GCOE Discussion Paper Series
Global COE Program
Human Behavior and Socioeconomic Dynamics

Discussion Paper No. 272

Nonlinear Pricing of Japanese Newspapers

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August 2012

GCOE Secretariat
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August 5, 2012

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abstract

In Japan, the newspapers with the greatest daily circulation offer both morning and evening editions in most of their distribution areas. Their prices per page of actual content are different for morning-and-evening subscribers than for morning-only subscribers. So the subscription price schedules could be described as sliding scales. These are tariff schedules that are step functions, and thus nonlinear. My focus is on two aspects of nonlinear pricing by Japanese newspapers. The first is that pricing and circulation of the differing editions reveal parameters of the demand for newspaper content. I estimate these parameters using nonlinear least squares and find that price elasticity of demand is around *1.2*, while elasticity of demand with respect to pages of content is around *0.5*. Estimates from micro-data have price elasticity around *1.3* and elasticity with respect to pages of content around *0.4*. The second aspect of nonlinear pricing on which I focus is the distorting effect of demanders' incentive compatibility constraints on the newspaper publishers' choice of newspaper content. The newspaper publishers wastefully reduce the number of pages of content of their morning editions to deter morning-and-evening subscribers from cancelling their evening subscriptions. It is wasteful in the sense that the marginal value to subscribers of an additional page of content in the morning edition is less than the marginal cost.

JEL codes: D4,L4
Keywords: nonlinear pricing, two-sided markets, newspapers, advertising

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This research is supported by Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research (C), grant no. 22530227.

Nonlinear Pricing of Japanese Newspapers

1. Introduction

In Japan, the newspapers with the greatest daily circulation offer both morning and evening editions in most of their distribution areas. The national dailies (Yomiuri, Asahi, Mainichi, and Sankei) all do so and the bloc newspapers (Chunichi, Chogoku and Hokkaido) do as well. Typically, these offer subscribers a choice between subscribing to the morning edition only, or subscribing to both morning and evening edition. In some locales away from urban centers, the national newspapers are only offered as morning editions. And a number of regional newspapers with smaller circulation (To-o Nippo, Oita Godo, Iwate Nippo, Yamagata Shimbun, Ryukyu Shimpo) offer both morning and evening editions together, but with no option of subscribing to the morning edition only. Shizuoka Shimbun purports to offer subscribers a choice between morning and evening editions or just evening edition, but almost none opt for just the evening edition.

Consider the subscription pricing of the newspapers offered either as morning edition or morning plus evening edition. The modal prices (set by Yomiuri, Asahi, and Mainichi) since 2003 are 3,007 yen per month for the morning-only and 3,925 yen per month for morning-and-evening. Though seldom remarked, this is an example of nonlinear pricing in the sense that the price per page of actual content, that is price divided by printed pages exclusive of advertising, is different for morning-and-evening subscribers than for morning-only subscribers. So the subscription price schedules could be described as sliding scales. These are tariff schedules that are step functions, and thus nonlinear. Other examples of such pricing abound. Transport fares offered in differing quality classes, beverage prices that differ per unit depending on the size of container, prices of electricity that vary depending on monthly number of kilowatts used, and so on, are obvious examples.

My focus is on two aspects of nonlinear pricing by Japanese newspapers. The first is that pricing and circulation of the differing editions reveal parameters of the demand for newspaper content. I estimate these parameters using nonlinear least squares and find that price elasticity of demand lies around *1.2*, while elasticity of demand with respect to pages of content is around *0.5*. Producing these estimates solves a difficult problem in that almost all of the newspapers set exactly the same prices as one another. With virtually no cross-section (or temporal) variation in prices it is still possible to infer price elasticity of demand based on

an assumed relationship between individuals' valuations of pages of content and their valuations of subscriptions.

The second aspect of nonlinear pricing on which I focus is the distorting effect of demanders' incentive compatibility constraints on the newspaper publishers' choice of newspaper content. The newspaper publishers wastefully reduce the number of pages of content of their morning editions to deter morning-and-evening subscribers from cancelling their evening subscriptions. I estimate the value of this waste at around six yen per month per morning-only subscriber. All of this requires a general framework for thinking about newspaper pricing that takes into account that newspapers are platforms in two-sided markets. They sell both subscriptions and advertising, and the demand for advertising depends on the number of subscribers.

This paper contributes to the empirical literature on second-degree price discrimination. It also contributes to the econometric analysis of platforms in two-sided markets, newspapers in particular. Empirical studies of second-degree price discrimination, that is price discrimination relying on self-selection of demanders when presented with a nonlinear pricing schedule, include Cohen (2001) for paper towels, Busse and Rysman (2005) for yellow pages advertising, McManus (2007) for coffee drinks, and Shum and Crawford (2007) for cable television subscriptions. Econometric analysis of newspaper pricing include Van Argentesi and Filistrucchi (2007) for Italy, Cayseele and Vanormelingen (2009) for Belgium, and Fan (2011) for the United States.

A novel contribution here is an original partial-equilibrium model of the demand for subscriptions to morning edition and morning-and-evening edition of a newspaper that enables estimates of the effect of incentive-compatibility constraint on pages of content in the morning edition. I find that the Japanese newspapers that offer a choice between morning-only subscription and morning-and-evening subscription reduce the number of pages of content in the morning edition by about six percent, to deter morning-and-evening subscribers from switching to morning-only. A further novel contribution is use of the same model as a new way of estimating elasticity of demand for newspapers with respect to subscription price and pages of content, using very limited data.

2. Basic Framework.

I begin by describing the pricing and content choices of a single-edition newspaper, for example one that is offered in morning edition only. Let us suppose that the demand for ads

"*a*" depends on the price to place an ad per subscriber "p_a/s" and that the readers regard the ads indifferently. Here an ad is defined as a printed item supplied to all subscribers, the same as the subscription content *k*. The only difference is that the ad is paid for by the advertiser but the other content is paid for by the subscribers. To keep matters simple, posit a constant elasticity demand system facing the newspaper:

[1] $$s = Ap_s^{-\xi_s} k^{\theta}$$

[2] $$a = B\left(\frac{p_a}{s}\right)^{-\xi_a}$$

where $\xi_s > 1$, $\xi_a > 1$, and $0<\theta<1$.

Let the cost of newspaper production depend on number of ads and circulation and on amount of content. These costs include first-copy costs $f_a a + f_k k$, and costs that depend on number of copies $c_0 s + \bar{c}as + \bar{c}ks$:

[3] $$\boldsymbol{Cost} = f_a a + f_k k + c_0 s + \bar{c}as + \bar{c}ks$$

Here, c_0 is the unit cost of distribution net of advertisers' payments to distributors for including inserts (substantial in Japan, almost as large as advertisers' payments to newspapers for print ads). $\bar{c}$ is the cost per page of actually printing the newspaper (where *k* and *a* are the numbers of pages of content and of ads), f_k is the first-copy cost of producing a page of content and f_a is the first-copy cost of producing a page of advertising. Notice that because of the term $\bar{c}as$ in the cost function, the costs are not separable into cost of subscription and cost of advertising. This makes it problematic to speak separately of the profits from subscriptions and from advertising.

The incremental costs c_s , c_a , and c_k of supplying subscriptions, ads and content are the following:

[4] $$c_s = \frac{\partial \boldsymbol{Cost}}{\partial s} = c_0 + \bar{c}a + \bar{c}k$$

[5] $$c_a = \frac{\partial \boldsymbol{Cost}}{\partial a} = f_a + \bar{c}s$$

[6] $$c_k = \frac{\partial \boldsymbol{Cost}}{\partial k} = f_k + \bar{c}s$$

The newspaper chooses content, price of ads, and price of subscriptions to maximize total profit:

[7] $$\max_{p_s,p_a,k} \pi = p_s s + p_a a - f_a a - \bar{c}as - f_k k - \bar{c}ks - c_0 s$$

The necessary conditions for maximum profit reduce to the following pricing rules[2]:

[2]The price-cost margin for subscriptions exemplifies the behavior of a multi-product monopolist supplying two goods that are complements in demand. In general, where the demands are as follows

[8] $$\frac{p_a - c_a}{p_a} = \frac{1}{\xi_a}$$

[9] $$\frac{p_s - c_s}{p_s} = \frac{1}{\xi_s} - \frac{p_a a}{p_s s}$$

Profit-maximizing also requires that content *k*, the number of pages not including ads, fulfills the condition:

[10] $$\frac{c_k k}{p_s s} = \frac{\theta}{\xi_s}$$

This expression resembles the Dorfman-Steiner condition describing optimal advertising expenditure. This is because, analytically, the model here is the same as the Dorfman-Steiner advertising model: Demand for subscriptions has constant elasticity ($0 < \theta < 1$) with respect to content, just as in the Dorfman-Steiner model demand for the product has constant elasticity with respect to quantity of ads.

Rearranging in a useful way, the pricing and content rules are:

[11] $$p_a = (f_a + \bar{c}s)\left(1 - \frac{1}{\xi_a}\right)^{-1}$$

[12] $$p_s = \left(c_0 + \bar{c}a + \bar{c}k - \frac{p_a a}{s}\right)\left(1 - \frac{1}{\xi_s}\right)^{-1}$$

[13] $$k = \frac{\theta p_s s}{\xi_s (f_k + \bar{c}s)}$$

The subscription price p_s is set as though the newspaper were receiving a subsidy per subscriber equal to the marginal profit that arises indirectly from advertising with each copy sold (for given price of advertising p_a):

[14] $$\begin{aligned} \frac{\partial(p_a a - f_a a - \bar{c}as)}{\partial a}\frac{\partial a}{\partial s} + \frac{\partial(p_a a - f_a a - \bar{c}as)}{\partial s} &= (p_a - f_a - \bar{c}s)\frac{\partial a}{\partial s} - \bar{c}a \\ &= (p_a - f_a - \bar{c}s)\frac{p_a \xi_a}{s} - \bar{c}a \\ &= \frac{p_a a}{s} - \bar{c}a \end{aligned}$$

This marginal profit equals the marginal revenue that arises indirectly from advertising ($=p_a a/s$), minus the added-cost-per-copy attributable to advertising ($=\bar{c}a$).

$Q_1 = A\, p_1^{-\xi 1}\, p_2^{\xi 12}$
$Q_2 = B\, p_2^{-\xi 2}\, p_1^{\xi 21}$,
and marginal costs are c_1 and c_2, the profit-maximizing pricing rules are:
$(p_1\text{-}c_1)/p_1 = 1/\xi_1 + ((p_2\text{-}c_2)/p_2)\,(\xi_{21}/\xi_1)\,(p_2Q_2 / p_1Q_1)$
$(p_2\text{-}c_2)/p_2 = 1/\xi_2 + ((p_1\text{-}c_1)/p_1)\,(\xi_{12}/\xi_2)\,(p_1Q_1 / p_2Q_2)$.
See for example Tirole (1988, pp.69-71). But here the cross-elasticities of demand are:
$\xi_{12} = \partial ln\, a / \partial ln\, p_s = -\xi_a\xi_s (= \xi_1\xi_2)$, and
$\xi_{21} = \partial ln\, s / \partial ln\, p_a = 0$.

3. Subscription to morning-edition-only versus morning-and-evening edition.

Many of the large circulation daily newspapers in Japan have both morning and evening editions. Most of these offer their customers a choice between subscribing to the morning edition only, or subscribing to both editions. The evening editions of these papers generally have about one third as many pages of content as the morning editions and about one fifth the number of pages of ads. For detailed data on the subscription prices, pages of content and pages of ads of morning and evening editions of selected Japanese newspapers in 2007, refer to Table 1. The newspapers in this table include the various regional editions of the four national dailies, include the regional "bloc" dailies, and include the local (one-prefecture) newspapers that offer their subscribers a choice between morning-only and morning-and-evening and that have circulation greater than 100,000 for each. I exclude the Nikkei Shimbun which is a business newspaper similar to the Wall Street Journal, not really a general news daily like the newspapers in the sample.

A useful way of thinking about the pricing and content of morning and evening editions is with reference to the economics of nonlinear pricing. The nonlinearity inheres in the fact that the price per page of content is different for combined morning and evening subscriptions than for just morning editions. This suggests some useful lines of inquiry. For instance, do newspaper publishers reduce the number of content pages of their morning editions to discourage dual subscribers from cancelling their evening subscriptions, in the same way that airlines reduce the quality of economy seating to discourage first-class passengers from switching to economy? This is a phenomenon noted by the nineteenth century French economist Jules Dupuit (1804-1866) with respect to train fares. The Dupuit phenomenon is an example of monopoly waste in the sense that quality of the lower priced version of the product is reduced below the economically efficient level to conform with the incentive compatibility constraint of the higher valuing customers. This waste has been empirically verified and estimated by McManus (2007) for coffee drink pricing. Shum and Crawford (2007) infer similar wasteful degradation in the quality of cable TV offerings.

Another line of inquiry is whether comparisons of the demand for morning editions and for combined morning and evening editions reveal underlying parameters related to the elasticity of demand for newspapers with respect to prices and to pages of content. Within the simple framework set out above, I would suggest that these parameters are so revealed.

This requires developing the micro-foundations of the constant-elasticity demand system.

Posit a population of households *s=1,..,n*, each of which has marginal valuation of newspaper content per page (that is printed pages *k* not including advertising), for a particular newspaper, as follows:

[15] $$v' = \frac{\theta}{\xi_s} A^{\frac{1}{\xi_s}} s^{-\frac{1}{\xi_s}} k^{-\frac{\xi_s-\theta}{\xi_s}}$$

where $0 < \theta < 1$, and $\xi_s > 1$. This means that for each household, marginal value per page of content becomes less as the number of pages increases, but this relationship is inelastic

[16] $$\frac{\partial \ln v'}{\partial \ln k} = -\left(\frac{\xi_s-\theta}{\xi_s}\right) < 0$$
$$> -1$$

It also means that the index *s* numbers households in rank order from the highest marginal valuer (*s=1*) to the least (*s=s>>>*) :

[17] $$\frac{\partial \ln v'}{\partial \ln s} = -\frac{1}{\xi_s} < 0$$

The value to household *s* of a newspaper with k_m pages of content is

[18] $$\begin{aligned} v(s) &= \int_0^{k_m} v'(k)dk \\ &= \int_0^{k_m} \frac{\theta}{\xi_s} A^{\frac{1}{\xi_s}} s^{-\frac{1}{\xi_s}} k^{-\frac{\xi_s-\theta}{\xi_s}} dk \\ &= A^{\frac{1}{\xi_s}} s^{-\frac{1}{\xi_s}} {k_m}^{\frac{\theta}{\xi_s}} \end{aligned}$$

And the demand for a newspaper with k_m pages of content is the number of households for which the value of the paper is greater than or equal to the price p_m (of the morning edition, say). Because the index *s* numbers households in rank order from the highest valuer to the lowest, the number of households for which the value of the newspaper is greater than or equal to its price equals the index identifying the household for which the value just equals price. That is the demand for morning edition with k_m pages of content is

[19] $$s_m = A {p_m}^{-\xi_s} {k_m}^{\theta}$$

Now suppose that rather than just the one newspaper, there are several newspapers, not just a monopoly but an oligopoly. If there are several different newspapers from which demanders can choose, then $v'(s)$, the marginal value of content pages in the one newspaper by individual *s*, should be understood to mean the individual's marginal value of content pages in the one newspaper relative to his next highest valued alternative. And as the one newspaper comes to have more content, the alternative that is the individual's next highest

valued may become a different one than before. The population of demanders and their marginal valuations of content in the one newspaper thus depend upon: (1) the choice set for each demander, in other words which newspapers are available in the place where the demander resides, (2) the number of pages of content of each alternative newspaper, and (3) the subscription price of each alternative newspaper. The current framework represents the demand for the one newspaper, while holding as fixed all these various details of the prices and content of rival newspapers. Stole (2007, Section 6.2) discusses the deeper foundation for such a demand function, in cases where the products of competing firms are horizontally differentiated and where vertically differentiated. A superficial treatment of these foundations is adequate for the partial equilibrium analysis I conduct here.

Next suppose that, again given the prices and contents of rival newspapers, subscribers to the morning edition of the one newspaper may also subscribe to an evening edition of the same newspaper. Denote the numbers of pages of content in the two editions k_m and k_e . By similar reasoning to the above, the value of the evening edition to a subscriber of the morning edition is

[20] $$v_e(s) = \int_{k_m}^{k_m+k_e} v'(k)dk$$
$$= A^{\frac{1}{\xi_s}} s^{-\frac{1}{\xi_s}} \left((k_m + k_e)^{\frac{\theta}{\xi_s}} - k_m^{\frac{\theta}{\xi_s}} \right)$$

Denote by p_e the price of the evening edition (so a joint subscription including both morning and evening editions is priced p_m+p_e). The demand for the evening edition (that is, s_e such that $v_e(s_e)=p_e$) is

[21] $$s_e = A p_e^{-\xi_s} \left((k_m + k_e)^{\frac{\theta}{\xi_s}} - k_m^{\frac{\theta}{\xi_s}} \right)^{\xi_s}$$

Now

[22] $$\frac{s_e}{s_m} = \left(\frac{p_m}{p_e}\right)^{\xi_s} \left(\left(\frac{k_m}{k_m+k_e}\right)^{-\frac{\theta}{\xi_s}} - 1 \right)^{\xi_s}$$

I estimate the parameters ξ_s and θ in this equation [22] using nonlinear least squares. The data for the estimate are, first, that shown in Table 1, for which the unit of observation is the nation (aggregate data). The number of observations equal to *23* is simply the number of newspapers in the sample. The results of estimation using this dataset are in the left-hand column of Table 2. It seems that price elasticity of demand ξ_s is near *1.2*, while elasticity of demand with respect to pages of content is around *0.5*, values that seem plausible. But

the standard errors are very large. In an attempt to estimate the parameters more precisely I compiled a second dataset, including the same newspapers but for which the unit of observation for circulation is the city, town or village rather than the nation. I exclude any observations with only morning subscribers or only morning-and-evening subscribers. The source of the circulation data is the Japan Audit Bureau of Circulation (from their website, behind a paywall). Using this disaggregated data there are actually enough observations to estimate separate equations for Yomiuri and for Asahi which are shown in the table. The estimates for Yomiuri have price elasticity near *1.2* and elasticity with respect to pages of content of *0.4*, with standard errors much smaller than for the small sample.

Other results are less satisfactory. The estimate for Asahi has elasticity of demand implausibly less than one at *0.9*. The full sample including all of the newspapers in the aggregate dataset also has this same disappointing result (price elasticity less than one). Elasticity with respect to pages of content is estimated to be *0.3* for Asahi and for the full sample. In short, the results of this nonlinear estimation are mixed, but not entirely discouraging. The specification in equations [19] and [21], while not rendering precise estimates of the elasticity parameters, does seem to be a reasonable framework for further approximation of the effects of second-degree price discrimination by Japanese newspapers. And I will proceed on that presumption. But before getting to that, I will first describe estimates of the elasticity parameters using a different method.

An alternative to the nonlinear estimation (as in Table 2), is to construct estimates of the demand for each newspaper from estimates of an indirect utility function using microdata. This I have done in another paper Flath (2012) that mainly focuses on the effects of coordinated pricing by the leading Japanese newspapers. Some details of the econometric specification are described in the Appendix here, and estimates of the indirect utility function as reported in the other paper are reprinted here as appendix Table A.1. The estimated elasticity parameters based on simulations using that indirect utility function estimate are shown in Table 4. These represent the arc elasticities of demand for the morning edition with respect to increases in the number of pages of morning content $\left(\frac{\partial \ln s_m}{\partial \ln k_m} = \theta\right)$, and with respect to an increase in the monthly morning subscription price $\left(\frac{\partial \ln s_m}{\partial \ln p_m} = \xi_s\right)$. The simulations for computing these arc elasticities entail five percent increases in pages of morning content or in price of the morning edition, for each newspaper individually. It seems from the results reported in Table 4 that the elasticity of demand for morning edition

with respect to pages of morning content is about *0.4* and the elasticity with respect to morning subscription price averages about *1.3* and is a bit higher for the national newspapers than for the local ones. This is not terribly different from the results using nonlinear estimation. The next task is to estimate the distorting effects of the incentive compatibility constraint using the above framework.

3. Towards an expanded model of pricing and content

Extending the basic framework to accommodate pricing and content choices by newspaper publishers offering morning and evening editions requires some additional assumptions. First consider the demand for advertising. The incremental cost of supplying ads per subscriber is inversely related to number of subscribers. The evening subscribers are a subset of the morning subscribers. Why then would the newspaper even want to offer advertising in the evening edition? Or to put it a different way, if as seems likely given the higher incremental cost, the ad price per subscriber is greater for ads in the evening edition than in the morning edition, then what advertiser would place an ad in the evening edition? Perhaps advertisers who wish to specifically target evening subscribers would do so. The evening subscribers have a greater demand for newspaper content and so plausibly are more educated and have higher incomes, which might make them valuable targets for some advertisers. In the logic of the very general framework developed by Veiga and Weyl (2012), enabling targeted advertising could be a sufficient motivation for offering an evening edition in the first place, not mutually exclusive from the motivation of profiting from nonlinear pricing of subscriptions.

Let us assume then that the demand for ads in the morning edition is independent of the demand for ads in the evening edition. Now, given the number of pages of content in both morning and evening editions k_m and k_e, and assuming the demands for ads in the two editions are independent of one another, the profit-maximizing pricing rules are edition-specific variants of the rules derived in the basic framework[1]:

[1] Perhaps the notation here is obvious enough from analogy with the single-edition case shown by equations [3]-[10]. So for example, the profit function for the dual-edition newspaper becomes

$$\pi = p_{s_m} s_m - (\bar{c}(a_m + k_m) + c_{0m}) s_m + (p_{am} - f_{am}) a_m - f_{km} k_m + p_{s_e} s_e - (\bar{c}(a_e + k_e) + c_{0e}) s_e + (p_{ae} - f_{ae}) a_e - f_{ke} k_e \ ,$$

and the incremental cost of morning content is

$$c_{km} = \frac{\partial \boldsymbol{Cost}}{\partial k_m} = f_{km} + \bar{c} s_m$$

and so on.

[23] $$\frac{p_{a_m}-c_{a_m}}{p_{a_m}} = \frac{1}{\xi_{a_m}}$$

[24] $$\frac{p_{s_m}-c_{s_m}}{p_{s_m}} = \frac{1}{\xi_s} - \frac{p_{a_m}a_m}{p_{s_m}s_m}$$

[25] $$\frac{p_{a_e}-c_{a_e}}{p_{a_e}} = \frac{1}{\xi_{a_e}}$$

[26] $$\frac{p_{s_e}-c_{s_e}}{p_{s_e}} = \frac{1}{\xi_s} - \frac{p_{a_e}a_e}{p_{s_e}s_e}$$

Notice that in the framework here, the demands for subscriptions are independent with respect to changes in prices. This is because the marginal subscriber to the evening edition attains positive consumer surplus from the morning edition. Thus a slightly higher or lower price for the morning edition p_m only affects demand by morning-only subscribers, not morning-and-evening subscribers. And a slightly higher or lower price of the evening edition has no effect on demand for the morning edition. The rules for profit-maximizing content are a bit different, reflecting the interdependence in demand for subscriptions with respect to choice of content. The interdependence is a manifestation of the incentive -compatibility constraint. The newspaper publisher adjusts pages of content mindful that the marginal morning-and-evening subscriber attains zero consumer surplus from the evening edition but positive consumer surplus from the morning edition.

The profit-maximizing content rules are:

[27] $$\frac{c_{k_m}k_m}{p_{s_m}s_m} = \frac{\theta}{\xi_m{}^*} + \frac{1}{\xi_e{}^*}\left(\frac{p_{s_e}s_e}{p_{s_m}s_m}\right)\left(\frac{\partial \ln s_e}{\partial \ln k_m}\right)$$

where

[28] $$\frac{\partial \ln s_e}{\partial \ln k_m} = -\theta\left(\frac{\left(\frac{k_m}{k_m+k_e}\right)-\left(\frac{k_m}{k_m+k_e}\right)^{\frac{\theta}{\xi_s}}}{1-\left(\frac{k_m}{k_m+k_e}\right)^{\frac{\theta}{\xi_s}}}\right) < 0 \ ,$$

and

[29] $$\frac{c_{k_e}k_e}{p_{s_e}s_e} = \frac{\left(\frac{\partial \ln s_e}{\partial \ln k_e}\right)}{\xi_e{}^*}$$

where

[31] $$\frac{\partial \ln s_e}{\partial \ln k_e} = \theta\left(\frac{\left(\frac{k_e}{k_m+k_e}\right)}{1-\left(\frac{k_m}{k_m+k_e}\right)^{\frac{\theta}{\xi_s}}}\right) > \theta,$$

and where

[32] $$\frac{1}{\xi_m{}^*} = \frac{p_{s_m} - c_{s_m} + \frac{p_{a_m} a_m}{s_m}}{p_{s_m}},$$

and

[33] $$\frac{1}{\xi_e{}^*} = \frac{p_{s_e} - c_{s_e} + \frac{p_{a_e} a_e}{s_e}}{p_{s_e}}.$$

The stipulations [32] and [33] are to allow for the possibility of collusive setting of subscription prices. Many of the leading newspapers of Japan set the same subscription prices as one another which are higher than the prices set by other newspapers. Thus it may well be, as argued in Flath (2012), that the newspapers are collusively raising their prices so that $\xi_m{}^* < \xi_s$ and $\xi_e{}^* < \xi_s$. But the equation [27] would in that case still characterize the profit-maximizing choice of morning content pages k_m.

The second term on the right-hand side of equation [27], which as shown by equation [28] is negative, reflects the incentive-compatibility constraint. The upshot is that the newspaper publisher reduces the content of the morning edition compared to what it would choose if not offering a morning and evening edition. By how much? Setting parameters θ*=0.4* and ξ_s*=1.3*, and based on the values for $\left(\frac{k_e}{k_m+k_e}\right)$ and $\left(\frac{p_{s_e} s_e}{p_{s_m} s_m}\right)$ implied in Table 1 for the sample newspapers, $\frac{\partial \ln s_e}{\partial \ln k_m}$*=−0.08*. Setting θ and ξ_s at the levels indicated by the micro data estimates increases this slightly (to *−0.09* on average) as shown in the last column of Table 3. It seems from this that the incentive compatibility constraint causes a reduction in $\frac{c_{k_m} k_m}{p_{s_m} s_m}$ of about *6%* $= -\left(\frac{\partial \ln s_e}{\partial \ln k_m}\right)\left(\frac{1}{\xi_m{}^*}\right) = 0.08 \div 1.3$. If the daily content in the morning edition is k_m*=20 pages*, which is about average for the sample newspapers, then we could say that the incentive-compatibility constraint leads to withholding of around one page daily from the morning edition. That is, the newspaper shorts the content of the morning edition by about one page each day, only to preserve demand for the evening edition. To determine the monetary value of the economic waste from this shorting of the morning edition content requires an estimate of the actual demand for newspapers as in the Flath (2012) estimate of

indirect utility function using micro data, described in the Appendix, and which I will again exploit.

Appendix Table A.1 reports the utility function parameter estimates from Flath (2012). Dividing the other coefficients by the estimated marginal disutility of subscription price converts them to monetary units (yen per month). Using this procedure, I am able to construct the marginal value of pages of content per month for each individual respondent. Summing the marginal values of the respondents that subscribe to each edition of each newspaper gives the marginal value of content pages in those newspapers. This is a similar exercise to the McManus (2007) estimate of the marginal value of coffee drinks. But his estimate relied on aggregate data, where mine is based on micro-data. My estimation procedure is less technically demanding which is not necessarily a bad thing. The marginal values of content for each newspaper are in Table 4.

The marginal value of content pages is slightly less for morning-only subscribers than for morning-and-evening subscribers of the same newspaper, averaging *1.13* yen per page per month per morning-only subscriber compared to *0.91* yen per page per month per morning-and-evening subscriber. The net social benefit per morning-only subscriber from increasing the content of the morning edition by one page per month while decreasing the content of the evening edition by one page (that is switching the content page from the evening edition to the morning edition) equals the marginal value to the representative morning-only subscriber minus the cost per morning-only subscriber of printing the page. In Flath (2012) I estimate that cost to be *0.96* yen per page, which means that the net social benefit per morning-only subscriber of switching a content page from the evening edition to the morning edition is *1.13-0.96=0.17* yen. To do this daily would have a social benefit of approximately $30 \times 0.17 = 6.1$ yen per month. This is small compared to the subscription prices that average around *3,000* yen per month for morning-only subscription.

6. Conclusion

Many of the large circulation Japanese newspapers offer demanders a choice between subscribing to the morning edition only, or to both the morning edition and evening edition. The price per page of content differs between these, which is an example of second-degree price discrimination based on self-selection by demanders. The subscription price schedule

amounts to a nonlinear tariff, gauged to maximize newspaper profit. The possibility of engaging in such profitable price discrimination is one reason even to offer an evening edition in the first place, which seems not to have been previously remarked. The possibility of targeting advertising on higher income subscribers who are more likely to subscribe to an evening edition along with the morning edition is another reason to offer an evening edition. Subscriber preference for more frequent news is yet another reason. As newspapers move to digital rather than print format, some analogue of the "evening edition" is likely to be profitable for all of the reasons that apply to the print version.

Here I have argued that not only the subscription prices but also the number of pages of content in each edition are gauged to maximize newspaper profit subject to the constraint that subscribers rationally maximize utility. I impute that if the typical large circulation Japanese newspaper added a page or two to the twenty pages of content in each day's morning edition it would provoke some cancellations of evening subscriptions. Except for that, switching a page from the evening edition to the morning edition each day would be profitable.

Appendix. Estimates of the Demand for Newspapers Using Micro-Data

In Flath (2012) I estimate an indirect utility function for Japanese newspaper subscriptions based on March 2007 survey data, and use the estimates to simulate the effect of a deviation from coordinated pricing by the leading newspapers. Here I will briefly describe the indirect utility estimate and note the parts of the estimate that are relevant to the second-degree price discrimination that is the main focus of the present essay.

The micro-data come from a March 2007 random-direct-dial telephone survey of 27,788 persons living throughout Japan conducted by Video Research, Ltd. (the 2007 edition of its annual JREAD survey). I use these data to estimate the common parameters of a mixed-logit indirect utility function relating respondents' choices among available daily newspaper subscriptions (including the choice of not subscribing to any newspaper), to their own individual characteristics such as age, income and education and to attributes of the newspapers available in the prefecture where each resides. Attributes of the newspapers include subscription price, number of pages of content per month, and whether the subscription is morning-and-evening or morning-only. Although the national newspapers are priced the same everywhere in Japan, they compete with different local and regional newspapers in each prefecture. The variation in choice sets across prefectures is sufficient to identify the effects of subscription price and other newspaper attributes on respondents' choices.

The basic econometric model is a multinomial logit model of utility with random coefficient on one variable, price of subscription. The utility of newspaper subscription choice *j* by individual *i* is a linear function of (1) attributes of the choice, (2) interactions between choice-invariant characteristics of the individual and attributes of the choice, and (3) an unobservable error ε_{ij} that varies randomly across individuals and alternatives according to the Gumbel distribution (Type I Extreme Value distribution). The utility function coefficient on price of subscription p_j varies randomly across individuals according to the Normal distribution.

[23] $$U_{ij} = \beta' x_{ij} + \alpha_i p_j + \varepsilon_{ij}$$
$$\alpha_i = \alpha + \sigma v_i, \text{ where } v_i \sim Normal\ [0,\ 1]$$
$$\varepsilon_{ij} \sim\ Gumbel$$

The individual *i* chooses from among his choice set C_i the one alternative with the greatest utility value. The choice set includes any newspapers available for subscription in the place

where the person lives and the choice of subscribing to no newspaper at all (*j=0*). Because $x_{i0} = 0$ and $p_0 = 0$, the mean utility value of not subscribing to any newspaper is zero: $U_{i0}=0$.

From the observed choice set of each individual, observed attributes of each alternative, observed characteristics of each individual, and observed choice of each individual, I estimate the parameters of the utility function that are common to all individuals $(\beta,\ \alpha,\ \sigma)$ using the method of simulated maximum likelihood (computed with the software NLOGIT).

The variables that enter the utility function are made up as follows.

Attributes of the newspaper subscription choices that do not vary across individuals:
—Subscription price (units=yen per month) p_j
—Natural logarithm of number of pages of content per month ("news hole")

Interactions between choice-invariant characteristics of the individual and attributes of the choice (with units of measurement equal to underlined expressions where present, otherwise equal to zero or one):
—Age head of household (one of four discrete intervals) ×
1. Natural log of pages of content per month
2. National newspaper × morning-and-evening subscription
3. Local or Bloc newspaper × morning-and-evening subscription

—Household annual income (one of sixteen discrete intervals ranging from zero to 30-million yen or more per year) if greater than zero ×
1. Natural log of pages of content per month
2. National newspaper × morning-and-evening subscription
3. Local or Bloc newspaper × morning-and-evening subscription

—Each national newspaper (Yomiuri, Asahi, Mainichi, Sankei) ×
1. Survey response: "Participates in local festivals and holiday events."
2. Head of household highest education level is college or above

—For each national and bloc paper, square of road distance (th. Km) from newspaper home base to each individual's prefecture of residence (home base for national papers Yomiuri, Asahi and Mainichi: Tokyo, for Sankei: Osaka; and for bloc papers Chunichi: Aichi, Chugoku: Hiroshima, and Nishi Nippon: Fukuoka).

Appendix Table A.1 reports the utility function parameter estimates. Dividing the other coefficients by the estimated marginal disutility of subscription price converts them to monetary units (yen per month).

Table A1. Random-parameter logit estimate of indirect utility function

Variable			Parameter	s.e.	z
Subscription price (yen per mo.) p_j		Mean of random coefficient α	-0.00073	0.00003	-23.8
		s.d. in subscription price random coefficient σ	0.00031	0.00005	7.0
		β:			
ln pages of content per month	$\ln k_j$		-0.143	0.057	-2.5
	$\ln k_j$	× Household annual income =			
		less than 1 million yen	-0.055	0.020	-2.8
		1million yen up to 2 million yen	-0.097	0.016	-5.9
		2 million yen up to 3 million yen	-0.050	0.015	-3.4
		3 million yen up to 4 million yen	-0.005	0.014	-0.4
		4 million yen up to 5 million yen	0.028	0.014	1.9
		5 million yen up to 6 million yen	0.039	0.015	2.6
		6 million yen up to 7 million yen	0.075	0.016	4.7
		7 million yen up to 8 million yen	0.096	0.017	5.5
		8 million yen up to 9 million yen	0.080	0.019	4.2
		9 million yen up to 10 million yen	0.084	0.019	4.3
		10 million yen up to 12 million yen	0.129	0.021	6.1
		12 million yen up to 15 million yen	0.153	0.027	5.7
		15 million yen up to 20 million yen	0.135	0.031	4.3
		20 million yen up to 30 million yen	0.113	0.053	2.1
		30 million yen or more	0.191	0.087	2.2
	$\ln k_j$	× Age, head of household =			
		up to 24 yrs.	0.271	0.050	5.4
		25 yrs to 44 yrs	0.400	0.056	7.2
		45 yrs to 64 yrs	0.603	0.057	10.5
		65 yrs or more	0.755	0.059	12.7
Morning-and-Evening subscription to National newspaper		× Household annual income =			
		less than 1 million yen	0.176	0.133	1.3
		1million yen up to 2 million yen	0.233	0.105	2.2
		2 million yen up to 3 million yen	0.309	0.073	4.2
		3 million yen up to 4 million yen	0.394	0.063	6.3
		4 million yen up to 5 million yen	0.287	0.062	4.6
		5 million yen up to 6 million yen	0.290	0.063	4.6
		6 million yen up to 7 million yen	0.359	0.063	5.7
		7 million yen up to 8 million yen	0.516	0.067	7.8
		8 million yen up to 9 million yen	0.495	0.077	6.5
		9 million yen up to 10 million yen	0.625	0.073	8.6
		10 million yen up to 12 million yen	0.656	0.069	9.5
		12 million yen up to 15 million yen	0.771	0.080	9.7
		15 million yen up to 20 million yen	0.844	0.102	8.3
		20 million yen up to 30 million yen	0.969	0.176	5.5
		30 million yen or more	1.089	0.217	5.0

Variable			Parameter	s.e.	z
Morning-and-Evening subscription to Local or Bloc newspaper	×	Household annual income =			
		less than 1 million yen	-0.187	0.192	-1.0
		1million yen up to 2 million yen	0.487	0.116	4.2
		2 million yen up to 3 million yen	0.553	0.079	7.0
		3 million yen up to 4 million yen	0.438	0.071	6.2
		4 million yen up to 5 million yen	0.365	0.075	4.9
		5 million yen up to 6 million yen	0.465	0.076	6.1
		6 million yen up to 7 million yen	0.447	0.079	5.6
		7 million yen up to 8 million yen	0.452	0.089	5.1
		8 million yen up to 9 million yen	0.699	0.102	6.9
		9 million yen up to 10 million yen	0.659	0.103	6.4
		10 million yen up to 12 million yen	0.495	0.101	4.9
		12 million yen up to 15 million yen	0.651	0.130	5.0
		15 million yen up to 20 million yen	0.727	0.171	4.3
		20 million yen up to 30 million yen	0.754	0.305	2.5
		30 million yen or more	1.267	0.300	4.2
Participates in local festivals and holiday events	×	Asahi	-0.647	0.030	-21.4
		Mainichi	-1.266	0.040	-31.9
		Yomiuri	-0.339	0.029	-11.9
		Sankei	-1.808	0.066	-27.4
Head of household highest education level is college or above	×	Asahi	0.272	0.036	7.6
		Mainichi	-0.471	0.048	-9.9
		Yomiuri	-0.152	0.039	-3.9
		Sankei	-1.028	0.079	-13.0
Asahi, Mainichi, Yomiuri	×	Th. Km from Tokyo, squared	-0.010	0.000	-41.3
Sankei	×	Th. Km from Osaka, squared	-0.056	0.002	-26.8
Chunichi	×	Th. Km from Aichi, squared	-0.211	0.021	-10.1
Chugoku	×	Th. Km from Hiroshima, squared	-0.932	0.064	-14.6
Nishi Nippon	×	Th. Km from Fukuoka, squared	-0.664	0.043	-15.5

n=27,778
Chi squared [65 d.f.]= 132,971
Log likelihood function= -51,966
Restricted log likelihood= -118,451
Inf.Cr.AIC=104062 AIC/N = 3.745

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Table 1. Morning and evening monthly subscription prices, circulation, pages of content and pages of ads; selected Japanese daily newspapers, 2007

	subscription price yen per month		circulation		pages of content per month		pages of ads per month	
Newspaper	p_e	p_m	s_m	s_e	k_m	k_e	a_m	a_e
THE ASAHI SHIMBUN (Hokkaido)	918	3,007	155,750	53,740	621	159	466	82
THE ASAHI SHIMBUN (Nagoya)	918	3,007	424,246	146,107	598	189	451	70
THE ASAHI SHIMBUN (Osaka)	918	3,007	2,336,911	1,294,724	599	188	544	163
THE ASAHI SHIMBUN (Tokyo)	918	3,007	4,358,660	1,958,061	606	223	618	190
THE ASAHI SHIMBUN (Seibu)	918	3,007	791,140	135,628	605	181	507	88
MAINICHI SHIMBUN (Hokkaido)	918	3,007	72,617	17,697	524	174	267	38
MAINICHI SHIMBUN (Nagoya)	918	3,007	176,101	49,069	546	169	267	47
MAINICHI SHIMBUN (Osaka)	918	3,007	1,419,552	830,585	547	180	377	113
MAINICHI SHIMBUN (Tokyo)	918	3,007	1,640,998	462,952	575	204	379	81
MAINICHI SHIMBUN (Seibu)	918	3,007	664,559	102,896	498	151	346	63
YOMIURI SHIMBUN (Hokkaido)	918	3,007	232,992	64,396	614	233	522	101
YOMIURI SHIMBUN (Osaka)	918	3,007	2,547,583	1,332,683	609	234	608	179
YOMIURI SHIMBUN (Tokyo)	918	3,007	6,068,547	2,357,250	590	282	640	195
YOMIURI SHIMBUN (Seibu)	918	3,007	914,687	109,479	578	191	521	78
SANKEI SHIMBUN (Osaka)	975	2,950	1,224,957	633,154	581	227	320	124
HOKKAIDO SHIMBUN	918	3,007	1,204,151	639,634	599	252	553	131
THE KAHOKU SHIMPO	918	3,007	501,356	109,871	611	136	364	65
THE TOKYO SHIMBUN	700	2,550	585,508	280,889	592	203	299	90
THE CHUNICHI SHIMBUN	925	3,000	2,774,585	650,297	617	217	465	121
KYOTO SHIMBUN	918	3,007	510,000	317,881	589	173	344	113
KOBE SHIMBUN	918	3,007	561,881	254,782	587	185	314	121
THE CHUGOKU SHIMBUN	918	3,007	717,794	73,628	629	162	416	46
THE NISHI-NIPPON SHIMBUN	918	3,007	854,655	175,518	600	183	476	131

Sources:

pages of ads, total pages: Dentsu Inc. Dentsuu koukoku nenkan (Dentsu advertising annual).

subscription prices, circulation: Japan Audit Bureau of Circulation. shimbun hakkousha repooto (newspaper publisher report), 2007 (Jan to June average) and 2007 (July to December average).

Table 2. Nonlinear least squares regression

Estimating equation:

$$\frac{s_e}{s_m} = \left(\frac{p_m}{p_e}\right)^{\xi_s} \left(\left(\frac{k_m}{k_m + k_e}\right)^{-\frac{\theta}{\xi_s}} - 1 \right)^{\xi_s} + \varepsilon$$

parameter	Estimates and Asymptotic Standard Errors			
	Aggregate Data*	Disaggregated Data (cities)		
		Yomiuri	Asahi	Full Sample**
ξ_s	1.24	1.21	0.86	0.93
s.e.	0.65	0.14	0.12	0.06
θ	0.50	0.41	0.31	0.29
s.e.	0.49	0.09	0.09	0.04
n	23	525	612	2377
F	64.7	1333.8	2446.9	6981.6

*Based on national circulation, from Table 1.

**Yomiuri, Asahi, Mainichi, Sankei, Hokkaido Shimbun, Kyoto Shimbun, Kobe Shimbun, Chugoku Shimbun, Chunichi, Kahoku Shimpo, Nishi Nippon, Tokyo Shimbun

Table 3. Arc elasticities of demand for the morning edition with respect to pages of content per month θ and with respect to subscription price ξ_s, based on indirect utility function, and value of $\frac{\partial \ln s_e}{\partial \ln k_e}$ implied by these elasticities

Newspaper	θ	ξ_s	$\frac{\partial \ln s_e}{\partial \ln k_e} = \theta \left(\frac{\left(\frac{k_e}{k_m + k_e}\right)}{1 - \left(\frac{k_m}{k_m + k_e}\right)^{\frac{\theta}{\xi_s}}} \right)$
THE ASAHI SHIMBUN	0.42	1.45	-0.12
MAINICHI SHIMBUN	0.44	1.60	-0.12
YOMIURI SHIMBUN	0.42	1.49	-0.11
SANKEI SHIMBUN	0.43	1.26	-0.12
HOKKAIDO SHIMBUN	0.29	0.84	-0.07
THE KAHOKU SHIMPO	0.41	1.06	-0.04
THE TOKYO SHIMBUN	0.39	1.15	-0.09
THE CHUNICHI SHIMBUN	0.40	1.51	-0.07
KYOTO SHIMBUN	0.37	1.33	-0.16
KOBE SHIMBUN	0.46	1.29	-0.10
THE CHUGOKU SHIMBUN	0.32	1.20	-0.02
THE NISHINIPPON SHIMBUN	0.36	1.27	-0.05
MEAN	0.39	1.29	-0.09
S.D.	0.05	0.21	0.04

Table 4. Marginal value of a page of content, averaged across morning-only subscribers and morning-and-evening subscribers, based on indirect utility function estimate

	pages of content per month			Marginal Value, averaged over subscribers (units=yen per page of content)		
Newspaper	k_m	k_e	k_m+k_e	$MV(k_m)$	$MV(k_m+k_e)$	Δ
THE ASAHI SHIMBUN (Hokkaido)	621	159	780	0.81	0.94	0.13
THE ASAHI SHIMBUN (Nagoya)	598	189	787	1.10	0.93	-0.17
THE ASAHI SHIMBUN (Osaka)	599	188	788	1.08	0.88	-0.21
THE ASAHI SHIMBUN (Tokyo)	606	223	829	1.09	0.87	-0.21
THE ASAHI SHIMBUN (Seibu)	605	181	785	1.07	0.95	-0.12
MAINICHI SHIMBUN (Hokkaido)	524	174	698	1.25	0.95	-0.30
MAINICHI SHIMBUN (Nagoya)	546	169	715	1.42	1.14	-0.28
MAINICHI SHIMBUN (Osaka)	547	180	727	1.33	0.94	-0.39
MAINICHI SHIMBUN (Tokyo)	575	204	779	1.33	0.90	-0.43
MAINICHI SHIMBUN (Seibu)	498	151	649	1.49	1.08	-0.42
YOMIURI SHIMBUN (Hokkaido)	614	233	847	1.00	0.83	-0.17
YOMIURI SHIMBUN (Osaka)	609	234	842	0.99	0.76	-0.24
YOMIURI SHIMBUN (Tokyo)	590	282	871	1.11	0.82	-0.29
YOMIURI SHIMBUN (Seibu)	578	191	808	1.16	0.84	-0.32
SANKEI SHIMBUN (Osaka)	581	227	851	0.97	0.78	-0.19
HOKKAIDO SHIMBUN	599	252	747	1.08	0.94	-0.14
THE KAHOKU SHIMPO	611	136	795	1.14	0.91	-0.23
THE TOKYO SHIMBUN	592	203	834	1.06	0.88	-0.19
THE CHUNICHI SHIMBUN	617	217	762	1.06	0.90	-0.16
KYOTO SHIMBUN	589	173	772	1.11	0.91	-0.21
KOBE SHIMBUN	587	185	791	1.05	0.93	-0.12
THE CHUGOKU SHIMBUN	629	162	783	1.13	0.97	-0.15
THE NISHI-NIPPON SHIMBUN	600	183	780	0.81	0.94	0.13
MEAN	588	196	784	1.13	0.91	-0.22
S.D.	33	35	54	0.15	0.09	0.12