

PRICE AND PRICE DISPERSION ON THE WEB:
EVIDENCE FROM THE ONLINE BOOK INDUSTRY OF TAIWAN*

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Abstract

We study how the levels of market price and price dispersion are associated with consumers' search costs and the level of competitiveness in the online market using data collected from the online book industry in Taiwan. Our empirical results show that prices and price dispersion are lower for books that are more often purchased or advertised. Moreover, we find that the big three bookstores and the fringe bookstores price differently when facing competition from their rivals and that price dispersion tend to be lower with the number of competing bookstores.

Keywords: internet, price dispersion, information, search

JEL Classification Codes: M21, M31

I. *Introduction*

E-commerce in Taiwan has been growing despite the island's great mass of retail outlets. At the end of 2008, online shopping in Taiwan reached NT\$243 billion (US\$7.29 billion), according to the estimates made by the Market Intelligence Center, a leading research and

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consulting firm in Taiwan.¹ A feature of the online virtual market place which makes it different from the brick-and-mortar retail outlet is the easy access of product or price information and the low search costs. Price dispersions on the web, or violations of the law of one price, are widely observed despite the fact that consumers can get access to the price information for seemingly identical products with just a few mouse clicks or web visits.

Models that study price dispersion for seemingly identical products can be divided into two types according to the magnitudes of search costs – “clearing house models” and “search-theoretic models.”² In clearing house models, consumer search cost is close to zero. Price information can be obtained through a clearing house which provides a list of prices charged by different firms in a market. For example, an online environment in which consumers can get access to the prices charged by different stores for a particular product by using a price comparison site is close to that of a clearing house model. The most general clearing house model is provided by Baye and Morgan (2001). Earlier models include Varian (1980), Rothensal (1980), Shilony (1977), and Narasimhan (1988). In search-theoretic models, consumers have to spend a cost (for example, time spent visiting a website or a store) in order to gather price information. Representative search-theoretic models include Reinganum (1979) and MacMinn (1980). Empirical research which documents online price dispersion has focused mainly on online versus offline comparisons and on the levels of price dispersion in clearing house models. Relatively little research examines online price dispersion in a search-theoretic framework.³

In this paper, we focus on two issues that are associated with the levels of online price dispersion and the market price in the search-theoretic framework. First, we would like to examine whether more efforts in advertisement lead to a lower price level and smaller price dispersion. The intuition is as follows. There is a direct association between consumers’ search costs and the intensity of firms’ advertising efforts. The more efforts firms spend on promoting their products (possibly through advertising campaigns), the less costly a consumer’s search cost is, which may in turn have an impact on the observed level of price and price dispersion.

The predictions on the levels of price and price dispersion in the search-theoretic literature vary depending on the model used. Janssen and Non (2008) study a duopoly model in which information can come through either advertising or sequential consumer search. They find that advertising and search are “substitutes” for a large range of parameters and that expected prices of firms can increase or decrease depending on the search cost parameter.⁴ Reinganum (1979) proposes a model in which consumer demand is downward sloping and firms have heterogeneous marginal costs. An equilibrium of price dispersion can arise with optimizing consumers and firms. The model also predicts that a reduction in search costs is associated with a lower level of price dispersion as a decrease in search costs reduce consumers’ reservation price, which induce the marginal high-cost firms to lower their prices. Since the low-cost firms do not change their prices, price dispersion becomes lower with lower search costs. On the

¹ See the article “Taipei’s Market Intelligence Center predicts e-shopping growth in Taiwan” by Ecommerce Journal on October 30, 2008.

² See Baye et al. (2006) for a summary of the literature on clearing house models and search-theoretic models.

³ For studies focusing on online versus offline comparisons see Brynjolfsson and Smith (2000) and Scholten and Smith (2001). See also the literature section for studies related to clearing house models.

⁴ Stivers and Tremblay (2005) recognize the importance of informative advertising in the reduction of consumer search costs.

other hand, MacMinn (1980) studies a model in which consumers engage in optimal fixed sample size search and shows that a dispersed price equilibrium exists if search costs are sufficiently low. Moreover, lower search costs induce consumers to sample more firms before they purchase, which leads to a higher level of price dispersion. Thus, depending on the model, a reduction in search costs may be associated with lower levels of price dispersion (the Reinganum model) or higher levels of price dispersion (the MacMinn model).

Our second objective is to investigate how a more competitive environment affects the price level and the price dispersion in the online market. For the effects of the number of firms on the level of price and price dispersion, economic theory does not give a clear-cut prediction. Although it is widely documented in the literature that an increase in the number of competitors leads to a lower market price, some works show the contrary (for example, Satterthwaite, 1979; Rosenthal, 1980; Stahl, 1989, 1996; Diamond, 1971). Recently, Janssen and Moraga-González (2004) examine an oligopoly model in which some consumers engage in costly non-sequential search. They find that the equilibrium expected price may be constant, increasing, or non-monotonic in the number of firms. Moreover, Janssen and Moraga-González (2000) show that price dispersion can increase or decrease with respect to the number of rivals. Thus, heightened competition can increase or decrease the level of price dispersion.

We examine the online book industry by providing evidence on the level of competition and price dispersion in the Taiwan online book market. Clay et al. (2001) study the U.S. online book market and provide evidence that prices and price dispersion are lower for advertised items or items that are purchased repeatedly than for unadvertised or infrequently purchased items. Although Clay et al. (2001) report that price dispersion is higher with more competitive firms, the level of price dispersion can vary depending on the model used as mentioned above. Thus, there is a need to re-examine how price dispersion is affected by adding competitive firms.

Pricing information from several online book sellers in Taiwan was collected for the purpose of this study. The shopping environment in the current study is closer to that of search-theoretic models as consumers have to incur costs (browse different web pages) in order to gather price information from different online bookstores. The online market in Taiwan is relatively mature among countries in the same region. According to the World Economic Forum (WEF) Global Information Technology Report of 2013, Taiwan ranks 5th in the B2C (Business-to-Customer) internet use and ranks 11th in the Network Readiness Index. Also, the report by McKinsey & Company (2012) states that online retail sales in Taiwan have reached \$2.4 billion in 2010, due to Taiwan's strong internet infrastructure and retail environment. Moreover, Taiwan's Internet ecosystem maturity is close to that of leading countries in the same region such as Japan and South Korea.⁵ The traditional paper-based book market is estimated to be worth \$1 billion (US dollars) per annum at the retail level, reaching \$1.38 billion in 2010.⁶ According to the 2010 Taiwan Publishers Survey published by the Taiwan Government Information Office, the sales revenue of online bookstores run by various book-selling channels

⁵ Our findings from the study of Taiwan's online market can provide useful reference to countries with similar internet maturity.

⁶ Information is found from the article "Doing Business in Taiwan: 2011 Country Commercial Guide for U.S. Companies" prepared by U.S. Commercial Service, Department of Commerce, United States of America. Also see the report: PA Market Report Taiwan, published on May, 2011, by Research and Markets, a leading market research firm with head office based in Dublin, Ireland.

such as book publishers or retailers account for about 76.7% of the total sales revenue of those different book-selling channels.⁷ Currently there are more than 80 online bookstores in operation. Some of the online bookstores such as Books.com and Kingstone.com carry a wide selection of books, while others such as mdnkids.com or skinfo.com are maintained by book publishers and carry only a limited selection. The general public, however, is most likely familiar with only less than five online stores.⁸ The fact that each book is identified by a unique ISBN number makes the data collection process easier compared to other types of products. Moreover, we do not have to worry about product heterogeneities when, for example, two bookstores both carry the same book with the same ISBN number.

Using data collected from several online booksellers in Taiwan, we find that both normalized prices and price dispersion are lower for books that are more often purchased or advertised. We also find that the big three bookstores and fringe bookstores price differently when facing competition from the rivals and that price dispersion tends to be lower with the number of competing rivals.

The rest of the paper is organized as follows. In the next section, we summarize the related literature. We then describe our dataset and the data collecting process, give summary statistics of the dataset, and analyze the results. Finally, we make conclusions and give suggestions for future research.

II. Literature

Stigler (1961) was the first to model price dispersion in a search-theoretic framework. Rothschild (1973) gives a critique by pointing out that the fixed sample size search in Stigler's model may not be optimal, and that the distribution of prices is not based on optimizing firm behavior. Diamond (1971) goes one step further by identifying conditions under which the unique equilibrium involves all firms charging the monopoly price. Reinganum (1979), MacMinn (1980), and Burdett and Judd (1983) are representative search-theoretic models of price dispersion. In addition to differences in predictions on the levels of price dispersion, different search-theoretic models differ in assumptions made about consumers' search behaviors – in the Reinganum model, consumers engage in sequential search while in MacMinn and Burdett and Judd models consumers engage in fixed sample size search.

Reinganum (1979) proposes a model in which there is a continuum of identical consumers and firms. Each consumer's utility can be represented by $U(W, p_0, p)$, where W is the wealth, p is the price paid by the consumer and p_0 is the vector of fixed prices for all other goods. Consumers search sequentially with replacement and free recall from a known price distribution $F(p)$ on the closed interval $[\underline{p}, \bar{p}]$ where $\bar{p} > \underline{p}$ in R^+ . Consumers have to incur a fixed sampling cost k for each price observation. Thus, they must weigh the expected benefits against the cost of an additional search. Firms have heterogeneous marginal costs. Firms offer a homogeneous product for sale. Each firm has a constant marginal cost distributed according to

⁷ The Taiwan Publishers Survey is conducted annually by the Taiwan Government Information Office, Executive Yuan. The purpose of the survey is to understand the operating environment, trend, and challenges facing booksellers and publishers in Taiwan.

⁸ Lu (2003) provides a detailed description of the recent emergence of the leading online book sellers in Taiwan.

a distribution function $G(c)$ which is continuously differentiable and has a positive density. Firms are perfectly informed of buyers' reservation prices and demand curves, and each firm sets its price in order to maximize its expected profits. Reinganum (1979) shows that there exists a unique reservation price r such that the expected net benefits from obtaining an additional price quote is just equal to zero. Using the Reinganum (1979) framework, Baye, Morgan and Scholten (2006) show that the reservation price r increases with the search cost k (i.e., $\frac{dr}{dk} > 0$) and that the variance of prices (σ^2) increases with the reservation price r (i.e., $\frac{d\sigma^2}{dr} \geq 0$).⁹ Hence, price dispersion is lower when the search cost becomes lower in the Reinganum model.

MacMinn (1980) studies a model in which consumers engage in an optimal fixed sample size search. A sample size n is drawn from a distribution of prices. Consumers need to search as they know the distribution of prices but not the price charged by a particular firm. Each price draw costs c dollars where $c > 0$. Thus, consumers' decision rule is to minimize the expected payment which includes an expected minimum price in n searches and the search cost cn . A consumer continues to increase the sample size as long as the expected gain, i.e., the reduction in searched price, is greater than the search cost. Firms differ in their marginal costs that are privately observed. The marginal costs are distributed according to an atomless distribution function $H(m)$ on $[\underline{m}, \bar{m}]$ where \bar{m} is less than the monopoly price. MacMinn (1980) shows that a non-degenerate price distribution exists for a sufficiently small search cost and that the level of price dispersion depends on the firms' cost distributions. Assuming that firms' costs are uniformly distributed, the variance of firms' equilibrium prices (σ^2_x) are given by $\sigma^2_x = \left(\frac{n-1}{n}\right)^2 \sigma_m^2$, where n is the number of searches by consumers and σ_m^2 is the variance of firms' costs. MacMinn (1980) shows that the variance of equilibrium price is a monotonic decreasing function of the search cost.¹⁰

For the effect of the number of firms on the level of price, there exists works which show that price and the number of firms exhibit a positive relationship despite the vast literature that shows that price and the number of firms are negatively related (Satterthwaite, 1979; Rosenthal, 1980; Stahl, 1989, 1996; Diamond, 1971). Moreover, a non-definite relationship between the level of competition and price or price dispersion are found in some other works (Janssen and Moraga-González, 2004; Janssen and Moraga-González, 2000).

Empirical studies related to the search literature include Milyo and Waldfogel (1999) and Sorenson (2000). Milyo and Waldfogel (1999) found that increased advertising lower prices on some but not all products, and that price dispersion was stable or increasing in the short run. Sorenson (2000) examines drug prices and finds that price dispersion is lower if the prescription is purchased repeatedly than if its purchased occasionally. Clay et al. (2001) first examine price and price dispersion online in a search-theoretic framework. Other empirical works related to consumers' information acquisition include Baye et al. (2004), Hong and Shum (2006), and Baye et al. (2006). Baye et al. (2006) find that the 28 percent of price dispersion

⁹ In Baye, Morgan, and Scholten (2006), consumer search cost is denoted c .

¹⁰ Baye, Morgan, and Scholten (2006) also give a good mathematical summary of the Macminn (1980) model.

remains after controlling for spatial heterogeneities. They argue that the remaining proportion of observed price dispersion is attributable to consumers' information acquisition.¹¹

III. *The Model*

Given our previous discussions, the regression models can be summarized as follows. First, for the relationship between the price level, advertising, and the level of competition, the following regression model is estimated.

$$\begin{aligned} \text{Normalizedprice} = & \alpha_0 + \alpha_1 \text{BestSeller} + \alpha_2 \text{NumberofFirms} + \alpha_3 \text{BookCategories} \\ & + \alpha_4 \text{ControlVariables} + \varepsilon_1 \end{aligned}$$

where the dependent variable is the normalized price of each observation. Notice that in the above specification, subscripts it denoting each book (i) and each week (t) are omitted for conciseness. *BestSeller* is a dummy variable which indicates whether a book is included in the best seller list of an online bookstore in a particular week. Clay et al. (2001) also include this variable in their regression analysis as an indicator of observation that is subject to more advertising. *NumberofFirms* denotes the number of firms posting prices for a particular book in a particular week. The number of firms is commonly used in the economic literature to capture the extent of firm competition. For example, Clay et al. (2001), Barron et al. (2004), and Baye et al. (2004), among others, include the number of firms as an indicator of the level of competitiveness in their regression analysis. *BookCategories* denotes book categories. We divide the sample books into eight categories – Arts and design, body and soul, business and money, children and family, language and learning, life and leisure, literature and fiction, and science and human science. These are also the categories used by Books.com. *ControlVariables* denotes the vector of other explanatory variables which may influence the price level such as firm and week fixed effects while ε_1 is the error term.

Similarly, for the relationship between price dispersion, advertising, and the level of competition, the following regression model is estimated:

$$\begin{aligned} \text{PriceDispersion} = & \beta_0 + \beta_1 \text{BestSeller} + \beta_2 \text{NumberofFirms} + \beta_3 \text{BookCategories} \\ & + \beta_4 \text{ControlVariables} + \varepsilon_2 \end{aligned}$$

where the dependent variable is the level of price dispersion for each book in each week. The independent variables (*BestSeller*, *NumberofFirms*, *BookCategories*, and *ControlVariables*) are of the same meaning as in the previous specification. ε_2 is the error term.

¹¹ In addition to considerations on consumers' information acquisition, empirical work examining violations of the "law of one price" in seemingly homogeneous online product markets can also be rationalized by considerations on spatial heterogeneities. Empirical spatial considerations have ranged from examining observable seller heterogeneities on dimensions like branding, trust, and whether the seller use single- or multi-channels to distribute its products (cf. Smith et al.(1999); Brynjolfsson and Smith (2000); Clay et al. (2001); Smith and Brynjolfsson (2001); Tang and Xing (2001); Chen and Hitt (2002); Resnick and Zeckhauser (2002); Chevalier and Goolsbee (2003); and Brynjolfsson et al. (2004)).

TABLE 1. LIST OF ONLINE BOOKSTORES INVESTIGATED

Bookstores	Sales scale (in TWD)	Number of Brick-and-mortar establishments
博客來 Books.com.tw	4,000,000,000 in 2010	0
金石堂 Kingstone.com.tw	3,000,000,000 in 2012	73
誠品 Eslite.com	9,800,000,000 in 2012	43
華文網 book4u.com.tw	Unknown	0
三民 sanmin.com.tw	40,000,000 paid in capital in 2011	2
遠流 ylib.com	184,373,750 paid in capital in 2011	0
聯經 linkingbooks.com.tw	800,000,000 to 900,000,000 in 2005	2
三采 suncolor.com.tw	Unknown	1
新絲路 silkbook.com	Unknown	0
舒讀 sudu.cc	Unknown	0
晨星 morningstar.com.tw	Unknown	0
城邦花園 cite.com.tw	1,800,000,000 in 2008 for the entire Cite Publishing Ltd.	4
PChome 24H PChome.com.tw	3,134,000,000 in 2011 for the entire PChome	0

Notes:

1. The sales scale for Books.com.tw is obtained from the news reported by Chinatimes.com on Jun 9, 2011. The sales scale for Linkingbooks.com.tw is obtained from the news reported by Udnnews.com.tw on December 21, 2005. The sales scales for Kingstone.com.tw, Eslite.com, Sanmin.com.tw, Ylib.com, Cite.com.tw, and PChome.com.tw are obtained from Wikipedia. For Sanmin.com.tw and Ylib.com, only paid in capital is reported as information of sales revenue for these two bookstores are not available. Sales revenues for the following online bookstores Book4u.com.tw, Suncolor.com.tw, Silkbook.com, Sudu.cc, and Morningstar.com.tw are unknown.
2. One USD (US dollar) was equivalent to about 32 TWD in 2005, 2008, and 2010. One USD was equivalent to about 29 to 30 TWD in 2011 and 2012.
3. The 38 brick-and-mortar establishments reported above for Eslite.com have excluded those establishments that do not sell books. Eslite.com's sales revenue from books takes up about 30% of its total sales revenue of 9,800,000,000 New Taiwan Dollars (TWD).
4. The sales revenue reported above for cite.com.tw is the sales revenue for the entire Cite Publishing Ltd. It is not clear, however, how much revenue is generated from the cite.com.tw website. Similarly, the sales revenue reported above for PChome.com.tw represents sales revenue for the entire PChome online Inc. Since PChome.com.tw carry a lot of merchandises other than books, it is not clear how much revenue is generated from the sale of books.

IV. Data

We focus on online bookstores selling Chinese books and investigate the list of online book sellers in Taiwan provided by Industrial Technology Research Institute.¹² After eliminating those bookstores that went out of business, those without accessible websites, and those that sell only electronic books, we are left with 13 online booksellers.¹³ Table 1

¹² The Industrial Technology Research Institute (ITRI) is a non-profit R&D organization engaging in applied research and technical services. Founded in 1973, ITRI is headquartered in Hsinchu, Taiwan, and has offices and partners around the globe.

¹³ For example, Pubu.com sells electronic books only, while Coolbooks.com.tw and Aplo.com.tw do not carry any books sampled in our current study.

summarizes the 13 online book sellers we investigate in the current sample. Among the 13 bookstores in our list, Books.com.tw (or simply Books.com), Kingstone.com.tw (or Kingstone.com or simply Kingstone when there is no confusion), and Eslite.com (or simply Eslite) are the largest three online book sellers in Taiwan.¹⁴ Kingstone.com and Eslite.com both have their brick-and-mortar establishments in addition to their online businesses, while Books.com operates its business purely online.

Kingstone is the oldest chain bookstore in Taiwan. Since its establishment in 1983, it has accumulated more than 70 branches around the island of Taiwan. In year 2000, it extended its business into the internet and established its online store Kingstone.com.¹⁵ Eslite was established in 1989. It has a total of 38 branches in Taiwan in addition to its online business.¹⁶ Books.com has grown to be the largest online bookstore in Taiwan since it started its business in 1996. Each day more than 100,000 unique visitors visit the website of Books.com according to Website Shadow, a web research firm who collects information from other websites and reports the number of page views, unique visitors, and potential website value, etc.¹⁷ In addition to books, Books.com also carries a huge stock of other merchandise such as CDs, DVDs, electronics, and other appliances.¹⁸

Most of the online booksellers we investigate carry a balanced variety of books compared to other online booksellers.¹⁹ Among these booksellers, Kingstone.com, Eslite.com, Sanmin.com, Lingkingbooks, Suncolor, and Cite.com.tw have their brick-and-mortar establishments in addition to the online businesses, while the rest booksellers operate their businesses purely online.

Price information was collected each week starting from the week of August 30, 2010 up to the week of December 27, 2010 for a total of 18 weeks. Since most online bookstores do not change their prices on a daily basis, we do not lose too much information by collecting data on a weekly basis. Each week we collected price information on a panel of books which include the most popular 100 books of Books.com. When a book goes out of the best seller list, we continue to track the price information for that particular book. Our sample includes a total of 337 books. Each book can be identified by a unique ISBN number. Hence, a book carried by one online seller is exactly the same book carried by another online seller if these books share the same ISBNs. The unique ISBN associated with each book makes price comparisons across

¹⁴ According to our casual chats with some book sellers, most identify these three as the largest bookstores in Taiwan.

¹⁵ Lu (2003) reports that Digital Kingstone Co. Ltd, or Kingstone.com, has about 120,000 books available online.

¹⁶ Eslite.com has some branches that do not carry books. These 38 branches reported here have excluded those establishments that do not sell books.

¹⁷ According to Website Shadow's report as of December 25th, 2009, Books.com has 102,795 unique visitors and 760,683 unique pageviews each day. Similar information on Eslite.com and Kingstone.com, however, is not available.

¹⁸ Books.com claims to sell close to 3 million types of merchandise on its website. Lan and Sun (2006) report that Books.com boasts a total of 1.41 million products sold online, and has been posting an average daily turnover of 200,000 items. In 2005, the online bookstore's sales amounted to NT\$1.15 billion.

¹⁹ Some online booksellers are not included in our sample because of their specialized varieties. For example, Skinfo.com, Gotop.com, Flag.com and OpenTech.com mainly specialize in computer books and books related to science and technology. Two other online booksellers, Gotop.com and flag.com, are excluded from our sample since consumers can not buy directly from their websites. A consumer who sees a price or book information on either Gotop.com or Flag.com either has to go to a brick-and-mortar store or is referred to other online booksellers such as Books.com or Kingstone.com if he/she wants to make a purchase.

TABLE 2. SUMMARY STATISTICS

# of price observations	31548	
# of books	337	
# of book-weeks	4144	
Average (Equal weight for each observation)		
Recommended price	311	(104.2)
Unit price	252	(84.7)
Discount	82%	(0.05)
Average (Equal weight for each book)		
Recommended price	313.84	(118.35)
Unit price	251.68	(90.05)
Discount	82%	(2.73)
Normalized price	0.82	(0.04)
Minimum price	240.29	(85.29)
Maximum price	273.393	(102.43)
Range	33.11	(33.98)
Number of sellers	7.69	(1.22)
Price Dispersion Measures		
Average percentage gap	1.36	(2.91)
Average percentage range	13.9	(13.56)
Average coefficient of variation	5.23	(3.55)

Notes: Standard deviations are in the parenthesis.

The recommended price is the publisher's suggested retail price of a book. The unit price is the price offered by an online bookseller on its website. The normalized price is defined as the unit price divided by the publisher's recommended price.

The three price dispersion measures are defined as follows. For each book-week, "percentage gap" is defined as the percentage change between the lowest two prices, "percentage range" is defined as the percentage change between the highest price and the lowest price, and "coefficient of variation" is defined as the standard deviation divided by the mean price times 100.

different online sellers easy since consumers know that they are getting exactly the same product.

For each book, we collect information on its advertised price, the publisher's recommended price, percentage discount, and other specials such as rebates, coupons, or earned store points, etc., offered by a particular online bookstore.

V. Summary Statistics

Table 2 summarizes the statistics of the dataset. The current sample includes 337 books. A book is included in the sample if it is among the top 100 best sellers on Books.com in one of the sample weeks. For each book, we track its price information on the 13 online bookstores as in Table 1. This gives us a total of 66,834 website visits. Some online booksellers do not carry books in our sample. After eliminating those observations without price information or with missing values, we are left with 31,548 price observations in the current sample. Therefore, for

TABLE 3. PERCENTAGE AVAILABILITY OF BOOKS BY BOOKSTORE

Bookstore	Percentage availability	Standard deviation
博客來 Books	100.00	0
金石堂 Kingstone	95.69	1.84
誠品 Eslite	93.90	1.64
華文網 Book4u	95.43	1.25
三民 Sanmin	93.22	2.46
遠流 Ylib	8.72	1.03
聯經 Linkingbooks	75.49	2.05
三采 Suncolor	0.58	0.19
新絲路 Silkbook	94.50	1.42
舒讀 Sudu	3.94	0.34
晨星 Morningstar	1.24	0.19
城邦花園 Cite	13.30	1.32
PChome	82.44	1.71

Notes: Percentage availability is defined as the number of sample books advertised by a bookstore on its website in a week divided by the total number of sample books for the same week, and then averaged across all weeks.

each book in each week (we call this a book-week), we have a list of online booksellers posting a price on their respective websites. We have a total of 4,144 book-weeks in the sample.

Table 2 reports average prices for the recommended price, the unit price and the normalized price. Average prices are taken with equal weight for each observation and with equal weight for each book respectively. The recommended price is the publisher's suggested retail price of a book. The unit price is the price offered by an online bookseller on its website. The normalized price is defined as the unit price divided by the publisher's recommended price.²⁰ Since the unit price or the publisher's recommended price may differ across different categories of books, using the normalized price allows us to make comparisons across different categories of books. The average normalized price for our sample (with equal weight for each book) is 0.82.

Following the traditional measures of price dispersion, we also report the average percentage gap, the average percentage range, and the average coefficient of variation. For each book-week, "percentage gap" is defined as the percentage change between the lowest two prices, "percentage range" is defined as the percentage change between the highest price and the lowest price, and "coefficient of variation" is defined as the standard deviation divided by the mean price times 100.

Table 3 summarizes the percentage availability of books for each bookstore in our sample. Percentage availability is defined as the number of sample books advertised by a bookstore on its website in a week divided by the total number of sample books for the same week, and then averaged across all weeks. Six online booksellers – Books.com, Kingston.com, Eslite.com,

²⁰ We compute the normalized price since some online bookstores do not report the percentage discounts of a book on their websites. We can infer the percentage discounts by dividing the unit price by the publisher's recommended price. Thus, the normalized price is the inferred percentage discount.

TABLE 4. AVERAGE NORMALIZED PRICE BY BOOKSTORE

Bookstore	Mean	Standard deviation
博客來 Books	0.79	0.0067
金石堂 Kingstone	0.80	0.0047
誠品 Eslite	0.84	0.0287
華文網 Book4u	0.82	0.0036
三民 Sanmin	0.83	0.0117
遠流 Ylib	0.87	0.0121
聯經 Lingkingbooks	0.78	0.0010
三采 Suncolor	0.76	0.0473
新絲路 Silkbook	0.82	0.0033
舒讀 Sudu	0.79	0.0026
晨星 Morningstar	0.73	0.0496
城邦花園 Cite	0.80	0.0066
PChome	0.79	0.0008

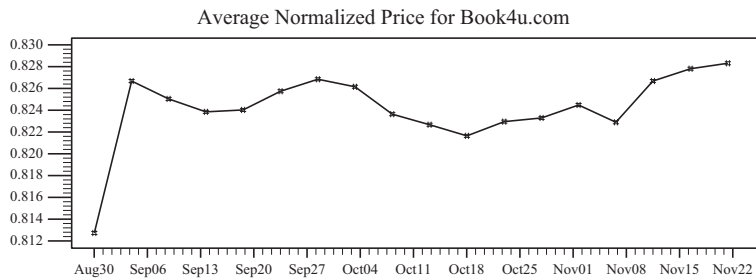
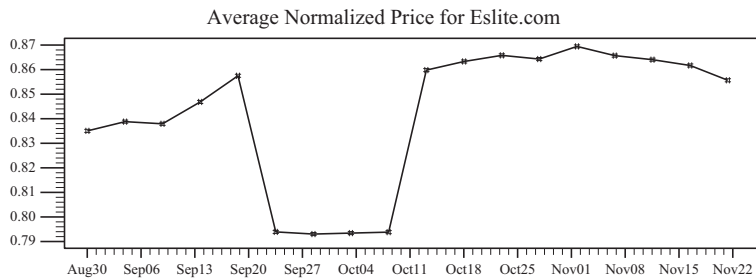
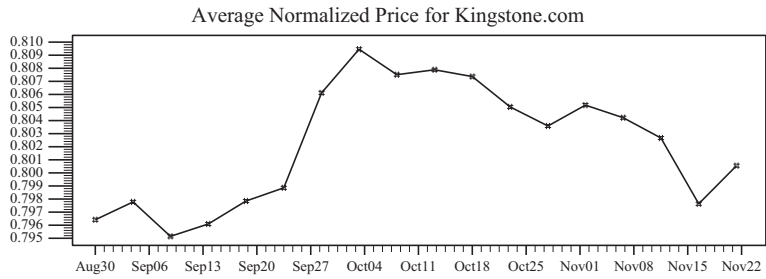
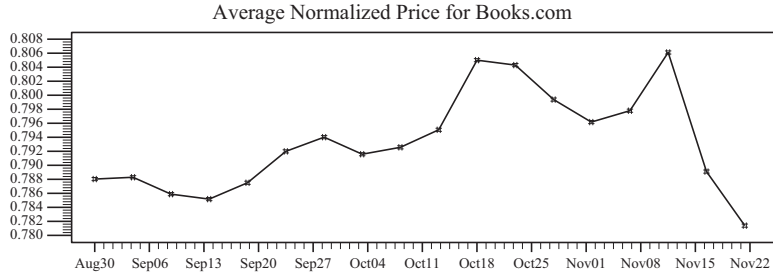
Book4u.com, Sanmin.com, and Silkbook.com carry more than 90 percent of the books in our sample. The percentage availability varies across the rest of the booksellers, with PChome.com carrying about 82 percent and Lingkingbooks.com carrying about 75 percent of the sample books. Cite.com and Ylib.com each carry only less than 15 percent of the sample books. Sudu.com, Suncolor.com, and Morningstar.com each carry less than 5 percent of the sample books.

VI. Results

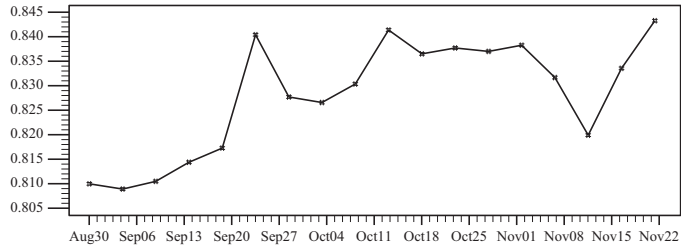
Table 4 summarizes the average normalized price for each bookseller in our sample. We see that the average normalized price differ across booksellers, with 0.87 to be the highest for Ylib.com, and 0.73 to be the lowest for Morningstar.com. Figure 1 illustrates the average normalized price for each bookseller. There is no clear pattern of price changes for the booksellers except Sudu.com, which maintains a mostly stable normalized price except during late September and early October of 2010. Suncolor.com maintains a stable normalized price for about 7 weeks before it adjusted its prices downwards. The rest of the booksellers all fluctuate in their normalized prices over the entire period of the sample period. The normalized prices illustrated in the diagrams are consistent with the average normalized prices found in Table 4. The overall pattern of the price changes, however, is restricted only to the duration of our sample.

In Table 5 and Table 6, we run four sets of regressions using normalized price and standard deviation of normalized price as independent variables respectively. In both Tables, specification (1) shows the baseline regression with book categories, store and week fixed effects as independent variables. As mentioned earlier, the sample books are divided into eight categories – Arts and design, body and soul, business and money, children and family, language and learning, life and leisure, literature and fiction, and science and human science. The omitted variable in this table is science and human science. Specification (2) adds a variable “best seller” into the regression. The variable “best seller” is a dummy variable which indicates whether a book is included in the best seller list of an online bookstore in a particular week. In

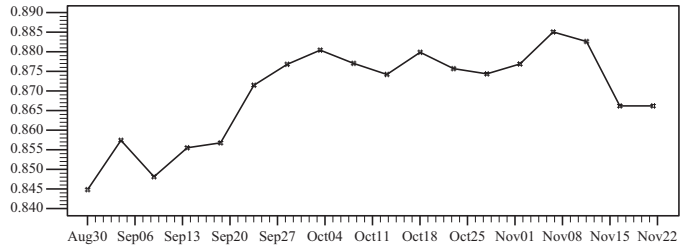
FIG. 1. AVERAGE NORMALIZED PRICE FOR EACH BOOKSTORE



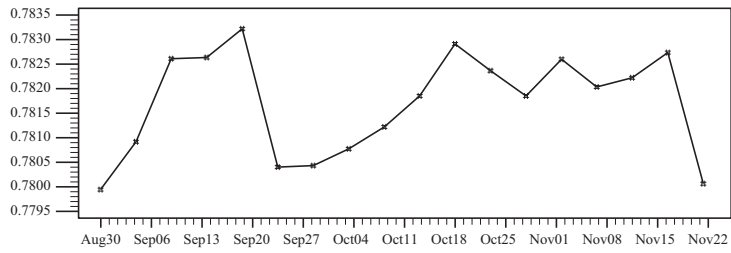
Average Normalized Price for Sanmin.com



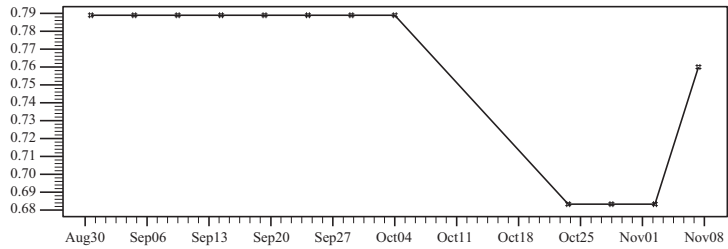
Average Normalized Price for Ylib.com

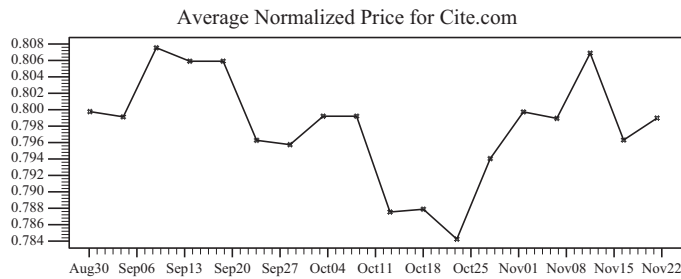
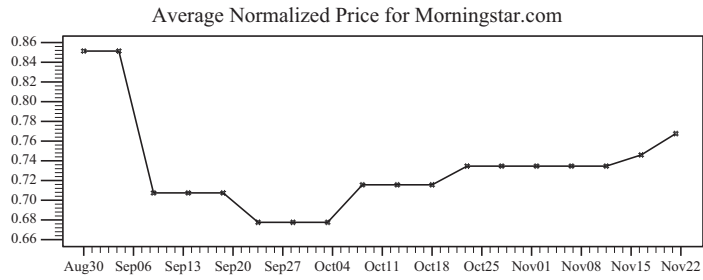
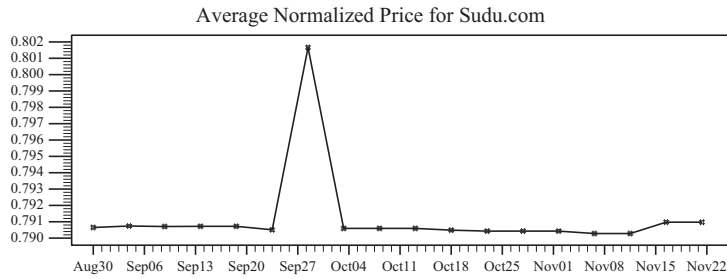
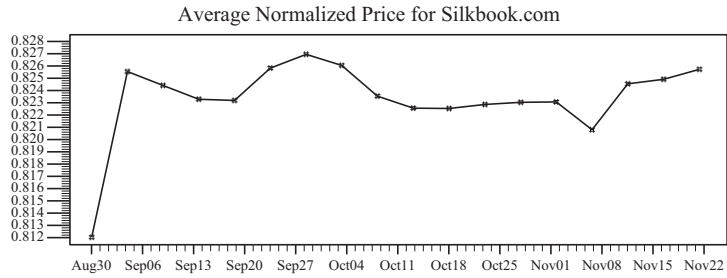


Average Normalized Price for Lingkingbooks.com



Average Normalized Price for Suncolor.com





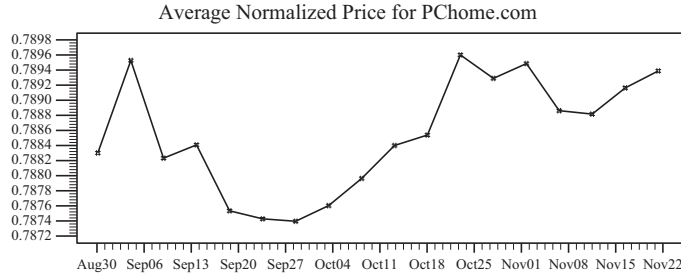


TABLE 5. NORMALIZED PRICE REGRESSION FOR THE BIG THREE AND FRINGE BOOKSTORES

	Entire sample (1)	Entire sample (2)	Big three bookstores (3)	Fringe bookstores (4)
Constant	0.82314 (0.002256)	0.8240066*** (0.0022464)	0.841197*** (0.00659)	0.858446*** (0.005412)
Best seller		-0.0159021*** (0.0009538)	-0.00679*** (0.001279)	-0.02762*** (0.001488)
Number of big three bookstores			-0.01497*** (0.001989)	-0.0135*** (0.001612)
Number of fringe bookstores			0.002875*** (0.000508)	0.00022 (0.000441)
Arts and design	-0.00257 (0.001792)	-0.0032819* (0.001785)	0.000997 (0.0003083)	-0.00589*** (0.002136)
Body and soul	-0.01574*** (0.001436)	-0.144743*** (0.0014319)	-0.01671*** (0.002474)	-0.01304*** (0.001721)
Business and money	-0.00846*** (0.001419)	-0.0077753*** (0.0014137)	-0.01401*** (0.002457)	-0.00442*** (0.001685)
Children and family	-0.00188 (0.00159)	-0.0014801 (0.0015827)	-0.00963*** (0.002719)	0.004099** (0.00191)
Language and learning	-0.00445*** (0.001545)	-0.0046606*** (0.0015387)	0.004059 (0.002654)	-0.00973*** (0.001896)
Life and leisure	-0.00365*** (0.001386)	-0.0029952** (0.0013805)	-0.01258*** (0.002396)	0.001207 (0.001671)
Literature and fiction	-0.01317*** (0.001316)	-0.0126271*** (0.0013109)	-0.01885*** (0.002275)	-0.00848*** (0.00158)
Store fixed effects	Yes	Yes	Yes	Yes
Week fixed effects	Yes	Yes	Yes	Yes
Number of observations	31548	31548	19519	12029
R-squared	0.1875	0.1946	0.215	0.2107

Notes: Standard errors are in the parentheses.

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

specifications (3) and (4), we run another two sets of regressions by dividing the entire sample into two subsets – the big-three bookstores sample and the fringe bookstores sample.

Specification (2) of Table 5 shows that after controlling for store and week fixed effects, and the effects coming from different categories of books, a book is priced about 1.59% lower

TABLE 6. STANDARD DEVIATION REGRESSION FOR THE BIG THREE AND FRINGE BOOKSTORES

(Independent Variable: Standard deviation of normalized price in a book-week)

	Entire sample (1)	Entire sample (2)	Big three bookstores (3)	Fringe bookstores (4)
Constant	0.042799*** (0.002392)	0.0457817*** (0.0023566)	0.058092*** (0.002582)	0.058008*** (0.004362)
Best seller		-0.0102919*** (0.0003233)	-0.01095*** (0.000419)	-0.00929*** (0.000522)
Number of big three bookstores			-0.00158** (0.000785)	0.000855 (0.000566)
Number of fringe bookstores			-0.00096*** (0.000168)	-0.00176*** (0.000155)
Arts and design	-0.0021*** (0.000612)	-0.002555*** (0.0006027)	-0.00391*** (0.001004)	-0.00196** (0.00075)
Body and soul	-0.01051*** (0.000491)	-0.0096908*** (0.0004835)	-0.01164*** (0.000807)	-0.00934*** (0.000604)
Business and money	-0.0076*** (0.000485)	-0.0071555*** (0.0004774)	-0.00835*** (0.000801)	-0.00641*** (0.000592)
Children and family	-0.00294*** (0.000544)	-0.0026405*** (0.0005359)	-0.0042*** (0.000891)	-0.00245*** (0.00067)
Language and learning	-0.00254*** (0.000528)	-0.0026715*** (0.0005195)	-0.00453*** (0.000865)	-0.00364*** (0.000665)
Life and leisure	-0.01004*** (0.000474)	-0.0095992*** (0.0004664)	-0.01184*** (0.000783)	-0.0094*** (0.000587)
Literature and fiction	-0.01033*** (0.00045)	-0.0099795*** (0.0004427)	-0.01161*** (0.000742)	-0.01008*** (0.000555)
Store fixed effects	Yes	Yes	Yes	Yes
Week fixed effects	Yes	Yes	Yes	Yes
Number of observations	31548	31548	19519	12029
R-squared	0.0758	0.1047	0.1339	0.0948

Notes: Standard errors are in the parentheses.

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

if it is included in the best-seller list of an online bookstore than if it is not. Specifications (3) and (4) show the regression results for the big-three bookstores and the fringe bookstores, respectively. The coefficients on “best seller” are negative and significant in both specifications. Thus, an increase in the number of best sellers in a book-week has a negative impact on the normalized price of big-three bookstores and the fringe bookstores. Best selling books are associated with a larger customer base than non-best selling books. Thus, bookstores tend to lower their prices in order to compete for the larger customer base associated with best selling books. The effect of the decrease in the normalized price, however, is larger for the fringe bookstores (2.76%) than for the big-three bookstores (0.68%). The reason may be due to the fact that fringe bookstores are less well-known than the big three bookstores. Thus, fringe bookstores have to cut their prices further than the big three in order to attract customer attention. On the other hand, each of the big-three bookstores carries a brand name which allows them to set prices higher than the fringe bookstores.

The coefficient on the number of big three bookstores is negative and significant while the

coefficient on the number of fringe bookstores is positive and significant in specifications (3). Thus, the big-three bookstores tend to lower their prices when there are more firms of the same type but raise their prices when there are more firms of the other type in a book-week. The coefficient on the number of big-three bookstores is negative and significant in specification (4), indicating that fringe bookstores tend to lower their prices when there are more firms of the other type. The coefficient on the number of fringe bookstores is positive but not significant in specification (4). Overall, the coefficients on the number of big three bookstores and the number of fringe bookstores in specifications (3) and (4) suggest that competition is more intense when there are more big-three bookstores but less intense when there are more fringe bookstores in a book-week.

Table 6 shows the regression results using standard deviation of normalized price in a book-week as the dependent variable. Specification (2) shows that after controlling for store and week fixed effects, and the effects coming from different categories of books, the standard deviation of normalized price is lower when the number of best selling books is higher. Moreover, specifications (3) and (4) show that an increase in the number of best sellers leads to a decrease in the standard deviation of normalized price for the big-three bookstores and the fringe bookstores sample.

For the coefficients on the number of big three bookstores and the number of fringe bookstores, specification (3) shows that for the big-three bookstores sample, standard deviation of the normalized price decreases with the number of big three bookstores and the number of fringe bookstores. Specification (4) shows that for the fringe bookstores sample, standard deviation of the normalized price increases with the number of big three bookstores but decreases with the number of fringe bookstores. However, only the coefficient on the number of fringe bookstores is significant in specification (4).

VII. *Conclusions and Discussions*

We study how consumers' search costs are associated with the levels of online price dispersion and the market price. The intuition is as follows. The more efforts firms spend on promoting their products, the less costly a consumer's search cost is, which may in turn have an impact on the observed level of price and price dispersion. We collect data from 13 online booksellers in Taiwan and provide evidence that both normalized prices and price dispersion are lower for books that are more often purchased or advertised. Our result that normalized prices are lower for books that are more often purchased or advertised is consistent with Clay et al. (2001). Moreover, we find that price dispersion is also lower for items that are more often purchased or advertised. As stated in the Introduction section, the level of price dispersion can vary depending on the model used. Our result that price dispersion is lower for items that are more often purchased or advertised is consistent with the predictions of Reinganum (1979).

For the effect of the number of firms on the normalized price, our results show that competition tend to be heightened when there are more big-three bookstores but lessened when there are more fringe bookstores in a book-week. Thus, for both the big-three and the fringe bookstores samples, the observed normalized prices are lower when the number of big-three bookstores increases but higher when the number of fringe bookstores increases. Interestingly, our data shows that facing competition from the rivals, the fringe bookstores may adopt

different pricing strategies from those of the big three bookstores. This result is different from that documented by Clay et al (2001), who find that normalized prices are lower with the number of competing firms.

For the effect of the number of firms on the level of price dispersion, our results show that for both the big-three and the fringe bookstores sample, price dispersion is significantly lower when the number of fringe bookstores increases. Price dispersion is lower for the big-three bookstores sample when there are more big-three bookstores in a book-week, but the effect is not significant for the fringe bookstores sample. Taken together, our results indicate that price dispersion tend to be lower when the number of bookstores increases. This result is also different from that documented by Clay et al (2001), who find that price dispersion is mostly higher with the number of firms. Although past empirical literature generally agrees that the number of sellers has a crucial impact on the level of price dispersion, the direction of the impact is not entirely clear. For example, Marvel (1976) reports a negative relationship between the number of sellers and the dispersion of gasoline prices.²¹ Barron et al. (2004) find that an increase in station density reduces the dispersion of gasoline prices.²²

Our findings that the big three bookstores and the fringe bookstores price differently when facing competition from the rivals and that price dispersion tend to be lower with the number of competing bookstores are not entirely consistent with the findings of Clay et al (2001). Thus, our results provide useful reference for future research in the following two respects. First, more theoretical work is needed for giving a clear prediction on the different pricing responses of the big three and the fringe bookstores. One possibility may be for researchers to incorporate more types of firms (including the dominant firms and the fringe competitors) into the current search-theoretic framework. Second, more empirical work needs to be done in order to get a more definite conclusion on the relationship between the number of firms and the level of price dispersion especially for the online books industry.

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²¹ Note that Marvel (1976) measures dispersion by using the range of prices.

²² For a positive relation between price dispersion and the number of firms, see, for example, Borenstein and Rose (1994).

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