bestseller list, 20% discount on selected featured titles, and no discount on most other titles (Barnes & Noble 2002).

On first impression, it seems odd for a bookstore to offer larger discounts for bestsellers than other titles. Since bestsellers are in the hottest demand, bookstores should be able to extract relatively higher margins. In conventional microeconomic models of both perfect competition and monopoly, when demand is higher, the price will be higher.[1] One possible rationalization is that retailers use bestsellers as loss leaders. Steve Riggio, then Vice Chairman of Barnes & Noble.com once remarked: "best sellers, which make up only 3% of sales, have long been treated as loss leaders".[2] [3]

During the week of August 3, 2003, we engaged surveyors to report the pricing of eight titles and store attributes at bookstores in four areas – around two East and West Coast campuses. We asked each surveyor to survey any ten bookstores in their area. After eliminating duplicate outlets of chain stores, we had 22 unique stores.

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[1] The practice of discounting bestsellers also contradicts the general retail policy of managing uncertain demand by setting a high initial price and marking down if demand turns out to be low (Lazear 1986; Pashigian and Bowen 1991; and Png 1991).

[2] "Web Booksellers Give Potter Fans Rush Delivery", *Wall Street Journal*, June 22, 2000.

[3] In the DVD market, retailers systematically discount bestsellers more heavily than other titles (Tang and Xing 2000, Table 4-2).

The eight titles consisted of four bestsellers and four non-bestsellers. The four bestsellers comprised the top two titles in the Sunday, August 3, 2003 *New York Times* hardcover fiction and paperback fiction bestseller lists. To represent titles that were not bestsellers, the other four titles consisted of the top two titles in the same headings for the week of August 4, 2002, excluding those titles that were among the August 3, 2003 bestsellers.

In the case of a conventional bookstore, the extent to which a customer attracted by a loss leader might buy other items depends on the availability and selection of the other items. Hence, appropriate measures of loss leader scope would be store area and selection of titles, and also the presence of other product categories. The surveyors recorded, for each store, the estimated store area (Area), the number of titles in stock (Selection), and the presence of other product categories (Other_Cat).

Table 1 reports descriptive statistics of the sample. The discount rates ranged from 0% to 42% with a mean of 9.4% (±13.4%).[4] The average store area was 8577 square feet (±12,330 square feet) and the average selection of titles was 114,023 (±181,770).[5] The surveyors also recorded whether the store was located in a shopping mall (Mall), and whether the store had a visible competitor (Competitor).

During the same week of August 3, 2003, we visited 11 online bookstores to record the pricing of the same eight titles, and various retailer attributes. These were identified from Clay et al.'s (2001) list of "wide selection" online booksellers and after eliminating stores that had ceased operations. In the case of an online bookstore, the loss leader scope could be measured by the selection of titles and the number of other product categories, such as music and videos.

Absent direct information on the stores' selection of titles, we built an index by the following procedure. First, we constructed a random sample of book titles by randomly generating 10 digit numbers in ISBN (International Standard Book

[4] Number in parentheses is the standard deviation.

[5] For the chain stores – Barnes & Noble, B. Dalton (which belongs to Barnes & Noble, Inc.), Borders, and Waldenbooks (which belongs to Borders, Inc.), we used the average of the discounts observed by our surveyors over the outlets of the chain surveyed, and the chain-wide average store area and title stock, as reported in the respective 2002 corporate annual reports.

Number) format, and then discarding those were not listed by bookfind-online.com as representing an actual title. We repeated the procedure until we had accumulated 1000 titles. Next, for each online store, we checked the availability of these titles to derive its selection of titles (Selection_Total), as measured as out of 1000. We also constructed a narrower index of titles available for delivery within five working days (Selection_Onhand).

Table 2 reports descriptive statistics of the sample. The average discount rate among the online stores was 17.6% (±15.1%), which was higher than that among the conventional stores. On the broader measure, Selection_Total, the average selection of titles was 322.7 (±264.4), while on the narrower measure, Selection_Onhand, the average selection was 208.6 (±224.0).[6] We also recorded whether the online store was related to a conventional store, as previous research into the retail pricing of DVDs has suggested that online affiliates of conventional stores price higher than pure online stores (Tang and Xing 2001).

Accordingly, we operationalized our tests as follows.

Hypothesis 1. Among conventional stores, the discount on bestsellers is increasing in

(i) the area of the store,
(ii) the selection of titles, and
(iii) the presence of other product categories.

Hypothesis 2. Among online stores, the discount on bestsellers is increasing in

(i) the selection of titles, and
(ii) the number of product categories.

[6] Data on page views from Trafficranking.com provided independent validation of our selection measures: the correlation between Selection_Total and page views per visit was 0.739, while the correlation between Selection_Onhand and page views per visit was 0.940.

4. Empirical Results

We tested the hypotheses using least-squares regression with White's (1980) adjustment of standard errors and covariance for heteroskedasticity. In all regressions, the dependent variable was the discount from the list price and the explanatory variables included indicators for hardcover titles and bestsellers to reflect industry pricing practices. Generally, the pricing of hardcover titles differs from paperbacks, and bestsellers are subject to discount.

For conventional stores, besides the variable to operationalize the empirical test, we also included the store area and presence of other product categories as explanatory variables to capture economies of scale and scope respectively.

Table 3 reports the results. Referring to column (a), the coefficient of Hardcover was positive and significant. The coefficient of store area was negative and significant, which is not consistent with economies of scale. The coefficient of the presence of other product categories was positive and significant, which is consistent with economies of scope.

Regarding Hypothesis 1, the coefficient of the compound variable, Bestseller*Area, was positive and significant. Consistent with Hypothesis 1(i) that the extent of loss leader pricing increases with the loss leader scope, *larger* stores systematically offered *bigger* discounts on bestsellers. Specifically, a store that was larger by one standard deviation offered a 3.7 (±1.8) higher bestseller percentage discount. This seems very reasonable relative to the mean 9.4% (±13.4) percentage discount in our sample.

An alternative measure of loss leader scope is the selection of titles. However, we were able to collect data on selection for relatively fewer stores. Table 3, column (b), reports the regression with loss leader scope measured by the selection. The results were quite similar to those with loss leader scope measured by store area. While the coefficient of Selection itself was negative but not significant, the coefficient of the compound variable, Bestseller*Selection, was positive and significant, which was consistent with Hypothesis 1(ii). A store with a one standard deviation larger selection offered a 18.3 (±9.7) higher bestseller percentage discount.

Yet another measure of loss leader scope is whether the store also retails other product categories. Table 3, column (c), reports the regression with loss leader scope measured by the presence of other product categories. The results were quite similar to those with loss leader scope measured by store area. While the coefficient of Other_Cat itself was positive but not significant, the coefficient of the compound variable, Bestseller*Other_Cat, was positive and significant, which was consistent with Hypothesis 1(iii). A store that carried other categories offered a 10.3 (±3.4) higher bestseller percentage discount.

One possible reason why retailers discount bestsellers is that the wholesale cost of bestsellers to retailers is lower. However, this would not explain why the depth of the discount increases with the store area, selection of titles, or presence of other categories.

A variant of this explanation emphasizes that bookstores benefit from volume discounts. To the extent that the sales volume of bestsellers is correlated with store area, then the discount on bestsellers should increase with store area and selection. However, if bookstores with larger area benefited from volume discounts, these should be reflected in the pricing of *all* titles, not just bestsellers. In our regression, the coefficient of store area was negative. Further, volume discounts would not explain why the depth of the bestseller discount increases with the presence of other categories.

In addition, the volume discount explanation is not consistent with the pricing strategies of the Barnes & Noble and Borders groups. In each group, the large-format stores (Barnes & Noble and Borders) offer deeper and wider bestseller discounts than their smaller-format affiliates (B. Dalton and Waldenbooks respectively). By contrast, the volume discount explanation would predict that stores within the same group should set the same price discounts.

Finally, we also checked the impact of retail complementarity and competition on pricing. Mall bookstores benefit from the presence of anchor stores and may price differently from stand-alone bookstores that must draw their own traffic (Pashigian and Gould 1998). Table 3, column (d), reports a regression with additional

variables identifying stores located in malls (Mall) and stores from which another bookstore was visible (Competitor). In our regression, the coefficient for mall bookstores was positive but not significant. The coefficient for competition was positive *and* significant, consistent with bookstores pricing lower in the presence of nearby competition.

Next, we tested Hypothesis 2 for online stores. As reported in Table 4, the results were similar to those for conventional stores. Column (a) reports the regression with the loss leader scope measured by the selection of titles. The coefficient of Hardcover was positive and significant, showing that online booksellers followed industry practice of discounting hard cover titles. The coefficient of Selection_Total was negative and significant, which suggested that larger stores exercised some degree of market power. The coefficient of Categories was positive and significant, suggesting that the presence of significant scope economies.

The coefficient of the compound variable, Bestseller*Selection_Total was positive and significant. Consistent with Hypothesis 2(i) that the extent of loss leader pricing increases with the loss leader scope, stores with a *broader* selection of titles systematically offered *bigger* discounts on bestsellers. A store with one standard deviation larger total selection offered a 9.7 (±2.2) higher bestseller percentage discount.

Table 4, column (b) reports the regression with loss leader scope measured by the selection of titles deliverable within five days. The results were very close to those with loss leader scope measured by the total selection of titles. In particular, the coefficient of the compound variable, Bestseller*Selection_Onhand was positive and significant, which was consistent with Hypothesis 2(i). A store with one standard deviation larger selection on hand offered a 6.5 (±2.1) higher bestseller percentage discount.

Using data from Trafficranking.com, we found a high degree of correlation between page views per visit and our selection measures: the correlation with Selection_Total was 0.739, while that with Selection_Onhand was 0.940. The

number of pages a customer views during each visit directly measures browsing and the extent to which they might buy regular-priced items.

Table 4, column (c) reports the regression with loss leader scope measured by the number of product categories (Categories). The results were similar to those with loss leader scope measured by the selection of titles. The coefficient of the compound variable, Bestseller*Categories was positive and significant, which was consistent with Hypothesis 2(ii). A store with one standard deviation more product categories offered a 3.9 (±2.2) higher bestseller percentage discount.

Table 4, column (d) reports the regression with an indicator variable, Conventional_Affiliates. The coefficient was negative, suggesting that online affiliates of conventional stores did indeed offer lower discounts than pure online stores, which is consistent with the previous research into DVD retailing (Tang and Xing 2001). However, the coefficient was quite small (-0.2162) and not significant. Two possible explanations are that the pricing strategies of conventional stores' online affiliates and pure online stores have converged since the dot.com boom, and that the pricing of books differs from that of DVDs.

6. Concluding Remarks

We have focused on testing the presence of loss leader pricing, which is just one case of the more general issue of counter-cyclical pricing (Warner and Barsky 1995; McDonald 2000; Chevalier et al. 2003). Rotemberg and Woodford (1999) offer three other possible reasons why prices might rise when demand peaks: (a) high demand items have lower search costs; (b) high demand products have lower fixed supply costs; (c) tacit collusion. None of these three explanations would account for the correlation between price discounts and measures such as store area, titles in stock, and presence or number of other product categories. Accordingly, it seems reasonable to conclude that bookstores use bestsellers as loss leaders.

Besides store-level attributes, the effectiveness of loss leader pricing also depends on level of the consumer's switching costs. If a consumer could easily move from one store to another, then she could buy a cheap bestseller at one and then travel elsewhere to buy other items. In that case, she would not be locked in to the store offering the loss leader. An intriguing direction for future work is to compare the extent of loss leader pricing in online and conventional channels. If buyer switching costs are lower in online channels, then the use of loss leaders should also be lower. The challenge would be to construct a measure of loss leader scope that could be applied to both channels.

References

Barnes & Noble, Inc, *Annual Report*, 2002.

Chevalier, Judith, Anil Kashyap, and Peter Rossi, "Why Don't Prices Rise During Periods of Peak Demand? Evidence from Scanner Data," *American Economic Review*, Vol. 93 No. 1 (2003), 15-37.

Clay, Karen, Ramayya Krishnan, Eric Wolff, and Danny Fernandes, , "Prices and Price Dispersion on the Web: Evidence from the Online Book Industry", *Journal of Industrial Economics*, Vol.49 No. 4 (2001), 521-540.

Degraba, Patrick, "Volume Discounts, Loss Leaders, and Competition for More Profitable Customers", Working Paper, Federal Trade Commission, April 2003.

Hess, James, and Eitan Gerstner, "Loss Leader Pricing and Rain Check Policy," *Marketing Science*, Vol. 6 No. 4 (Fall 1987), 358-374.

Lal, Rajiv, and Carmen Matutes, "Retail Pricing and Advertising Strategies", *Journal of Business*, Vol. 67 No. 3 (1994), 345-370.

Lazear, Edward P., "Retail Pricing and Clearance Sales", *American Economic Review*, Vol. 76 (March 1986), 14-32.

MacDonald, James M., "Demand, Information, and Competition: Why Do Food Prices Fall at Seasonal Demand Peaks?" *Journal of Industrial Economics*, Vol. 48 No. 1 (March 2000), 27-45.

Pashigian, B. Peter, and Brian Bowen, "Why are Products Sold on Sale? Explanations of Pricing Regularities", *Quarterly Journal of Economics*, Vol. 106 (1991), 1015--1038.

Png, I.P.L., "Most-Favored-Customer Protection versus Price Discrimination Over Time", *Journal of Political Economy*, Vol. 99 No. 5 (1991), 1010--1028.

Rotemberg, Julio, and M. Woodford, "The Cyclical Behavior of Prices and Costs", in John Taylor and M. Woodford, Eds., *Handbook of Macroeconomics*, Amsterdam: North Holland, 1999.

Simester, Duncan, "Note: Optimal Promotion Strategies: A Demand-Side Characterization," *Management Science*, Vol. 43 No. 2 (1997), 251-256.

Tang, Fang-Fang, and Xiaolin Xing, "Will the Growth of Multi-Channel Retailing Diminish the Pricing Efficiency of the Web?", *Journal of Retailing*, Vol.77 No. 3 (Autumn 2001), 319-331.

Walters, Rochney G. and Scott McKenzie, "A Structural Equation Analysis of the Impact of Price Promotions on Store Performance," *Journal of Marketing Research*, Vol. 25 (February 1988), 51-63.

Warner, Elizabeth, and Robert B. Barsky, "The Timing and Magnitude of Retail Store Markdowns: Evidence from Weekends and Holiday", *Quarterly Journal of Economics*, Vol. 110 (1995), 322--352.

White, Halbert, "A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity", *Econometrica*, Vol. 48 (1980), 817—838.

Table 1: Conventional Bookstores

Variable	Unit	Min	Mean	Max	Std deviation
Discount*	Percent	0	9.40	42.00	13.40
Hardcover	Indicator	0	0.5	1	0.50
Bestseller	Indicator	0	0.5	1	0.50
Area#	'000 sq. feet	0.30	8.58	45	12.33
Selection#	'000	10.00	114.02	700.00	181.77
Mall	Indicator	0	0.19	1	0.39
Competitor	Indicator	0	0.11	1	0.31
Other_Cat	Indicator	0	0.59	1	0.49

* For the chain stores – Barnes & Noble, B. Dalton (which belongs to Barnes & Noble, Inc.), Borders, and Waldenbooks (which belongs to Borders, Inc.), the discounts were the average of the discounts observed by our surveyors over the outlets of the chain surveyed.

For the chain stores, we used the chain-wide average store area and title selection, as reported in the respective 2002 corporate annual reports. For other stores, the store area and title selection were as reported by our surveyors.

Table 2: Online Bookstores

Variable	Unit	Min	Mean	Max	Std deviation
Discount	Percent	0	17.60	46.00	15.13
Hardcover	Indicator	0	0.5	1	0.5
Bestseller	Indicator	0	0.5	1	0.5
Selection_Total	Of 1000	65	322.7	846	264.4
Selection_Onhand	Of 1000	30	208.6	688	224.0
Categories		1	6.36	31	8.86

Table 3: Conventional Store Discounts

	(a)	(b)	(c)	(d)
Constant	-2.8618* (1.6408)	-1.4865 (2.4326)	-1.2116 (1.8812)	-4.5665** (1.5949)
Hardcover	14.1652*** (1.9310)	14.0130*** (2.1804)	13.3361*** (1.7591)	14.0435*** (1.7446)
Bestseller	4.0562* (2.1746)	0.7440 (3.4821)	1.5546 (2.3498)	4.4866** (2.0764)
Area	-0.2674** (0.0901)	-0.0860 (0.2021)	-0.0000 (0.0000)	-0.2010** (0.0940)
Selection	-	-0.0580 (0.0611)	-	-
Other_Cat	7.5301*** (1.7021)	7.9177*** (2.4912)	1.6132 (2.3824)	7.1553*** (1.6111)
Bestseller*Area	0.2968** (0.1448)	-	-	0.2766* (0.1461)
Bestseller*Selection	-	0.1008** (0.0532)	-	-
Bestseller*Other_Cat	-	-	10.2677*** (3.3824)	-
Mall	-	-	-	1.3547 (2.0972)
Competitor	-	-	-	7.7433*** (2.6527)
No. of observations	128	80	128	128
Adjusted R^2	0.4396	0.4293	0.4606	0.4665
F-statistic	20.9241	10.9029	22.6926	16.8625

Standard errors in parentheses

* Significant at the 90% level

** Significant at the 95% level

*** Significant at the 99% level

Table 4: Online Store Discounts

	(a)	(b)	(c)	(d)
Constant	10.9894*** (3.0984)	7.7064*** (2.6851)	6.6125** (2.7964)	11.0629*** (3.5324)
Hardcover	9.8889*** (2.5863)	9.8410*** (2.6919)	9.8317*** (2.7477)	9.8867*** (2.5971)
Bestseller	-2.6096 (4.4380)	3.0363 (3.7954)	6.3192* (3.2662)	-2.6050 (4.4594)
Selection_Total	-0.0207*** (0.00641)	-	-0.00269 (0.00568)	-0.0205*** (0.00762)
Selection_Onhand	-	-0.0160** (0.00785)	-	-
Categories	0.5888*** (0.1341)	0.5734*** (0.1549)	0.3674* (0.2150)	0.5803*** (0.2108)
Bestseller *Selection_Total	0.0367*** (0.00835)	-	-	0.0362*** (0.00840)
Bestseller *Selection_Onhand	-	0.0291*** (0.00937)	-	-
Bestseller*Categories	-	-	0.4406* (0.2492)	-
Conventional_Affiliate	-	-	-	-0.2162 (3.8788)
No. of observations	87	87	87	87
Adjusted R^2	0.3636	0.3100	0.2834	0.3557
F-statistic	10.8286	8.7282	7.8037	8.9135

Standard errors in parentheses

* Significant at the 90% level

** Significant at the 95% level

*** Significant at the 99% level