Columbia Business School
AT THE VERY CENTER OF BUSINESS™
Center on Japanese Economy and Business

CENTER ON JAPANESE ECONOMY AND BUSINESS

日本経済経営研究所

Working Paper Series

March 13, 2019, No. 367

# Japanese Newspapers

David Flath

This paper is available online at www.gsb.columbia.edu/cjeb/research

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

March 13, 2019

# Japanese Newspapers

David Flath*
Faculty of Economics, Ritsumeikan University

*Abstract*

In 2017, Japanese newspaper advertising revenue, adjusted for inflation, was only half as great as at its 1997 mini-peak. Japanese newspaper circulation also peaked in 1997, and in the two decades since then has fallen by about one-fourth (counting a morning-and-evening subscription as two, by one-fifth if counting it as one). Based on the inferences in this paper, underlying these recent changes in Japanese newspaper revenue and circulation is an 83% decrease in the demand for newspaper ads from 1997 to 2017, and a 26% decrease in demand for newspaper subscriptions, measured at the 1997 inflation-adjusted prices of ads and subscriptions. The fall in demand for newspaper ads can be directly linked to the rise of the internet using an autoregressive distributed lag model.

JEL codes: L1, L82
Keywords: two-sided markets, newspapers, advertising

*Professor, Faculty of Economics, Ritsumeikan University
Noji Higashi 1 chome, 1-1 Kusatsu
Shiga 525-8577
JAPAN

Tel. +81(0)77-561-2821
Email: flath@fc.ritsumei.ac.jp

*This research was supported by Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research (C), grant no. 22530227. I also gratefully acknowledge the assistance of my Ritsumeikan colleague, Professor Yuki Ogawa, and of Mr. Toshiyuki Kitahara at the Dentsu Innovation Institute.*

# Japanese Newspapers

## 1. Introduction

The rise of the internet is having the same dramatic impact on newspaper publishers in Japan as in the US and many other countries. In 2017, Japanese newspaper advertising revenue, adjusted for inflation, was only half as great as at its 1997 mini-peak. Japanese newspaper circulation also peaked in 1997, and has fallen by about one-fourth in the two decades since then. But Japanese newspaper subscription revenue adjusted for inflation has fallen by only about five percent over that same interval. These much-remarked facts about the current situation of the Japanese newspaper industry do not tell the whole story. For that, we need an economic model and a little bit of econometrics, which it is the main contribution of this paper to provide.

The precipitous drop in Japanese newspaper advertising revenue and circulation presents a natural test of the standard model of newspaper pricing, a model that treats each newspaper as a platform in a two-sided market. One side of the market is the sale of newspaper subscriptions, and the other side is the sale of newspaper advertising. The two are interrelated because wider circulation makes newspaper ads more valuable to advertisers by increasing the reach of each ad. In pricing subscriptions, newspaper publishers must therefore consider how circulation affects their profit from selling ads. Such thinking has been the core idea behind models of newspaper pricing and content ever since it was first articulated by Rosse (1970). These models have been used to analyze the pricing of individual newspaper publishers in various countries, including Italy (Argentesi and Filistrucchi, 2007), Belgium (Van Cayseele and Vanormelingen, 2009), and the United States (Fan, 2013). The papers just mentioned are part of a broader empirical literature on newspaper economics, usefully surveyed by Chandra and Kaiser (2016). My previous contribution to this literature was to specify and estimate models of the pricing and content choices of individual Japanese newspaper publishers, using data from 2007 (Flath, 2016 and 2017). Here, I use the empirical findings from those two earlier studies to analyze the industry-wide time-series data on Japanese newspaper pricing, revenue, advertising and circulation, 1997-2017.

Based on the inferences in this paper, underlying the recent changes in Japanese newspaper revenue and circulation is an 83% decrease in the demand for newspaper ads from 1997 to 2017, and a 26% decrease in demand for newspaper subscriptions, measured at the 1997 inflation-adjusted prices of ads and subscriptions. Had the newspaper circulation not fallen, and the average ‘reach’ of newspaper ads remained unchanged, the demand for newspaper ads still would have fallen by 71%. To put it another way, the fall in newspaper circulation accounts for only about $1/7^{th}$ of the decrease in demand for newspaper ads.

The elasticity of demand for newspaper ads increased from 1.7 in 1997 to 2.7 in 2017, prompting newspaper publishers to lower their inflation-adjusted prices of ads by 33%. The effect of this price drop on the volume of newspaper ads and on newspaper ad revenue has masked the true fall in demand for newspaper ads, which was massive. Even though the demand for newspaper ads fell by 83% from 1997 to 2017, the volume of newspaper ads fell by a mere 14%, and the revenue from newspaper ads fell by 53%. The loss in ad revenue induced newspaper publishers to raise their inflation-adjusted subscription prices by 19%, with very little effect on the number of subscriptions. The 29% drop in number of subscribers from 1997 to 2017 is about equal to the 26% decline in demand for subscriptions over the same time period, measured at the 1997 inflation-adjusted price. The paltry 7% fall in subscription revenue from 1997 to 2017 masks the true decline in demand for subscriptions which was nearly four times greater.

A contribution of this paper is to directly link the fall in demand for newspaper print ads in Japan to the rise of internet advertising expenditures, using an autoregressive distributed lag econometric model. This paper also contributes to the recent empirical literature that quantifies the various effects on newspaper pricing, revenue and content, that have resulted from declining demand for newspaper ads. Pattabhiramaiah, Sriram & Sridhar (2017) show that one un-named US newspaper raised its subscription prices in response to an exogenous decline in its revenue from advertising. Angelucci and Cagé (2016) show that newspapers in France responded to the emergence of TV advertising from 1964 by lowering their subscription prices while raising their newsstand prices. The Japanese newspapers, that are the focus in this essay, derive little revenue from newsstand sales, and seem to have raised their subscription prices as the demand for newspaper ads has shrunk, as has also occurred in the US.

Japanese newspaper publishers can survive in the digital age, because the replacement of print newspapers with digital ones will significantly economize on the cost of meeting the demand for daily news. These economies on costs will offset the newspaper publishers' loss of ability to use profit from print ads to cross-subsidize their supply of daily news. Subscribers in Japan have a revealed willingness to pay for daily news. The Japanese newspaper publishers will continue to meet that demand, digitally. In reaching this conclusion, the validity and usefulness of the standard two-sided model of newspaper pricing and content will become evident.

## 2. The Japanese newspaper industry

Newspaper circulation relative to population in Japan is the highest in the world, and has been for many years. In 2006, newspaper circulation in both Japan and the US was about 52.3 million copies per day,[1] even though the population of Japan (127.8 million persons) was less than half that of the US (298.4 million persons). Newspapers in Japan include not only (1) news dailies, but also (2) various tabloids (including so-called "sports" dailies that cater mostly to men's interests, not limited to sports), (3) business newspapers (of which the *Nikkei Shinbun* is the leading example, but also including ones specialized on specific industries), and (4) some political newspapers (including *Shimbun Akahata* which is the daily newspaper of the Japanese Communist Party and *Seikyo Shimbun* which is the daily newspaper of the right-wing political organization Sōka Gakkai, affiliate of the Komeito political party).

My main focus here is on the news dailies, which altogether account for more than 90 percent of circulation of all newspapers in Japan. News dailies include (1) the four national newspapers—*Yomiuri*, *Asahi*, *Mainichi*, and *Sankei*—all available for subscription throughout Japan, (2) bloc newspapers—the main ones being *Tokyo Shinbun*, *Chunichi Shinbun*, *Chugoku Shinbun*, and *Nishi Nippon Shinbun*—each available in a few contiguous prefectures, and (3) local newspapers that each serve a single prefecture. The leading business newspaper, *Nikkei Shinbun*, which is often compared to the *Wall Street Journal*, is in a different category from the other four national news dailies, more focused on business than on general news and entertainment. Most of the subscribers to *Nikkei* also subscribe to at least one other newspaper, which is not true of the other four national

[1] This counts a combined morning and evening subscription to the same newspaper as one subscription. If counted as two—a morning subscription plus a separate evening subscription—the number of subscriptions in 2006 in Japan was 69.1 million.

newspapers.

Japanese newspapers change their subscription prices infrequently, and in concert. Many of the leading newspapers—including the three largest national dailies (*Yomiuri*, *Asahi* and *Mainichi*)—set exactly the same prices. Nevertheless, it seems that the prices are closer to the Bertrand-Nash equilibrium level than to a collusive level. Based on the estimates in Flath (2016), the own-price elasticity of demand for a subscription to a Japanese newspaper varies from newspaper to newspaper, but averages about 1.4. Furthermore, the elasticity of demand with respect to a five percent change in the subscription prices of ***all*** newspapers is a mere 0.23. Given these elasticities, if the publishers were an effective cartel, the price-cost margins of the newspaper publishers would be much higher (ten times higher) than it appears they actually are. In the analysis of this paper I will presume non-collusive price-setting.

One of the many difficulties in modelling Japanese newspaper industry aggregate data is how to treat morning-and-evening subscriptions and morning-only subscriptions offered by a same publisher. In Flath (2017) I explored the pricing of subscriptions to evening editions and morning editions of newspapers from same publishers, both theoretically and empirically, as an example of second-degree price discrimination. In a model for which content pages per day from each publisher are the objects of choice, a simple substitution pattern emerges in which morning subscriptions and evening subscriptions offered by the same publisher are neither substitutes nor complements in demand. This is true even though demanders of evening editions are invariably a subset of the subscribers to the morning editions of the same newspaper publisher. Under this model, in considering aggregate data we may regard morning subscriptions and evening subscriptions as separate, counting a combined morning and evening subscription as two subscriptions rather than one, priced no differently than they would be if offered by two separate publishers, holding content and advertising constant. That is the approach that I will take here.

A further detail to bear in mind is that most households in Japan subscribe to at most one daily newspaper. On this basis, I will follow the same assumption I adopted in Flath (2016, and 2017) that each newspaper publisher holds a monopoly with respect to newspaper advertisements that target its own subscribers. I will also maintain the presumption that newspaper advertisements have no effect on the demand for newspaper subscriptions. That is, newspaper ads are valued only by the ones placing the ads.

Before moving on to the detailed analysis of Japanese newspaper industry data, I will first describe the broad patterns in Japanese newspaper advertising expenditures, newspaper circulation, and newspaper revenue that the analysis aims to explain. These patterns are remarkably similar to those evident in analogous data for US newspapers. Figures 1a and 1b show how newspaper advertising expenditures in both Japan and the United States steadily rose from the mid-1950's until 1997, with downturns at each recession. Since 1997, newspaper advertising in both countries has decreased sharply, while internet advertising expenditures have shot upward.

As shown in Figure 2, newspaper circulation in both countries rose steadily from the 1950's until the 1970's, ultimately trending downward from around 1989 in the US and from 1997 in Japan. Newspaper circulation revenue in both countries follows the changes in circulation, but with a lag of about ten years. This is most evident in Figure 3 that shows Japanese newspaper circulation, newspaper subscription revenue and advertising revenue, from 1991 to 2015. Circulation peaked in 1997 while subscription revenue continued to rise, peaking in 2007. From 1997 to 2017, Japanese newspaper circulation fell by 29 percent, and subscription revenue (adjusted for inflation) by 7 percent. Over the same interval, Japanese newspaper advertising revenue (adjusted for inflation) fell by 53 percent and ad pages placed by 14 percent. These are the basic facts about the Japanese newspaper industry that are the focus of my analysis. That analysis begins with a basic framework describing the choices of a single newspaper publisher, and then goes on to consider what that framework implies for the industry aggregates.

## 3. Basic framework

The choices of a newspaper publisher are constrained not only by the demand for subscriptions, but also by the demand to place ads in the newspaper. As in Flath (2016, 2017), let us suppose that the demand for a page of ads "*a*" in a particular newspaper depends on the price received by the publisher to place such an ad per subscriber, "$p_a/s$"—which is proportionate to, but less than, the price actually paid by the one placing the ad, because of the (15 percent) commission charged by the ad agencies. Let us also presume 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.

Let us suppose that newspaper $i$ faces constant-elasticity demands for subscriptions $s_i$ and for ads $a_i$, as follows.

[1] $$s_i = A_i p_{s_i}^{-\xi_{s_i}} \prod_{j \neq i} p_{s_j}^{\xi_{s_{ij}}}$$

[2] $$a_i = B_i \left(\frac{p_{a_i}}{s_i}\right)^{-\xi_{a_i}},$$

where $\xi_{s_i} > 0$, $\xi_{s_{ij}} \geq 0$, and $\xi_{a_i} > 1$. Here, $A_i > 0$ and $B_i > 0$ are parameters.

Let us further presume that each household subscribes to at most one newspaper. This means that each newspaper publisher is in effect a monopolist in supplying newspaper ads that will be seen by its subscribers. The parameter $B_i$ may thus reflect characteristics of the subscribers of newspaper *i* but is completely unrelated to the prices of ads set by rival newspapers.

The demand for subscriptions is related to the subscription prices of rival newspapers. In Eq. [1] the cross-price-elasticities of demand, $\xi_{s_{ij}}$, are constant. In Flath (2017) I developed a model of newspaper demand in which cross-price elasticity of demand between morning and evening editions offered by the same publisher are zero, which is consistent with the formulation here of Eq. [1].

The subscription demand parameter $A_i$ must reflect content of newspaper *i* and of other newspapers $j \neq i$. Here I will treat content as exogenous. In section 5.2.3. below, I will modify this assumption and explore the meaning and implications of the rising average number of pages of content in Japanese newspapers. Although the number of pages of content is exogenous in the framework here, it does affect the incremental costs of subscriptions.

Again, as in Flath (2016, 2017), let the costs of newspaper production depend on number of ads, circulation, and 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 to the publisher of distribution, that is the publisher's monthly payments to independent news dealers per subscriber, $\bar{c}$ 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.

The incremental costs, $c_s$ and $c_a$ , of supplying subscriptions and ads are the following.

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

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

The newspaper publisher chooses price of ads and price of subscriptions to maximize total profit.

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

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

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

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

The logic underlying Eq. [8] may be more evident if expressed as follows.

[9] $$p_s \left(1 - \frac{1}{\xi_s}\right) = c_s - \frac{p_a a}{s}.$$

The newspaper publisher sets its subscription price, and implied number of subscribers, so that the marginal revenue from subscriptions, $p_s \left(1 - \frac{1}{\xi_s}\right)$, equals marginal cost of subscriptions net of the added marginal profit from advertising that accompanies expanded reach, $c_s - \frac{p_a a}{s}$.

Figure 3 illustrates the profit-maximizing choice of a publisher that faces constant elasticity of demand greater than one. Marginal advertising profit, $\frac{p_a a}{s}$, can be greater than the marginal cost $c_s$, with a small number of subscribers, but approaches zero as the number of subscribers increases. Figure 4 illustrates the case of a newspaper that faces unit-elastic demand. A newspaper that faces unit-elastic demand prices it subscriptions so that marginal cost net of marginal profit from advertising equals zero—the value of marginal revenue, whatever its number of subscribers.

My aim is to extend this basic model of pricing by a single newspaper to encompass industry-wide aggregates—average industry subscription price, aggregate number of subscribers to all newspapers, total volume of ads placed in all newspapers, and industry revenue from the sale of newspaper advertising.

## 4. Industry-level data

### 4.1. Data sources

Industry-level data on newspaper circulation, subscription revenue, advertising revenue and total volume of newspaper ads are available annually for Japan since 1997. These are the data behind my earlier assertions regarding the precipitous recent declines in Japanese newspaper circulation and advertising revenue that are the main focus of this paper.

Almost none of the Japanese newspaper publishers are publicly-traded companies, and they keep data on revenue and costs private. Most of the publically available data on the Japanese newspaper publishing industry come from two separate annual surveys. One is by the Japan Newspaper Publishers & Editors Association (Nihon Shinbun Kyokai—NSK), and the other is by Japan's largest advertising agency, Dentsu, Inc. The NSK annual survey collects data on newspaper circulation and on newspaper publisher revenue from ads and from sales (subscriptions mostly). The survey covers from 90 to 100 of the leading newspapers. Since 2002, the NSK survey data are based on fiscal year, and before that on calendar year. The aggregate data for recent years (since 2002) are available through the NSK website.[2] These and archival data from the NSK survey are also available from various other sources, including, until its suspension in 2013, Dentsu (Annual b). The annual aggregate newspaper circulation data are also reported in the *Japan Statistical Yearbook* and related sources, with archival data going back to 1956. I have found it impossible to collect NSK survey data on newspaper publisher revenue for any years before 1996.

The annual advertising survey by Dentsu covers advertising placed in all media, not just newspapers. From the survey, Dentsu compiles annual data on aggregate advertising expenditures in Japan, broken down into categories that include newspaper advertising. The survey data also include total columns of advertising in each newspaper (a newspaper page in Japan is divided into 15 columns). The standard newspaper advertising commission in Japan, as in the US, is 15 percent. That means that, in principle,

[2] http://www.pressnet.or.jp/english/data/

the ad revenue of a newspaper is 1÷1.15 (=87 percent) of the advertising expenditure, with the remainder absorbed by the ad agency commission. Based on this principle, the newspaper revenue from advertising reported in the NSK survey seems to encompass about 80 percent of that accounted for in the Dentsu compilation of ad expenditures. The Dentsu coverage of newspapers is a bit broader than that of the NSK survey; it includes around 120 daily newspapers compared to the 90 or 100 of the NSK survey. The NSK survey seems to exclude sports dailies and industry papers, which the Dentsu survey does include. The numbers of ad columns and total columns for each newspaper were, until 2010, reported in Dentsu (Annual a).[3]

The Table 1 describes variables in a dataset drawn from the sources just mentioned, or inferred from those sources based on the empirical findings of Flath (2016, 2017). The raw aggregate data are shown in Table 2. These are the industry-level data on newspaper pricing, revenue, subscriptions and advertising that I aim to interpret using the basic model of the behavior of a single newspaper publisher sketched in the previous section. Applying that model to the industry-level data requires some further development, which is the next task.

4.2. Average subscription price

The Eq. [8] describes the subscription price-cost margin of a single newspaper, premised on Bertrand-Nash equilibrium. That is, newspaper *i* is setting its subscription price, $p_{s_i}$, taking the prices of all rival newspapers as given. Together, equation [8] and the analogous equations for every other newspaper comprise the industry equilibrium. These equilibrium subscription price-cost margins will be reflected in aggregate data in a simple way. Some algebra yields the following expression for industry price-cost margin.

[10] $$\frac{p_s^* - c_s^*}{p_s^*} = \frac{1}{\xi_s^*} - \frac{\sum_i p_{a_i} a_i}{\sum_i p_{s_i} s_i},$$

where, $p_s^* \equiv \sum_i \left\{ \left( \frac{s_i}{\sum_j s_j} \right) p_{s_i} \right\}$, $c_s^* \equiv \sum_i \left\{ \left( \frac{s_i}{\sum_j s_j} \right) c_{s_i} \right\}$, and $\frac{1}{\xi_s^*} = \sum_i \left\{ \left( \frac{p_{s_i} s_i}{\sum_j p_{s_j} s_j} \right) \frac{1}{\xi_{s_i}} \right\}$.

[3] Dentsu still conducts the survey but no longer publishes the full results. The last edition of Dentsu (Annual a), with data from the 2010 survey, was published in 2013. For the purpose of this study, I was able to obtain data on pages of ads of each newspaper for years since 2010 directly from Dentsu (for which I thank the people in charge at Dentsu).

4.3. Elasticity of demand for subscriptions

Assuming, as here I shall, that the elasticity of demand facing each newspaper publisher is different from one, based on Eq. [10], the average equilibrium subscription price would evolve according to the following.

[11] $$p_s^* = \left(c_s^* - \frac{\sum_i p_{a_i} a_i}{\sum_j s_j}\right)\left(1 - \frac{1}{\xi_s^*}\right)^{-1}.$$

OLS estimates of the equation using annual data, 1997-2016, are as follows.

12] $$p_s^* = \widehat{\left(1 - \frac{1}{\xi_s^*}\right)^{-1}} \left(c_s^* - \frac{\sum_i p_{a_i} a_i}{\sum_j s_j}\right) + \hat{\varepsilon}.$$

3.24
(0.08)

95% confidence interval: (3.07, 3.41)

n=19
F(1,18)=1,571

$\left(1 - \frac{1}{\xi_s^*}\right)^{-1}$ =3.24 implies $\xi_s^*$ =1.45; 95% confidence interval: (1.41, 1.48).

These estimates constrain the intercept to be zero as Eq. [11] implies. I see no compelling reason to suppose that omitted variables would bias the resulting estimate of the slope parameter, $\left(1 - \frac{1}{\xi_s^*}\right)^{-1}$. A further robustness check reinforces this judgment. From Flath (2016) estimates of $\xi_{s_i}$ for each newspaper *i*, using data for 2007, it is possible to directly compute the weighted average $\xi_s^* = \sum_i \xi_{s_i} \frac{p_{s_i} s_i}{\sum_k p_{s_k} s_k} = 1.41$. This is close to the above estimate, which instills some confidence that my interpretation of the aggregate data is correct.

The residual error terms, $\hat{\varepsilon}_t$, from Eq. [12] show how actual subscription prices have deviated from profit-maximizing prices. My presumption is that, over the period of observation, average subscription prices tend towards Bertrand-Nash equilibrium levels, but with some deviation because price changes are infrequent. To put it another way, I presume that changes in cost and in advertising revenue per subscriber induce price changes but with a lag. Figure 6 shows the trajectory of nominal and real monthly subscription price of the leading national dailies—Yomiuri, Asahi and Mainichi—all of which set the same price. This is the trajectory on which the average real subscription price, $p_s^*$, used in the regression estimate of Eq. [12] is based. The Figure 7 shows the actual values of $p_s^*$ and the predicted value of the regression, for both nominal and real variables. The average real subscription price has risen by 19 percent, 1997 to 2017, but this is partly the result of deflation, the GDP deflator having fallen by 12 percent over the same interval. (The last observations, for 2016 and 2017, also reflect the increase in consumption tax from 5% to 8% in April 2014).

4.4. Industry demand for subscriptions

I have represented the demand for subscriptions to newspaper *i* by Eq. [1] which I reproduce here.

[1] $$s_i = A_i p_{s_i}^{-\xi_{s_i}} \prod_{j \neq i} p_{s_j}^{\xi_{s_{ij}}}.$$

To model the industry demand for subscriptions, first define

[13] $$s_i^* = A_i p_s^{*-\xi_s^*} \prod_{j \neq i} p_s^{*\xi_{\cdot j}^*},$$

where, $\xi_{\cdot j}^* \equiv \sum_i \frac{p_{s_i} s_i}{\sum_k p_{s_k} s_k} \sum_{j \neq i} \xi_{s_i j}$ is a weighted average of the cross-price elasticities of demand for subscriptions to each newspaper, with the weights defined in an analogous way to those for $1/\xi_s^*$. Thus, $s_i^*$, is the number who would subscribe to newspaper *i* if its price were set at the industry weighted average and its elasticity of demand and cross-elasticities of demand were also at the industry weighted averages. The number of subscribers to newspaper *i* is

[14] $$s_i = A_i p_s^{*-\xi_s^*} \prod_{j \neq i} p_s^{*\xi_{\cdot j}^*} \varepsilon_i,$$

where $\varepsilon_i$ is an implicitly-defined error term, $\varepsilon_i = \frac{s_i}{s_i^*}$, the ratio of actual number of subscribers to newspaper *i*, relative to the number predicated on Eq. [13]. I believe that most of the time-series variation in subscription prices is the result of forces that affect all newspapers in a similar way. This is because the newspaper publishers all seem to adjust their prices in synch with one another. Actually, many of them set exactly the same prices as one another, and have done so for decades. Cross-sectional variation in subscription prices is idiosyncratic. A natural assumption is that the expected number of subscribers to any randomly selected newspaper *i* is equal to $s_i^*$, that is $\mathrm{E}(s_i) = s_i^*$, so the expected value of the error term in Eq. [14] is one, $\mathrm{E}(\varepsilon_i) = 1$.

Aggregate industry demand for subscriptions becomes the following.

[15] $\sum_i s_i = p_s^{*-\xi_s^*} \prod_{j \neq i} p_s^{*\xi_{\cdot j}^*} \sum_i A_i \varepsilon_i$

As just related, we might suppose that the error term here, $\sum_i A_i \varepsilon_i$, has an expected value equal to the quasi-intercepts[4] of the demands for subscriptions, summed over all newspapers.

[16] $\mathrm{E}(\sum_i A_i \varepsilon_i) = \sum_i A_i$ .

To estimate this changing quasi-intercept of the industry-wide demand for subscriptions it is necessary to know the elasticity of demand for aggregate subscriptions with respect to a change in the prices of all newspapers, $\xi_s^* - \sum_j \xi_{\cdot j}^*$. This parameter cannot be estimated without bias from simple OLS estimation of Eq. [15], because the error term, $\sum_i A_i \varepsilon_i$, is correlated with average subscription price, $p_s^*$. The main forces behind the shifting demand for subscriptions—the rise of the internet, the shrinking population of Japan, the aging of the Japanese demographic profile—are apt also to precipitate increases in subscription prices by lowering advertising revenue per subscriber. Fortunately, in Flath (2016) I have already constructed estimates of the demand for Japanese newspapers, using random-parameter logit estimation of an indirect utility function, based on micro data from a 2007 nationwide household survey. The estimates use a control-function specification to counteract omitted variable bias, in an attempt to attain unbiased estimates of the effect of newspaper subscription price changes on quantity of subscriptions demanded.

Based on simulations using the indirect utility function estimated in Flath (2016), a 5% increase in all newspaper subscription prices results in 1.155% reduction in total subscriptions. Thus elasticity of industry-wide demand is 0.231. Let us therefore presume that $\xi_s^* - \sum_j \xi_{\cdot j}^* = 0.231$, in constructing estimates of the exogenous shifts in aggregate demand for subscriptions in each year, $\sum_i A_{it}, t = 1, \ldots, T$. The industry demand for subscriptions is the following.

[17] $\ln \sum_i s_i = \ln \sum_i A_i - 0.231 \ln p_s^*$

### 4.5. Industry demand for newspaper ads

In modeling the industry-wide demand for newspaper ads, we need to observe the

[4] By 'quasi-intercept' I mean the quantity of subscriptions demanded at price $p_s^* = 1$. There is no actual intercept in the sense of quantity demanded at $p_s^* = 0$.

industry-wide average price of an ad per subscriber, $\frac{p_a^*}{s^*} \equiv \frac{\sum_i p_{a_i} a_i}{\sum_j s_j a_j}$. Note that this is a weighted average of the price of an ad per subscriber $\frac{p_{a_i}}{s_i}$ in each newspaper *i*, with weights equal to $\frac{s_i a_i}{\sum_j s_j a_j}$, the share of industry-wide ad impressions $s_i a_i$ distributed by each newspaper *i*. The average price of an ad per subscriber is thus

[18] $$\frac{p_a^*}{s^*} \equiv \sum_i \frac{p_{a_i}}{s_i} \frac{s_i a_i}{\sum_j s_j a_j} = \frac{\sum_i p_{a_i} a_i}{\sum_i s_i a_i}.$$

This is also the weighted average price per ad, $p_a^*$, divided by the weighted average reach per ad, $s^*$, with weights equal to shares of total ads.

[19] $$p_a^* = \sum_i p_{a_i} \frac{a_i}{\sum_j a_j},$$

and

[20] $$s^* = \sum_i s_i \frac{a_i}{\sum_j a_j}.$$

In the aggregate data, we observe average ad price, $p_a^*$, but not average reach, $s^*$. But from the Dentsu survey data that reports pages of ads in each newspaper for each year, 1997 to 2016, and from the newspaper circulation data for each newspaper, available from JABC (behind a paywall), I was able to calculate the weighted average reach per ad, $s^*$, for each year. This is shown in Table 4. It is evident from the table that average reach has fallen 18.4% from 1997 to 2017, which is a bit less than the 28.7% decline in number of subscribers shown in Table 3.

The weighted average price-per-page-of-ads-per-subscriber, $\frac{p_a^*}{s^*}$, is inferred by dividing the average price-per-page-of-ads, $p_a^*$, by the estimated average reach per ad. This is a first step in deducing the industry-wide demand for newspaper ads. We will also need to know the elasticity of demand. Rather than estimating this elasticity directly I will infer it based on presumed monopoly price-setting by each newspaper publisher, and information about marginal cost.

In the framework of this paper, each newspaper is a monopolist in the sale of newspaper ads targeting its own subscribers. The monopoly ad pricing equation follows from Eq. [7] which I reproduce here.

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

where

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

Rearranging, we have the ad pricing equation.

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

Solving Eq. [21] for elasticity of demand, $\xi_a$, results in

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

From Flath (2016, p. 471) ,

$$f_a \approx 200{,}00\ yen\ per\ page, 2007$$

$$\bar{c} \approx 1\ yen\ per\ page, 2007$$

Based on these assumptions

[23] $$\xi_a = \left(1 - \frac{200{,}000}{p_a} - \frac{1}{p_a/s}\right)^{-1}.$$

$$= \left(1 - \frac{200{,}000 + s}{p_a}\right)^{-1}.$$

This is the equation used to compute the elasticity of demand in each year as shown in Table 4. The elasticity has risen from 1.7 in 1997, to 2.7 in 2017.

The demand for ads in newspaper *i* is shown by Eq. [2] which is reproduced below.

[2] $$a_i = B_i\left(\frac{p_{a_i}}{s_i}\right)^{-\xi_a}.$$

To model industry-wide demand for ads, let us follow similar logic to that just applied to the industry-wide demand for subscriptions. The result is an expression for industry-wide demand for newspaper ads as follows.

[24] $$\sum_i a_i = \left(\frac{p_a^*}{s^*}\right)^{-\xi_a} \sum_i B_i\,\varepsilon_i,$$

where $\varepsilon_i$ is an error term, and $\mathrm{E}(\sum_i B_i \varepsilon_i) = \sum_i B_i$.

5. Industry-wide supply and demand for subscriptions and advertising.

5.1. Four equations to describe industry aggregates.

From the previous discussion, we have a four-equation system for interpreting the industry-level data on Japanese newspapers. These are: (1) newspaper subscription supply-price equation, (2) demand for newspaper subscriptions, (3) newspaper advertising supply-price equation, and (4) demand for newspaper ads. These four equations are reprised below.

*Subscription price* (Eq. [12]).

[25] $$p_s^* = 3.24\left(c_s^* - \frac{\sum_i p_{a_i} a_i}{\sum_j s_j}\right),$$

where $p_s^* = \frac{\sum_i p_{s_i} s_i}{\sum_j s_j}$ is the average subscription price per month. Note also that in this equation, $3.24 = \left(1 - \frac{1}{\xi_s^*}\right)^{-1} = \left(1 - \frac{1}{1.45}\right)^{-1}$. Here, $c_s^*$ is the incremental cost of a subscription per month, and $\frac{\sum_i p_{a_i} a_i}{\sum_j s_j}$ is the newspaper advertising revenue per subscriber per month.

*Demand for subscriptions* (Eq. [17]).

[26] $$\ln \sum_i s_i = \ln \sum_i A_i - 0.231 \ln p_s^* .$$

Note that in this equation, $0.231 = \xi_s^* - \sum_j \xi_{\cdot j}^*$.

*Advertising price* from (Eq. [21]).

[27] $$p_a^* = (200{,}000 + s^*)\left(1 - \frac{1}{\xi_a}\right)^{-1} .$$

where $p_a^* = \sum_i p_{a_i} \frac{a_i}{\sum_i a_i}$ is the average price of an ad per page, and $s^* = \sum_i s_i \frac{a_i}{\sum_i a_i}$ is the average "reach" of a newspaper ad.

*Demand for newspaper ads* from (Eq. [25]).

[28] $$\ln \sum_i a_i = \ln \sum_i B_i - \xi_a \ln\left(\frac{p_a^*}{s^*}\right)$$

5.2. Interpreting the industry-level time-series data.

5.2.1. Separating the effects of exogenous demand shocks from the effects of price changes induced by those shocks.

Table 3 displays the data corresponding to variables in the newspaper subscription supply and demand equations, and Table 4 the data corresponding to variables in the newspaper advertising supply and demand equations, annually 1997-2017. The final columns in each of the two tables describe the annual shifts in demand for subscriptions and for ads, and shifts in elasticity of demand for ads, $\xi_a$. Here 'shifts in demand' mean annual percentage changes in the industry-wide demand, holding inflation-adjusted prices fixed at their 1997 levels, and presuming that the elasticity of industry-wide demand for subscriptions remained fixed at $\xi_s^* - \sum_j \xi_{\cdot j}^* = 0.231$.

The last columns of Tables 3 and 4 show a 26% decrease in demand for newspaper subscriptions, from 1997 to 2017, and an 83% decrease in the demand for newspaper ads, holding inflation-adjusted prices at their 1997 levels. Some portion of the decrease in demand for ads was a result of the falling reach of ads, which was induced by the fall in demand for subscriptions. The decrease in demand for ads, from 1997 to 2017, if holding inflation-adjusted average price of ads at its 1997 level, and also holding average reach per ad at its 1997 level, was 71%. To put it another way, only 1/7$^{\text{th}}$ of the 83% fall in demand for ads from 1997 to 2017 was because of the decrease in newspaper circulation. The other 6/7$^{\text{ths}}$ of the fall in demand for newspaper ads was because of the rise of the internet and other such related factors.

The price responses to shifts in demand for subscriptions and for ads are also evident in Tables 3 and 4. The price elasticity of the industry-wide demand for subscriptions was, by my estimate, equal to $0.231$, in other words, rather small. The 53% loss of advertising revenue, from 1997 to 2017, induced newspaper publishers to increase their inflation-adjusted subscription prices by 19%, but the effect of these increases in subscription prices on total number of subscriptions was small, and the effect on circulation revenue was great—largely offsetting the fall in revenue resulting from the decline in demand for subscriptions. From 1997 to 2017, demand for subscriptions fell by 26%, but subscription revenue fell by only 7%. Figure 8 depicts the shift in demand for subscriptions, and trajectory of inflation-adjusted price of subscriptions, from 1997 to 2017, as just described.

In spite of the 83% fall in demand for newspaper ads from 1997 to 2017, the volume of newspaper ads fell by a mere 14%. This is because the elasticity of demand for newspaper ads increased from 1.7 in 1997 to 2.7 in 2017, prompting newspaper publishers to lower their inflation-adjusted prices of ads by 33%.

Figure 9 shows the trajectory of volume of ads from 1997 to 2017, and also shows the simulated trajectories conditional on an unchanging inflation-adjusted average price of ads, and on an unchanging inflation-adjusted average price of ad per subscriber. The gray bars in the figure indicating recession years generally coincide with sharp declines in the volume of ads, except for the most recent recession in 2012. Much of the 83% drop in demand for ads over the entire period of observation was coincident with the 2008-9 Lehman shock recession.

Figure 10 depicts the 1997-to-2017 shift in industry-wide demand for newspaper ads as a function of inflation-adjusted average price of an ad per page per subscriber, and also shows the trajectory in that average price. The left-pointing arrow in the figure depicts the previously noted 71% fall in demand for newspaper ads from 1997 to 2017, measured at the 1997 price per page per subscriber. The Table 5 shows the precise numbers of newspaper ad pages that would have been demanded in each year, at the 1997 inflation-adjusted price per subscriber. The annual percentage changes in these numbers of ad pages demanded are shown in the penultimate column of Table 4.

Table 5 also shows the annual inflation-adjusted expenditures on internet advertising, from 1997 to 2017. As the demand for newspaper print ads was declining, internet advertising expenditures were soaring. To explore this relation in detail, I have estimated an auto-regressive distributed lag (ARDL) model showing the effect of internet advertising expenditures on the demand for newspaper print ads.

5.2.2. ARDL model relating the rise of internet advertising expenditures to the decreasing demand for newspaper ads.

The dramatic changes confronting the Japanese newspaper industry in the last two decades are widely attributed to the rise of the internet. Figure 11 shows the falling demand for newspaper print ads, at the inflation-adjusted 1997 average price of ad per page per subscriber, from 1997 to 2017, and also shows the change in inflation adjusted expenditures on internet advertising. The vertical scale for the internet advertising expenditures is in descending logarithmic units, shown on the right axis. The rise in expenditures is depicted as a *downward* sloping graph. The vertical scale for number of print ad pages demanded in each year is shown in ascending arithmetic units on the left axis. The trajectories of demand for newspaper ads and of internet ad expenditures shown in the figure are similar, which means that from 1997 to 2017, inflation-adjusted internet advertising expenditures were generally growing at an exponential rate, while the demand for newspaper print ads was decreasing at an arithmetic rate. The recession years, indicated by gray bars in the figure, coincide with particularly sharp decreases in demand for newspaper print ads, and slowing of growth in internet ad expenditures. These considerations point to an econometric model in which internet advertising expenditures have a long-term relationship with the demand for newspaper print ads, while the annual rate of growth in real GDP influences the short-run dynamics of that relationship. An ARDL model is the appropriate econometric representation of the intertwining of internet advertising expenditures and the demand for newspaper print ads.

The variables in the autoregressive distributed-lag model are the following ones. The actual annual time series, 1997 to 2017 of all three variables are shown in Table 5.

$y_t = newspaper\ ad\ pages\ demanded\ at\ year\ t,\ if\ p_{a,1997}\ and\ s_{1997}$

$x_{1,t} = \ln internet\ ad\ expenditures\ \ at\ year\ t,$ units=100 millions, 2005 yen

$x_{2,t} = \Delta \ln real\ GDP\ at\ year\ t$; real GDP units=billions, 2011 JPY

My claim is that demand for newspaper ads, $y_t$, and the natural logarithm of internet ad expenditures, $x_{1,t}$, are cointegrated with each other. Annual rate of growth in real GDP, $x_{2,t}$, is stationary, that is, integrated of degree zero, $I(0)$,[5] and is an exogenous variable affecting the short-run dynamics inherent in the cointegration relationship between the other two variables. These stipulations are all supported by statistical tests, about which more in due course.

Posit the following model for explaining the trajectory of demand for newspaper print ads, $y_t$.

[29]

$$y_t = \beta_0 + \sum_{i=1}^{p} \theta_{t-i} y_{t-i} + \sum_{i=0}^{q1} \beta_{1,t-i} x_{t-i} + \sum_{i=0}^{q2} \beta_{2,t-i} x_{t-i} + u_t$$

Here, $u_t$ is an i. i. d. random variable with zero mean. The parameters $p$, $q_1$, and $q_2$ are the numbers of lagged terms for each variable. Such an econometric specification is dubbed the ARDL($p$, $q_1$, $q_2$) model.

Experimentation with different lag lengths has led me to the ARDL(2,2,2) specification of this model which is depicted below.

---

[5] The order of integration, denoted $I$(d), of a time series is the minimum number of differences required to obtain a covariance-stationary series.

[30] $$y_t = \beta_0 + \theta_{t-1}y_{t-1} + \theta_{t-2}y_{t-2} + \beta_{1,t}x_{1,t} + \beta_{1,t-1}x_{1,t-1} + \beta_{1,t-2}x_{1,t-2} + \beta_{2,t}x_{2,t} + \beta_{2,t-1}x_{2,t-1} + \beta_{2,t-2}x_{2,t-2} + u_t$$

This 'levels' representation of the ARDL model is estimated with OLS. Interpreting the coefficient estimates is informed by two additional representations of the ARDL model, both algebraically equivalent to the levels representation shown as Eq.[30]. The first of these alternate representations depicts the long-term relationship among the underlying variables—the cointegrating equation linking $y_t$ and $x_{1,t}$—and the second shows the short-run dynamics—the error-correction process.

The long-term relationship between $y_t$ and $x_{1,t}$ is, by definition, time-invariant. Imposing the condition, $y_t = y_{t-1} = y_{t-2}$ and $x_{1,t} = x_{1,t-1} = x_{1,t-2}$, on Eq. [30] and solving for $y_t$ gives the relevant expression.

[31] $$y_t = \frac{\beta_0 + \sum_{i=0}^{2}\beta_{2,t-i}x_{t-i}}{(1-\theta_{t-1}-\theta_{t-2})} + \frac{\beta_{1,t}+\beta_{1,t-1}+\beta_{1,t-2}}{(1-\theta_{t-1}-\theta_{t-2})}x_{1,t} + \frac{u_t}{(1-\theta_{t-1}-\theta_{t-2})}$$

This shows the cointegrating relationship between $y_t$ and $x_{1,t}$, their long-term equilibrium relationship. The cointegrating coefficient is $\frac{\beta_{1,t}+\beta_{1,t-1}+\beta_{1,t-2}}{(1-\theta_{t-1}-\theta_{t-2})}$.

Next, focusing on the short-run dynamics, algebraic manipulation of Eq. [30] results in the following error-correction representation of the ARDL model.

[32] $$\begin{aligned}\Delta y_t = \beta_0 \;-\; &(1-\theta_{t-1}-\theta_{t-2})\left[y_{t-1} - \frac{\beta_{1,t}+\beta_{1,t-1}+\beta_{1,t-2}}{(1-\theta_{t-1}-\theta_{t-2})}x_{1,t-1}\right] \\ &- \theta_{t-2}\Delta y_{t-1} \\ &+ \beta_{1,t}\Delta x_{1,t} - \beta_{1,t-2}\Delta x_{1,t-1} \\ &+ \beta_{2,t}x_{2,t} + \beta_{2,t-1}x_{2,t-1} + \beta_{2,t-2}x_{2,t-2} \\ &+ u_t\end{aligned}$$

Here, $\Delta y_t \equiv y_t - y_{t-1}$ and so on. The term in brackets, $\left[y_{t-1} - \frac{\beta_{1,t}+\beta_{1,t-1}+\beta_{1,t-2}}{(1-\theta_{t-1}-\theta_{t-2})}x_{1,t-1}\right]$, is the 'error-correction' term. It shows the previous period's deviation of $y_t$ from its longrun equilibrium. The parameter $(1 - \theta_{t-1} - \theta_{t-2})$, which lies between zero and one if the assumptions of the model are correct, is called the 'adjustment coefficient.' It shows how much stronger is the tendency of $y_t$ to return to its long-term relationship with $x_{1,t}$ the farther it has deviated from it.

A key assumption on which this ARDL model rests is that the error term in Eq. [30] is stationary—has a mean and variance that does not change over time. This can be confirmed by a test for serial correlation of the residuals from an OLS estimate of Eq. [30]. But this is not by itself sufficient to establish a long-term levels relationship between $y_t$ and $x_{1,t}$, because such a relationship also requires that the cointegration coefficient in Eq. [31] is non-zero. Pesaran, Shin and Smith (2001) have proposed a 'bounds test' of whether OLS estimates of an ARDL model such as that shown in Eq. [30], imply a long-term relationship between the underlying regressors, $y_t$ and $x_{1,t}$, when it is not known with certainty whether the regressors are trend stationary or first-difference stationary. The bounds test has two parts. The first is a Wald $F$-test of the hypothesis that the coefficients on $y_{t-1}$ and $x_{1,t-1}$ in Eq. [32] are both zero, which if not rejected would mean the absence of a levels relationship between the variables—Eq. [31] would become $y_t = \frac{\beta_0 + \sum_{i=0}^{2} \beta_{2,t-i} x_{t-i}}{(1-\theta_{t-1}-\theta_{t-2})} + \frac{u_t}{(1-\theta_{t-1}-\theta_{t-2})}$. The second part of the Pesaran et alia. procedure is a $t$-test of the hypothesis that the coefficient on $y_{t-1}$ in Eq. [32] is less than zero, which if not rejected would also imply the absence of a levels relationship between $y_t$ and $x_{1,t}$. The critical values for the $F$-test and $t$-test statistics are non-standard (because of the presence of the lagged value of the dependent variable in the equation) and also depend upon whether $y_t$ or $x_{1,t}$ or both are integrated of degree zero, $I(0)$, or integrated of degree one, $I(1)$. Pesaran et alia. provide upper and lower bounds for these critical values, the lower bound reflecting the case in which both variables are $I(0)$, and the upper bound the case in which both are $I(1)$. The test is invalid if either variable is integrated of degree two, $I(2)$. Augmented Dickey-Fuller tests suggest that $x_{1,t}$ –the natural log of internet advertising expenditures— and $y_t$—the demand for newspaper print ads—are both trend-stationary.

The estimated coefficients of the error-correction representation of the ARDL model, their standard errors and $p$-values are reported in Table 6. At the bottom of the table are also reported the results of the Pesaran, Shin and Smith (2001) bounds test, which soundly rejects the null hypothesis of no levels relationship among the variables. Beneath that is reported the results of Durbin's alternative test for autocorrelation, results that suggest the absence of serial correlation in the error term. These test results support the ARDL model as a valid specification.

The adjustment coefficient, shown in Table 6, is 0.332. All of the coefficients of the model are estimated precisely, with small standard errors and low $p$-values, and the adjusted R-squared is 0.94. The cointegration coefficient is estimated to be $-62{,}175$. That means that in the long-term, each 10 percent increase in inflation-adjusted internet advertising expenditures —each 0.1 increase in $x_{1,t}$—will reduce the number of pages of newspaper ads demanded, $y_t$, by 6,217. That is about 5 percent of the 2017 value for $y_t$ shown in Table 5, which is 114,269 pages of ads. From these estimates, it seems that the demand for newspaper print ads is negatively but inelastically affected by increases in internet advertising expenditures. Based on the estimates, it would require a near-tripling of internet advertising expenditures over their 2017 value—a 200 percent increase—to reduce the demand for newspaper print ads to zero.

5.2.3. Analyzing the changing demand for newspaper subscriptions and changing supply of newspaper content.

The previous section presented econometric evidence linking the decline in demand for newspaper print ads to the rise of internet advertising. We may well ask whether similar analysis might link the decline in newspaper subscriptions to the rise of the internet. This is difficult to do in a precise way because of the many possible influences on the demand for newspaper subscriptions other than the expansion of the internet. Although the Japanese population and labor force have been declining in the last two decades, the number of households has been increasing—by 26.3 percent from 1997 to 2017. The Japanese population is aging, the marriage rate among young persons has declined, and the number of one-person households has increased. All of this must have affected the demand for print newspaper subscriptions in ways that are difficult to measure. In short, the growth of the internet probably accounts for some of the decline in demand for print newspaper subscriptions, but I am unable to say precisely how much. What is more, the rise of the internet, along with the widening use of computers, since 1997, has not only reduced the demand for subscriptions to print newspapers, but has also lowered the costs of actually composing newspaper content, which has induced an expanded supply of newspaper content.

By my calculation, the average number of content pages per month per newspaper subscription increased by 26.3 percent from 1997 to 2017. In spite of this increase in pages of content averaged across newspapers, the number of reporters and editors per newspaper publisher has not changed significantly in Japan, from 1997 to 2017, which suggests that the average product of these workers increased. It is natural to think that such an increase in productivity of newspersons would accompany the advent of word processing and digital communication. To understand how these technological changes might have affected the newspaper publishers' chosen number of content pages requires a little further modeling. This will also be useful in constructing estimates of the changing costs of producing newspaper content, which we will need when calculating newspaper publisher economic profit.

Let us amend the demand for subscriptions facing an individual newspaper $i$ (as previously represented by Eq. [1], which I reproduce below), so that $A_i = \tilde{A}_i k_i^{\theta} \prod_{j \neq i} k_j^{\theta_{\cdot j}}$.

[1] $$s_i = A_i p_{s_i}^{-\xi_{s_i}} \prod_{j \neq i} p_{s_j}^{\xi_{s_{ij}}}$$

now becomes the following.

[33] $$s_i = \tilde{A}_i k_i^{\theta} \prod_{j \neq i} k_j^{\theta_{\cdot j}} p_{s_i}^{-\xi_{s_i}} \prod_{j \neq i} p_{s_j}^{\xi_{s_{ij}}},$$

where $0 < \theta < 1$. That is, elasticity of demand with respect to pages of content per month is $\theta$ and cross elasticity of demand with respect to pages of content is $\theta_{\cdot j}$.[6]

Aggregate industry demand for subscriptions, the analogue of Eq. [15], becomes the following.

[34] $$\sum_i s_i = k_i^{*\theta^*} \prod_{j \neq i} k_j^{*\theta^*_{\cdot j}} p_s^{*-\xi_s^*} \prod_{j \neq i} p_s^{*\xi^*_{\cdot j}} \sum_i \tilde{A}_i \varepsilon_i,$$

where $k_i^* = k_j^*$, is the industry weighted average number of pages of content in each newspaper, and $\theta^*$ and $\theta^*_{\cdot j}$ are the industry weighted average elasticity of demand and cross-elasticities of demand for subscriptions with respect to pages of content, with weights equal to industry shares of subscription revenue.

[6] In Flath (2016) I estimated these elasticities, and in Flath (2017) I modelled and empirically estimated the interaction between publishers' choices of whether to offer their morning subscribers the option of also subscribing to an evening edition, and how many pages of content to include in each edition.

Now stipulate that an increase in content by all newspapers simultaneously has no effect on the demand for subscriptions, a reasonable presumption based on the demand estimates of Flath (2016). This means that

[35] $$\theta^* - \sum_j \theta_{\cdot j}^* = 0.$$

Then, because $k_i^* = k_j^*, \forall\, i, j$, it follows that $k_i^{*\theta^*} \prod_{j \neq i} k_j^{*\theta_{\cdot j}^*} = 1$ and $\sum_i A_i \varepsilon_i = \sum_i \tilde{A}_i \varepsilon_i$. In other words, Eq. [34] exactly matches Eq. [15]. Under these presumptions, introducing pages of content as a determinate of the demand for subscriptions to any one newspaper requires no change in the previous analysis of industry wide demand for subscriptions.

The upshot of Eq. [33] is that in addition to choosing the subscription price $p_{s_i}$ and ad price $p_{a_i}$, the newspaper publisher also chooses the pages of content per month, $k_i$ to maximize profit. Its rule for doing so becomes the following.

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

where $c_k$ is the incremental cost of a page of content.

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

From the estimates of demand facing each Japanese newspaper in Flath (2016), on average across newspapers $\xi_s = 1.41$, as already reported, and $\theta = 0.39$. Thus $\theta/\xi_s = 0.28$. Let us use these values to impute $f_k$, the first-copy cost per page of content. Some algebraic manipulation yields the following.

[38] $$\begin{aligned} f_k k &= \left(\frac{\theta}{\xi_s} p_s - \bar{c}k\right) s \\ &= (0.28 p_s - k)s. \end{aligned}$$

Presuming as before, $\bar{c} = 1$,

[39] $$f_k = 0.28 \frac{p_s s}{k} - s.$$

Substituting for the right-hand side variables the average subscription price per month, average reach, and average pages of content per month—in the notation of this paper, $p_s = p_s^*$, $s = s^*$, and $k = k^*$ —results in an estimate of average first-copy cost per page of content, $f_k$. These estimates are shown in Table 7. As shown in the table, average first-copy cost per page of content, $f_k$, has fallen from around 1.61 million 2005 yen in 1997 to 1.25 million 2005 yen in 2017, a 22 percent decrease.

From Eqs. [36] and [37],

[40] $$k^* = \frac{\theta}{\xi_s}\left(\frac{p_s s}{f_k + \bar{c}s}\right) = \frac{\theta}{\xi_s}\left(\frac{p_s}{\bar{c} + {}^{f_k}/_{s}}\right).$$

The total differential is the following.

[41] $$\frac{dk^*}{k^*} = \frac{dp_s}{p_s} + \frac{1}{\left(1+\frac{\bar{c}s}{f_k}\right)}\frac{ds}{s} - \frac{1}{\left(1+\frac{\bar{c}s}{f_k}\right)}\frac{df_k}{f_k}.$$

In considering Eq. [41], note that $\frac{1}{\left(1+\frac{\bar{c}s}{f_k}\right)} = \frac{f_k}{c_k}$ is the fraction of the cost per page of content (including both first-copy cost and printing cost) that is attributable to first-copy cost. By my calculation that fraction is consistently around 2/3 throughout the period of observation, 1997 to 2017. Given that $\frac{f_k}{c_k} = {}^{2}/_{3}$, the profit-maximizing number of pages of content would rise in proportion to any increase in subscription price, $p_s$, and fall with any decline in circulation, holding constant the first-copy cost per page of content, $f_k$. But as just related, in Japan, from 1997 to 2010, it seems that the first-copy cost per page of content actually fell.

From 1997 to 2017, the average inflation-adjusted subscription price was raised by 20.7 percent, and the average number of subscribers fell by 18.7 percent. Absent any change in the first-copy cost of a page of content, we should have expected the number of pages of content to have increased by about 7 percent: 20.7−(2/3×18.7)=7.4, by linear approximation based on Eq. [41]. Actually, the number of pages of content averaged across newspapers increased by 26.3 percent, much more than would have been predicted based only on the increase in subscription price and fall in circulation. This is my general basis for inferring that first-copy cost per page, $f_k$, actually fell (by 22 percent), from 1997 to 2017.

5.2.4. The effect of demand shocks on newspaper publisher profit.

The previous sections have documented the major reduction in demand for Japanese newspaper print advertising from 1997 to 2017, and have linked that demand shock to the rise of internet advertising expenditures. It is natural now to ask, what effect has this had on newspaper publisher profit? In the notation of this paper, the profit of a single newspaper publisher, *i*, is as follows.

[42] $$\pi_i = (p_{s_i} - c_{0_i})s_i + p_{a_i}a_i - \bar{c}k_i s_i - \bar{c}a_i s_i - f_{a_i}a_i - f_{k_i}k_i \ .$$

Summing over all newspaper publishers shows industry profit.

[43] $$\sum_i \pi_i = \sum_i (p_{s_i} - c_{0_i} - \bar{c}k_i)s_i - \sum_i f_{k_i}k_i + \sum_i (p_{a_i} - \bar{c}s_i)a_i - \sum_i f_{a_i}a_i.$$

All parameters of this expression have been asserted or estimated here. From above, $f_{a_i} = 200{,}000$ yen and $\bar{c} = 1$ yen. Year-to-year changes in $f_{k_i}k_i$ –the cost of actually creating the newspaper content, including the wages of reporters and editors, and their tools and office buildings—was imputed in the previous section of the paper. It seems to reflect significant technological advance in the production of newspaper content, unrelated to changing demands for newspaper advertising and newspaper subscriptions.

The year-to-year changes in newspaper industry profit, ignoring any changes in $\sum_i f_{k_i}k_i$, might be a reasonable approximation of the change in newspaper publisher profit directly arising from the falling demand for newspaper ads and subscriptions. Let us call this 'net receipts,' denoted with a tilde: $\tilde{\pi}_i$. This is what remains of newspaper publisher revenue both from subscriptions and from advertising, after subtracting all costs of producing ads and after subtracting the costs of printing and distributing the newspaper. These 'net receipts,' minus the costs of actually composing the newspaper content, $\sum_i f_{k_i}k_i$, equal the newspaper publisher economic profit. The industry-wide 'net receipts' are the following.

[44] $$\sum_i \tilde{\pi}_i = \sum_i \pi_i + \sum_i f_{k_i}k_i.$$

Based on the data compiled here, inflation-adjusted 'net receipts' per subscriber per month have actually not changed much from 1997 to 2017. They are about 1,600 yen per subscriber per month, measured in 2005 prices, roughly half the average monthly price of a newspaper subscription. These and related data are reported in Table 7. The upshot is that from 1997 to 2017, total newspaper publisher industry-wide 'net receipts' have fallen by about the same percent as newspaper circulation—roughly 28 percent—from 13,198 100-millions of 2005 yen in 1997 to 10,039 100-millions of 2005 yen in 2017. That is a fall of about 3-billion USD per year, roughly 25-million USD per newspaper, per year. As Senator Everett Dirksen once remarked, "a million here, a million there, pretty soon you're talking real money."

Factoring in the changing cost of producing newspaper content, results in estimates also shown in Table 7, that newspaper industry annual economic profit has fallen from 4,845 100-millions of 2005 yen in 1997 to 1,123 100-millions of 2005 yen in 2017. The annual economic profit of the Japanese print newspaper publishing industry has greatly diminished over the last twenty years, but is still greater than zero.

## 6. Conclusion

Newspapers in Japan, as in the US and other countries, have experienced a sharp decline in the demand for print advertising in the last twenty years, the direct consequence of the growth of the internet. To describe this singular event in detail, accounting for the demand shocks to newspaper advertising and subscriptions, and also accounting for the effects of changes in newspaper advertising and subscription prices that these shocks induced, is a great challenge for empirical economics. In this paper, building on two previous papers of mine, Flath (2016) and Flath (2017), I have attempted to meet this challenge with econometric modeling and estimation.

Many of the newspapers in Japan already offer digital subscriptions, but at prices that are nearly the same as for their print editions. Will a point be reached when it is no longer economical to offer print editions? My answer is 'yes,' for the simple reason that the costs of printing and distributing print editions are large, and the on-going decline in profit from newspaper print advertising will continue to prompt increases in the price of subscribing to a print edition. As documented in Table 3, the newspaper publishers' payments to independent news dealers in 2017 absorbed a little more than 1/3 of the retail subscription revenue (=1,157÷3,221), and the cost of actually printing the paper absorbed another 1/5 of retail subscription revenue (=728÷3,221). The advertising revenue of the newspaper publishers was about equal to the cost of printing the newspaper, in other words, equaling about 1/5 of the retail subscription revenue (=757÷3,221). That means that a newspaper that abandoned its print edition and went completely digital, foregoing print advertising revenue altogether, could offer subscribers a 1/3 discount on the digital subscription price, compared to the price it is now setting on its print edition, and if there were no cancellations, would at least break even (this ignores any saving on the first-copy costs of print ads, denoted by $f_a a$ in this paper). If the number of subscribers increased as a result of such a price discount, the publisher would come out ahead by switching to digital-only. Of course, most newspaper subscribers in Japan have revealed a preference for the print edition when its price is the same as digital, which accounts for the persistence of print editions. But as the demand for print ads continues to decline, newspaper publishers will raise their prices of subscribing to the print edition, and more subscribers will switch to digital.

References


Angelucci, Charles and Julia Cagé. (2016). "Newspapers in Times of Low Advertising Revenues," CEPR Discussion Paper No. 11414.

Argentesi, E. and L. Filistrucchi (2007). "Estimating Market Power in a Two-Sided Market: The Case of Newspapers", *Journal of Applied Econometrics*, Vol. 22, pp. 1247-1266.

Chandra, Ambarish and Ulrich Kaiser. (2016). "Newspapers and Magazines", in *The Handbook of Media Economics*, Simon Anderson, David Stromberg and Joel Waldfogel eds., Elsevier, 2016.

Dentsu Inc. (Annual a). Dentsuu koukoku nenkan (Dentsu advertising annual), until 2013, Tokyo: Dentsu.

———— (Annual b). Dentsuu shinbun nenkan (Dentsu newspaper annual), Tokyo: Dentsu.

———— (2009). Jouhou medeia hakushou 2009 (Information media white paper 2009), Tokyo: Daiyamondo sha. annual.

———— (Annual c). "Advertising Expenditures in Japan," annual. http://www.dentsu.com/knowledgeanddata/ad_expenditures/

———— (Annual d)."Dentsu Advertising Statistics," annual.

Fan, Ying. (2013) "Ownership Consolidation and Product Characteristics: A Study of the US Daily Newspaper Market", *American Economic Review*, Vol. 103, No. 5, pp. 1598-1628.

Flath, David. (2016). "Resale Price Maintenance by Japanese Newspapers," *Japanese Economic Review*, vol. 67, no. 4, pp. 441-473.

Flath, David. (2017). "Second-Degree Price Discrimination by Japanese Newspapers," *Japan and the World Economy*, Vol. 44, pp. 14-25.

Pattabhiramaiah, Adithya; S. Sriram & Shrihari Sridhar. (2017). "Rising prices under declining preferences: the case of the US print newspaper industry," *Marketing Science*, Volume 37, Issue 1, pp. 97-122.

Pesaran, M. Hashem; Yongcheol Shin, and Richard J. Smith. (2001). "Bound Testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics*, 16, pp. 289-326.

Rosse, J. N. (1970) "Estimating Cost Function Parameters Without Using Cost Data: Illustrated Methodology," *Econometrica*, Vol. 38, No. 2, pp. 256-275.
Van Cayseele, Patrick and Stijn Vanormelingen. (2009). "Prices and Network Effects in Two-Sided Markets: the Belgian Newspaper Industry", unpublished manuscript.

Table 1. Data definitions and sources.

| Variable | Definition | Name | Units | Source |
|---|---|---|---|---|
| Number of subscribers | $\sum_i s_i$ | | Thousands (combined morning-and-evening subscription counts as two) | Japan Newspaper Publishers & Editors Assoc.[a] |
| Volume of ads, per year | $\sum_i a_i$ | | Pages per year (one page= 15 columns) | Dentsu[b] |
| Advertising **expenditures**, per year (incl 15 pct commission) | $1.15 \sum_i p_{a_i} a_i$ | | 100 millions 2005 yen per year | Dentsu[b] |
| Advertising **revenue**, per year | $\sum_i p_{a_i} a_i$ | | 100 millions 2005 yen per year | Ad expenditures ÷ 1.15 |
| Ad **revenue** relative to subscription revenue | $\frac{\sum_i p_{a_i} a_i /12}{\sum_i (p_{s_i} - c_{0_i})\, s_i}$ | | | Japan Newspaper Publishers & Editors Assoc.[a] |
| Subscription revenue, per year | $\sum_i (p_{s_i} - c_{0_i})\, s_i \times 12$ | | 100 millions 2005 yen per year | Ad revenue ÷ Ad revenue relative to subscription revenue |
| Average subscription price per month | $\frac{\sum_i p_{s_i} s_i}{\sum_j s_j}$ | $p_s^*$ | 2005 yen per month | Centered on Flath (2016) dataset mean in 2007 (=3205 yen per mo.), evolving w Asahi set price, adjusted for inflation |
| Publishers' payments to news dealers per subscriber, per month | $\frac{\sum_i c_{0_i} s_i}{\sum_j s_j}$ | $c_0^*$ | 2005 yen per subscriber, per month | Average subscription price per month − (Subscription revenue ÷ Number of subscribers) |
| Average pages per month, per newspaper | $\frac{\sum_i (a_i + k_i)/12}{120}$ | $a^* + k^*$ | Pages per month for each subscription | Total pages (from Dentsu[b]) ÷120 (the approximate number of newspapers in the Dentsu sample) |
| Incremental cost of subscription per month, averaged across newspapers | $c_0^* + a^* + k^*$ | $c_s^*$ | 2005 yen per month | Assumes cost per page of printing is one yen, as estimated by Flath (2016) |
| Advertising **revenue** per subscriber, per month | $\frac{\sum_i p_{a_i} a_i /12}{\sum_j s_j}$ | $p_a^* a^* / s^*$ | 2005 yen per subscriber, per month | Ad revenue ÷ Number of subscribers |

| Variable | Definition | Name | Units | Source |
|---|---|---|---|---|
| Ad **revenue** per page of ads | $\frac{\sum_i p_{a_i} a_i}{\sum_j a_j}$ | $p_a^*$ | 2005 yen per page of ads | Ad revenue ÷ Pages of ads |
| Average 'reach' per ad | $\sum_i s_i \frac{a_i}{\sum_j a_j}$ | $s^*$ | Thousands of subscribers | Number of subscribers to each edtion of each newspaper, $s_i$, from JABC.[c] Number of ad pages in each edition to each newspaper, $a_i$, from Dentsu.[b] |
| Average price of ads per page, per subscriber (net of 15 percent commission) | $\frac{\sum_i p_{a_i} a_i}{\sum_i s_i a_i}$ | $p_a^*/s^*$ | 2005 yen per page of ads, per subscriber | $p_a^*$ divided by $s^*$ |
| Elasticity of demand for ads | | $\xi_a$ | | Imputed from ad pricing equation $p_a^* = (f_a + \bar{c}s^*)\left(1 - \frac{1}{\xi_a}\right)^{-1}$, with $f_a = 200{,}000$ and $\bar{c} = 1$. |
| First-copy costs per page of content | | $f_k$ | 2005 yen per page of content | From $f_k k^* = \left(\frac{\theta}{\xi_s} p_s^* - \bar{c}k^*\right) s^* = (0.28 p_s^* - k^*) s^*$, based on $\theta = 0.36$ and $\xi_s = 1.41$. |
| First-copy costs of content | | $\sum_i f_k k_i$ | 100 millions 2005 yen per year | $f_k k^* \times 12 \times 120$ (12= number of mos., and 120= number of newspapers). |

[a] **The Japan Newspaper Publishers & Editors Association** (Nihon Shinbun Kyokai—NSK), Nippon Press Center Bldg., 2-2-1 Uchisaiwai-cho, Chiyoda-ku, Tokyo 100-8543, Japan. Recent NSK annual survey data available at pressnet website: http://www.pressnet.or.jp/english/data/

Archival data of the NSK annual survey is from other published sources:

Dentsu Inc. (Annual a) Dentsuu koukoku nenkan (Dentsu advertising annual), until 2013, Tokyo: Dentsu.

——— (Annual b) Dentsuu shinbun nenkan (Dentsu newspaper annual), Tokyo: Dentsu.

——— (2009) Jouhou medeia hakushou 2009 (Information media white paper 2009), Tokyo: Daiyamondo sha. annual.

[b] **Dentsu** Inc. annual advertising survey data is available from Dentsu, Inc. (Annual a), from the *pressnet* website and from:

Dentsu Inc. “Advertising Expenditures in Japan,” annual.
http://www.dentsu.com/knowledgeanddata/ad_expenditures/

———— “Dentsu Advertising Statistics,” annual.

[c] **Japan Audit Bureau of Circulation.**
http://www.jabc.or.jp/

Table 2. Industry data on Japanese Newspapers.

| Variable | Number of subscribers (set counts as one) | Number of subscribers | Volume of ads | Advertising **expenditures** (incl 15pct commission) | Advertising **revenue** | Ad revenue relative to subscription revenue | Subscription revenue |
|---|---|---|---|---|---|---|---|
| Definition | | $\sum_i s_i$ | $\sum_i a_i$ | $1.15 \sum_i p_{a_i} a_i$ | $\sum_i p_{a_i} a_i$ | $\frac{\sum_i p_{a_i} a_i}{\sum_i (p_{s_i} - c_{0_i}) s_i}$ | $\sum_i (p_{s_i} - c_{0_i}) s_i \times 12$ |
| Units | Thousands (set counts as one) | Thousands (set counts as two) | Pages per year | 100 millions 2005 yen | 100 millions 2005 yen | | 100 millions 2005 yen |
| 1997 | 53,765 | 72,699 | 391,156 | 11,467 | 9,971 | 0.707 | 13,780 |
| 1998 | 53,670 | 72,410 | 379,268 | 10,703 | 9,307 | 0.664 | 13,700 |
| 1999 | 53,757 | 72,218 | 402,793 | 10,609 | 9,225 | 0.656 | 13,744 |
| 2000 | 53,709 | 71,896 | 417,736 | 11,617 | 10,102 | 0.702 | 14,068 |
| 2001 | 53,681 | 71,694 | 419,730 | 11,337 | 9,858 | 0.676 | 14,263 |
| 2002 | 53,198 | 70,815 | 402,737 | 10,252 | 8,914 | 0.605 | 14,409 |
| 2003 | 52,875 | 70,340 | 397,338 | 10,229 | 8,895 | 0.597 | 14,568 |
| 2004 | 53,022 | 70,364 | 401,041 | 10,427 | 9,067 | 0.600 | 14,760 |
| 2005 | 52,568 | 69,680 | 407,460 | 10,377 | 9,024 | 0.592 | 14,895 |
| 2006 | 52,310 | 69,100 | 405,382 | 10,100 | 8,782 | 0.566 | 15,178 |
| 2007 | 52,029 | 68,437 | 396,060 | 9,660 | 8,400 | 0.535 | 15,336 |
| 2008 | 51,491 | 67,207 | 375,338 | 8,557 | 7,441 | 0.461 | 15,789 |
| 2009 | 50,353 | 65,080 | 345,550 | 7,003 | 6,089 | 0.396 | 15,036 |
| 2010 | 49,322 | 63,199 | 344,497 | 6,797 | 5,910 | 0.380 | 15,186 |
| 2011 | 48,345 | 61,581 | 334,054 | 6,483 | 5,637 | 0.378 | 14,563 |
| 2012 | 47,778 | 60,655 | 352,197 | 6,822 | 5,932 | 0.387 | 14,983 |
| 2013 | 46,999 | 59,396 | 355,737 | 6,780 | 5,896 | 0.391 | 14,756 |
| 2014 | 45,363 | 56,719 | 356,354 | 6,548 | 5,694 | 0.389 | 14,310 |
| 2015 | 44,247 | 55,121 | 348,600 | 6,016 | 5,231 | 0.381 | 13,437 |
| 2016 | 43,276 | 53,690 | 342,323 | 5,717 | 4,971 | 0.372 | 13,052 |
| 2017 | 42,128 | 51,829 | 336,529 | 5,418 | 4,711 | 0.359 | 12,839 |
| Pcnt chg, 1997-2017 | −21.6% | −28.7% | −14.0% | −52.7% | −52.7% | | −6.8% |

Table 3. Supply and demand for newspaper subscriptions.

| Variable | Average subscription price per month | Publishers' payments to news dealers per subscriber | Average content pages per month, per newspaper | Average pages per month, per newspaper | Incremental cost of subscription, averaged across newspapers | Advertising **revenue** per subscriber, per month | Number of subscribers | Pcnt change in demand for subscriptions at 1997 price, $p_s^*$, compared to previous year |
|---|---|---|---|---|---|---|---|---|
| Definition | $\frac{\sum_i p_{s_i} s_i}{\sum_j s_j}$ | $\frac{\sum_i c_{0_i} s_i}{\sum_j s_j}$ | $\frac{\sum_i k_i}{120}$ | $\frac{\sum_i (a_i + k_i)}{120}$ | $c_0^* + a^* + k^*$ | $\frac{\sum_i p_{a_i} a_i}{\sum_j s_j}$ | $\sum_i s_i$ | |
| Name | $p_s^*$ | $c_0^*$ | $k^*$ | $a^* + k^*$ | $c_s^*$ | $p_a^* a^* / s^*$ | | |
| Units | 2005 yen per month | 2005 yen per month | Pages per month for each subscription | Pages per month for each subscription | 2005 yen per month | 2005 yen per month | Thousands (set counts as two) | |
| 1997 | 2,699 | 1,120 | 391 | 663 | 1,782 | 1,143 | 72,699 | |
| 1998 | 2,713 | 1,136 | 381 | 644 | 1,781 | 1,071 | 72,410 | −0.28% |
| 1999 | 2,753 | 1,167 | 420 | 700 | 1,867 | 1,064 | 72,218 | 0.07% |
| 2000 | 2,787 | 1,156 | 433 | 723 | 1,879 | 1,171 | 71,896 | −0.16% |
| 2001 | 2,822 | 1,164 | 453 | 744 | 1,908 | 1,146 | 71,694 | 0.00% |
| 2002 | 2,870 | 1,174 | 463 | 743 | 1,917 | 1,049 | 70,815 | −0.84% |
| 2003 | 2,910 | 1,184 | 466 | 742 | 1,926 | 1,054 | 70,340 | −0.36% |
| 2004 | 2,994 | 1,246 | 473 | 752 | 1,997 | 1,074 | 70,364 | 0.69% |
| 2005 | 3,030 | 1,249 | 475 | 758 | 2,007 | 1,079 | 69,680 | −0.69% |
| 2006 | 3,053 | 1,223 | 483 | 764 | 1,987 | 1,059 | 69,100 | −0.66% |
| 2007 | 3,079 | 1,212 | 486 | 761 | 1,973 | 1,023 | 68,437 | −0.76% |
| 2008 | 3,097 | 1,139 | 483 | 744 | 1,883 | 923 | 67,207 | −1.67% |
| 2009 | 3,139 | 1,214 | 472 | 712 | 1,926 | 780 | 65,080 | −2.86% |
| 2010 | 3,192 | 1,189 | 474 | 713 | 1,903 | 779 | 63,199 | −2.52% |
| 2011 | 3,240 | 1,269 | 476 | 708 | 1,977 | 763 | 61,581 | −2.22% |
| 2012 | 3,266 | 1,207 | 488 | 733 | 1,940 | 815 | 60,655 | −1.32% |
| 2013 | 3,266 | 1,196 | 485 | 732 | 1,928 | 827 | 59,396 | −2.07% |
| 2014 | 3,185 | 1,083 | 496 | 743 | 1,826 | 837 | 56,719 | −5.06% |
| 2015 | 3,142 | 1,111 | 491 | 733 | 1,843 | 791 | 55,121 | −3.12% |
| 2016 | 3,235 | 1,209 | 496 | 734 | 1,943 | 772 | 53,690 | −1.94% |
| 2017 | 3,221 | 1,157 | 494 | 728 | 1,885 | 757 | 51,829 | −3.56% |
| Pcnt chng, 1997-2017 | 19.4% | 3.4% | 26.3% | 9.9% | 5.8% | −33.7% | −28.7% | −25.7% |

Table 4. Supply and demand for newspaper ads.

| Variable | Ad **revenue** per page of ads | Average price of ads per page, per subscriber (net of 15% commission) | Average reach of a newspaper ad | Volume of ads | Elasticity of demand for ads | Pcnt change in demand for ads at 1997 price per subscriber, $p_a^*/s^*$, compared to previous year | Pcnt change in demand for ads at 1997 price, $p_a^*$, compared to previous year |
|---|---|---|---|---|---|---|---|
| Definition | $\frac{\sum_i p_{a_i} a_i}{\sum_j a_j}$ | $\frac{\sum_i p_{a_i} a_i}{\sum_i s_i a_i}$ | $\sum_i s_i \frac{a_i}{\sum_i a_i}$ | $\sum_i a_i$ | | | |
| Name | $p_a^*$ | $p_a^*/s^*$ | $s^*$ | | $\xi_a$ | | |
| Units | 2005 yen per page of ads | 2005 yen per page of ads, per subscriber | Subscribers | Pages per year (one page= 15 columns) | | | |
| 1997 | 2,549,226 | 3.030 | 841,279 | 391,156 | 1.691 | | |
| 1998 | 2,453,818 | 2.912 | 842,628 | 379,268 | 1.739 | −9.51% | −9.26% |
| 1999 | 2,290,278 | 2.706 | 846,234 | 402,793 | 1.841 | −7.57% | −6.83% |
| 2000 | 2,418,292 | 2.827 | 855,468 | 417,736 | 1.774 | 12.88% | 15.03% |
| 2001 | 2,348,692 | 2.724 | 862,114 | 419,730 | 1.826 | −6.41% | −5.00% |
| 2002 | 2,213,455 | 2.574 | 859,854 | 402,737 | 1.919 | −14.79% | −15.02% |
| 2003 | 2,238,539 | 2.592 | 863,710 | 397,338 | 1.905 | 0.16% | 0.99% |
| 2004 | 2,260,911 | 2.618 | 863,744 | 401,041 | 1.889 | 3.11% | 3.07% |
| 2005 | 2,214,646 | 2.580 | 858,257 | 407,460 | 1.915 | −1.53% | −2.65% |
| 2006 | 2,166,417 | 2.532 | 855,579 | 405,382 | 1.950 | −4.65% | −5.16% |
| 2007 | 2,120,795 | 2.504 | 846,936 | 396,060 | 1.975 | −4.85% | −6.70% |
| 2008 | 1,982,461 | 2.356 | 841,547 | 375,338 | 2.107 | −18.75% | −19.76% |
| 2009 | 1,762,258 | 2.072 | 850,706 | 345,550 | 2.477 | −38.99% | −37.33% |
| 2010 | 1,715,679 | 2.050 | 836,921 | 344,497 | 2.528 | −4.77% | −8.57% |
| 2011 | 1,687,487 | 2.052 | 822,304 | 334,054 | 2.537 | −3.12% | −7.36% |
| 2012 | 1,684,298 | 2.083 | 808,649 | 352,197 | 2.493 | 11.30% | 6.86% |
| 2013 | 1,657,359 | 2.060 | 804,679 | 355,737 | 2.539 | −3.52% | −4.90% |
| 2014 | 1,597,853 | 2.057 | 776,635 | 356,354 | 2.572 | −1.37% | −10.10% |
| 2015 | 1,500,635 | 2.020 | 742,862 | 348,600 | 2.690 | −11.05% | −21.82% |
| 2016 | 1,452,188 | 2.017 | 720,118 | 342,323 | 2.729 | −3.79% | −12.05% |
| 2017 | 1,399,941 | 2.039 | 686,547 | 336,529 | 2.727 | 1.43% | −10.92% |
| Pcnt chg, 1997-2017 | −45.1% | −32.7% | −18.4% | −14.0% | | −70.8% | −83.2% |

Table 5. Data for ARDL model of shifting demand for newspaper ads.

| Variable | Demand for ads at 1997 price per subscriber | Internet ad expenditures | Natural log of inflation-adjusted Internet ad expenditures | Annual rate of growth in real GDP |
|---|---|---|---|---|
| Name | $y$ | | $x_1$ | $x_2$ |
| f.y.* | Pages per year (one page= 15 columns) | 100 mil 2005 yen | | |
| 1997 | 391,156 | 20 | 4.295 | 0.011 |
| 1998 | 353,941 | 73 | 4.938 | −0.012 |
| 1999 | 327,147 | 139 | 5.699 | −0.002 |
| 2000 | 369,299 | 299 | 6.609 | 0.027 |
| 2001 | 345,635 | 741 | 6.840 | 0.004 |
| 2002 | 294,531 | 934 | 6.994 | 0.001 |
| 2003 | 295,010 | 1,090 | 7.346 | 0.016 |
| 2004 | 304,182 | 1,550 | 7.785 | 0.022 |
| 2005 | 299,532 | 2,404 | 8.237 | 0.016 |
| 2006 | 285,609 | 3,777 | 8.490 | 0.014 |
| 2007 | 271,767 | 4,867 | 8.716 | 0.016 |
| 2008 | 220,823 | 6,100 | 8.877 | −0.011 |
| 2009 | 134,718 | 7,164 | 8.895 | −0.056 |
| 2010 | 128,291 | 7,294 | 9.006 | 0.041 |
| 2011 | 124,286 | 8,151 | 9.063 | −0.001 |
| 2012 | 138,333 | 8,626 | 9.144 | 0.015 |
| 2013 | 133,460 | 9,363 | 9.225 | 0.020 |
| 2014 | 131,638 | 10,149 | 9.323 | 0.003 |
| 2015 | 117,096 | 11,188 | 9.399 | 0.014 |
| 2016 | 112,657 | 12,079 | 9.518 | 0.010 |
| 2017 | 114,269 | 13,609 | 9.662 | 0.017 |
| Pct chg, 1997-2017 | −70.8% | | | |

*Demand for ads is constructed from annual fiscal year data (Table 4). Internet ad expenditures are for the previous calendar year. For example, internet ads listed here as corresponding to fiscal year ‘1997’ (April 1996 - March 1997) are actually for calendar year 1996 (January 1996 – December 1996).

Sources. Internet ad expenditures: Dentsu Inc. (annual c). “Advertising Expenditures in Japan,” annual.
http://www.dentsu.com/knowledgeanddata/ad_expenditures/

Annual rate of growth in real GDP: Cabinet Office, Government of Japan.

Table 6. ARDL error-correction model—OLS estimates of parameters in Eq. [32].

| Coefficients | Variables | Estimates (*s.e.*) | *p*-values |
|---|---|---|---|
| $-(1-\theta_{t-1}-\theta_{t-2})$ | $y_{t-1}$ | −0.332 (0.055) | 0.000 |
| $\dfrac{\beta_{1,t}+\beta_{1,t-1}+\beta_{1,t-2}}{(1-\theta_{t-1}-\theta_{t-2})}$ | $x_{1,t-1}$ | −62,175 (11,573) | 0.000 |
| $-\theta_{t-2}$ | $\Delta y_{t-1}$ | −0.612 (0.178) | 0.007 |
| $\beta_{1,t}$ | $\Delta x_{1,t}$ | 57,846 (20,182) | 0.019 |
| $-\beta_{1,t-2}$ | $\Delta x_{1,t-1}$ | −43,966 (13,405) | 0.010 |
| $\beta_{2,t}$ | $x_{2,t}$ | 1,057,313 (106,865) | 0.001 |
| $\beta_{2,t-1}$ | $x_{2,t-1}$ | 1,037,169 (222,040) | 0.001 |
| $\beta_{2,t-2}$ | $x_{2,t-2}$ | 507,695 (127,404) | 0.003 |
| $\beta_0$ | | 195,690 (43,665) | 0.002 |
| Number of obs. | | 18 | |
| Adj. $R^2$ | | 0.936 | |

| | | | *p*-values I(0) | *p*-values I(1) |
|---|---|---|---|---|
| Pesaran, Shin, and Smith (2001) bounds test. $H_0$: no level relationship | $F$ | 20.86 | 0.001 | 0.002 |
| | $t$ | -6.02 | 0.001 | 0.002 |

| | | | *p*-value |
|---|---|---|---|
| Durbin's alternative test for autocorrelation $H_0$: no serial correlation | $\chi^2(1)$ | 0.001 | 0.972 |

Table 7. Newspaper publisher industry-wide ‘net receipts,’ economic profit, and related data 1997-2017.

| Variable | ‘Net receipts’ | Annual change in ‘net receipts’ | ‘Net receipts’ per subscriber per month | Average content pages per month, per newspaper | First-copy costs per page of content | First-copy costs of content | Economic profit | Annual change in economic profit |
|---|---|---|---|---|---|---|---|---|
| Name | $\sum_i \tilde{\pi}_i$ | $\Delta \sum_i \tilde{\pi}_i$ | $\frac{\sum_i \tilde{\pi}_i}{\sum_i s_i}$ | $k^* = \frac{\sum_i k_i}{120}$ | $f_k$ | $\sum_i f_k k_i$ | $\sum_i \pi_i$ | $\Delta \sum_i \pi_i$ |
| | 100 mil 2005 yen | 100 mil 2005 yen | 2005 yen | Pages per month for each subscription | 2005 yen | 100 mil 2005 yen | 100 mil 2005 yen | 100 mil 2005 yen |
| 1997 | 13,898 | | 1,593 | 391 | 1,607,940 | 9,053 | 4,845 | |
| 1998 | 13,453 | −445 | 1,548 | 381 | 1,680,105 | 9,217 | 4,236 | −609 |
| 1999 | 12,693 | −761 | 1,465 | 420 | 1,553,706 | 9,393 | 3,300 | −936 |
| 2000 | 13,527 | 834 | 1,568 | 433 | 1,543,354 | 9,612 | 3,915 | 615 |
| 2001 | 13,259 | −268 | 1,541 | 453 | 1,503,602 | 9,808 | 3,451 | −463 |
| 2002 | 12,744 | −515 | 1,500 | 463 | 1,492,643 | 9,950 | 2,794 | −657 |
| 2003 | 12,972 | 228 | 1,537 | 466 | 1,509,413 | 10,132 | 2,840 | 46 |
| 2004 | 13,213 | 241 | 1,565 | 473 | 1,529,606 | 10,426 | 2,787 | −52 |
| 2005 | 13,268 | 55 | 1,587 | 475 | 1,532,418 | 10,486 | 2,782 | −5 |
| 2006 | 13,343 | 75 | 1,609 | 483 | 1,514,661 | 10,532 | 2,811 | 29 |
| 2007 | 13,341 | −2 | 1,624 | 486 | 1,503,147 | 10,515 | 2,826 | 15 |
| 2008 | 13,323 | −18 | 1,652 | 483 | 1,510,557 | 10,508 | 2,815 | −11 |
| 2009 | 11,935 | −1,388 | 1,528 | 472 | 1,584,084 | 10,767 | 1,168 | −1,647 |
| 2010 | 12,114 | 180 | 1,597 | 474 | 1,577,718 | 10,770 | 1,344 | 176 |
| 2011 | 11,554 | −560 | 1,564 | 476 | 1,567,465 | 10,741 | 813 | −531 |
| 2012 | 12,029 | 475 | 1,653 | 488 | 1,514,828 | 10,648 | 1,381 | 568 |
| 2013 | 11,859 | −171 | 1,664 | 485 | 1,516,649 | 10,596 | 1,263 | −118 |
| 2014 | 11,465 | −393 | 1,685 | 496 | 1,397,460 | 9,975 | 1,490 | 227 |
| 2015 | 10,535 | −930 | 1,593 | 491 | 1,332,275 | 9,411 | 1,124 | −366 |
| 2016 | 10,146 | −389 | 1,575 | 496 | 1,315,047 | 9,392 | 754 | −370 |
| 2017 | 10,039 | −107 | 1,614 | 494 | 1,253,407 | 8,916 | 1,123 | 369 |
| Pct chg, 1997-2017 | −27.8% | | | 26.3% | −22.0% | −1.5% | −76.8% | |

Figure 1a. Real Advertising Expenditures, Newspaper ads and Internet Ads, Japan, 1955-2016.

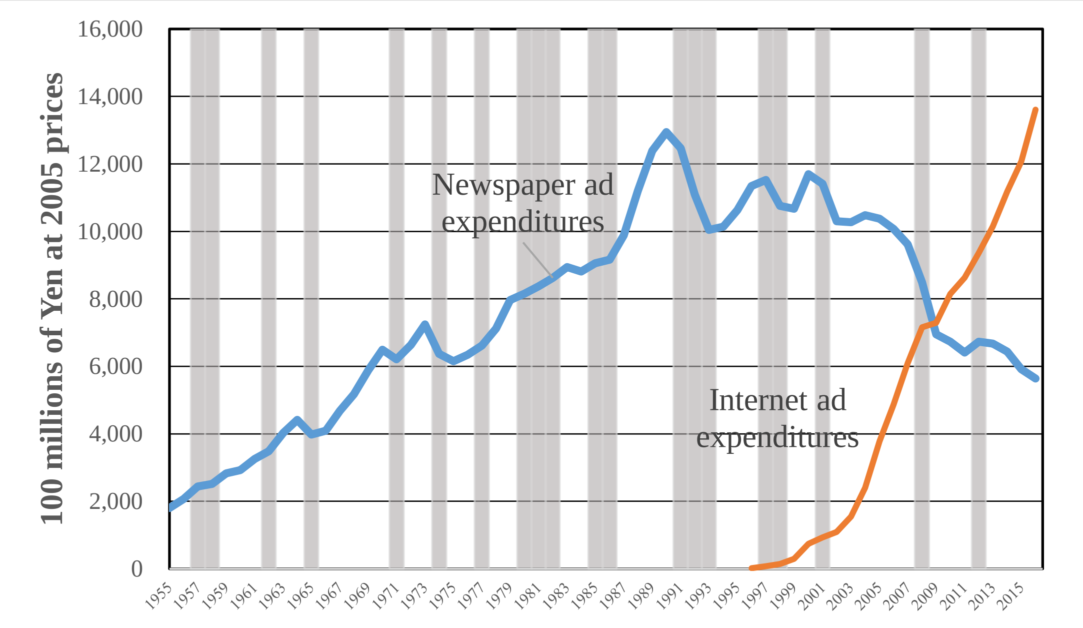



Figure 1b. Real newspaper advertising and circulation revenue, and internet advertising expenditures, US, 1956-2016 .

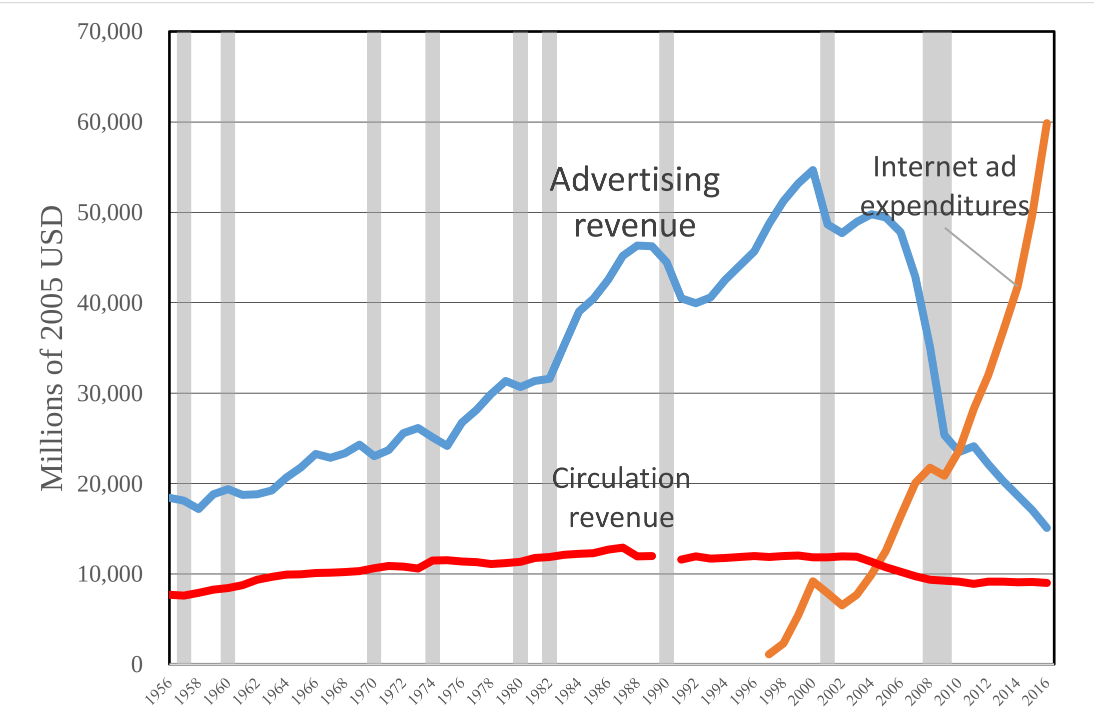


Figure 2. Newspaper circulation, Japan and the US, 1945-2016.

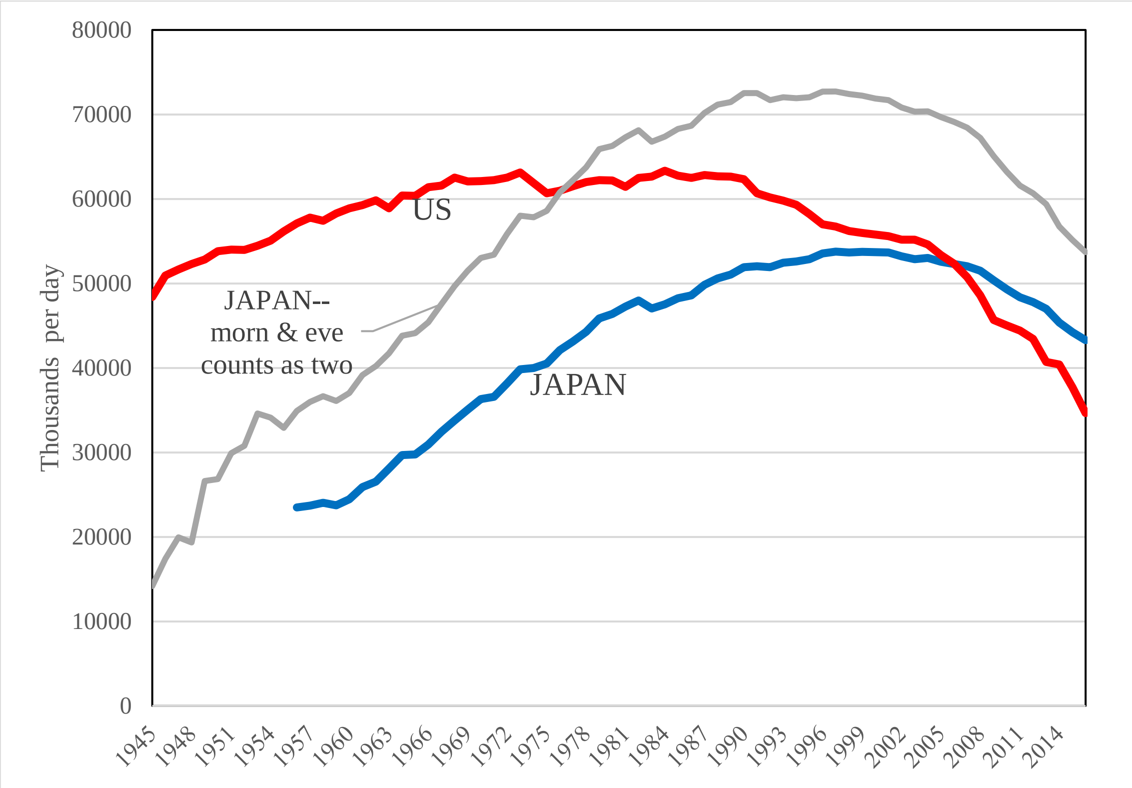


Figure 3. Japanese newspaper subscription revenue and advertising revenue, 1991-2015.

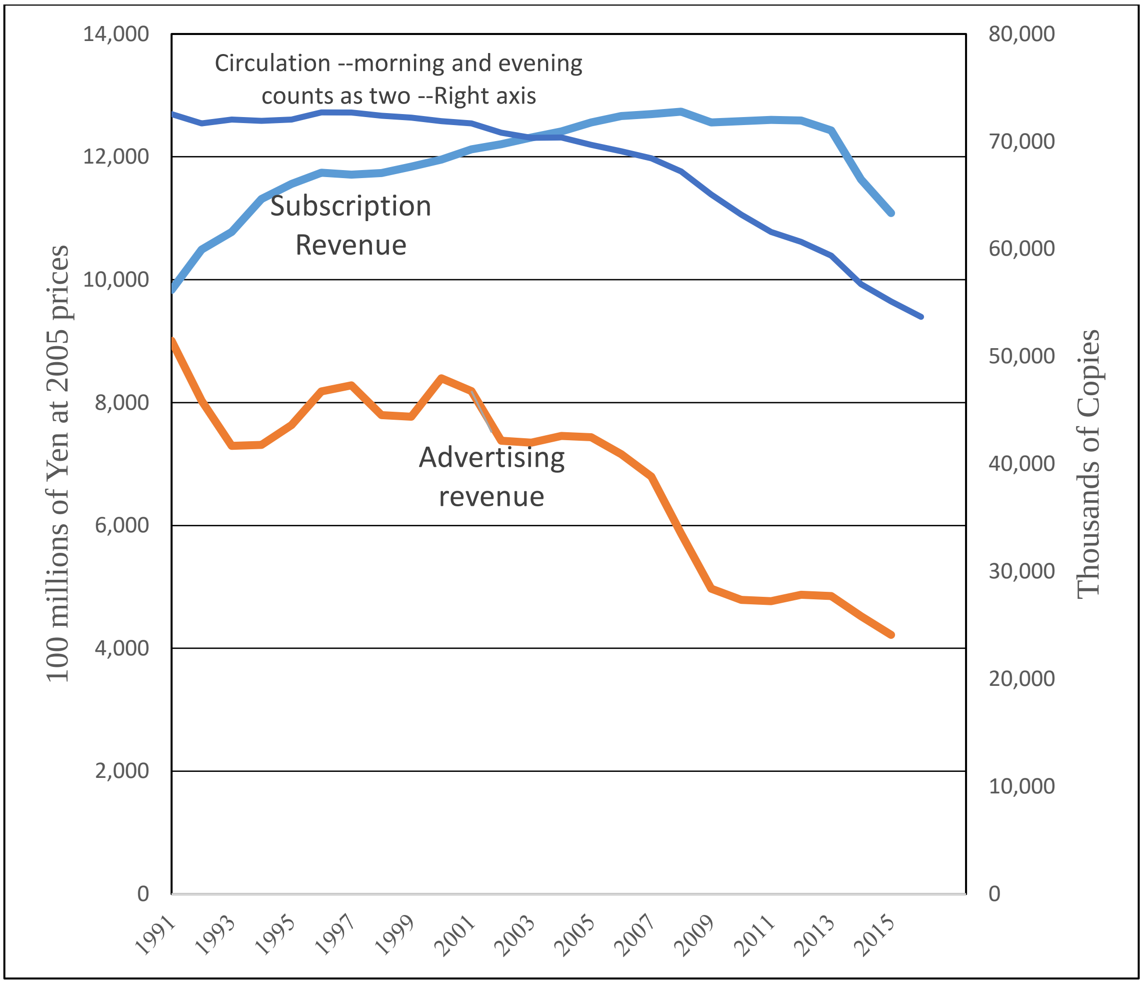


Figure 4. Profit-maximizing subscription price.

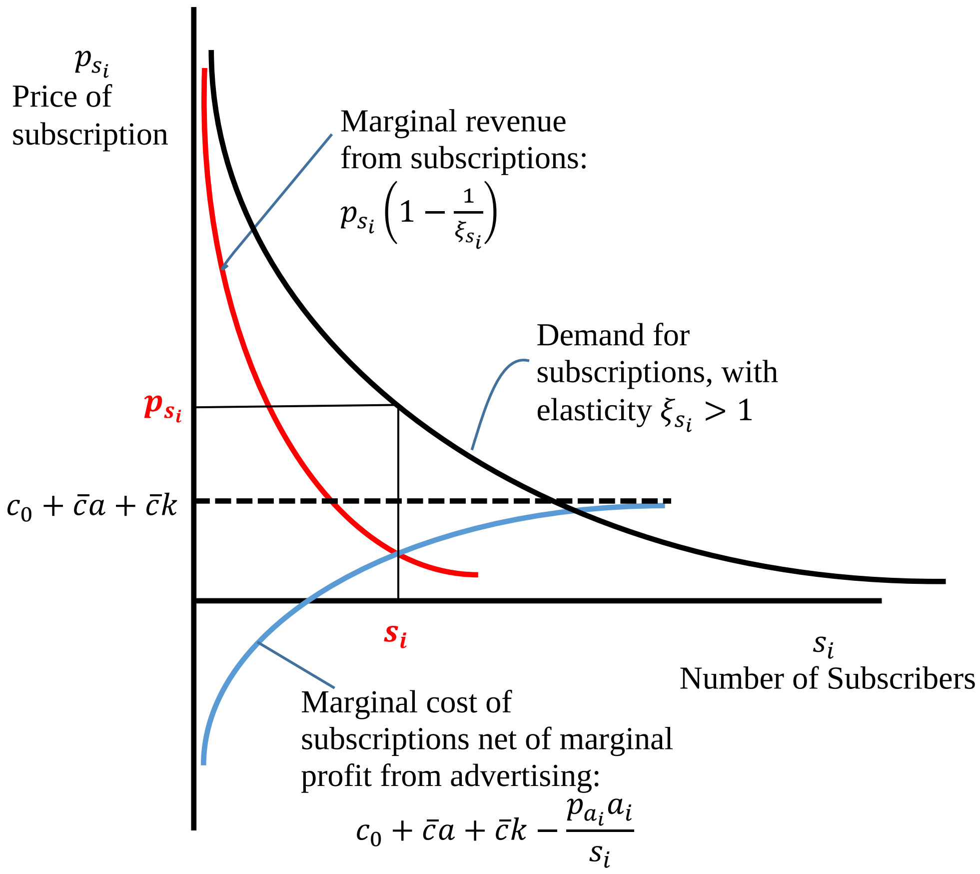


Figure 5. Profit-maximizing subscription price with unit-elastic demand.

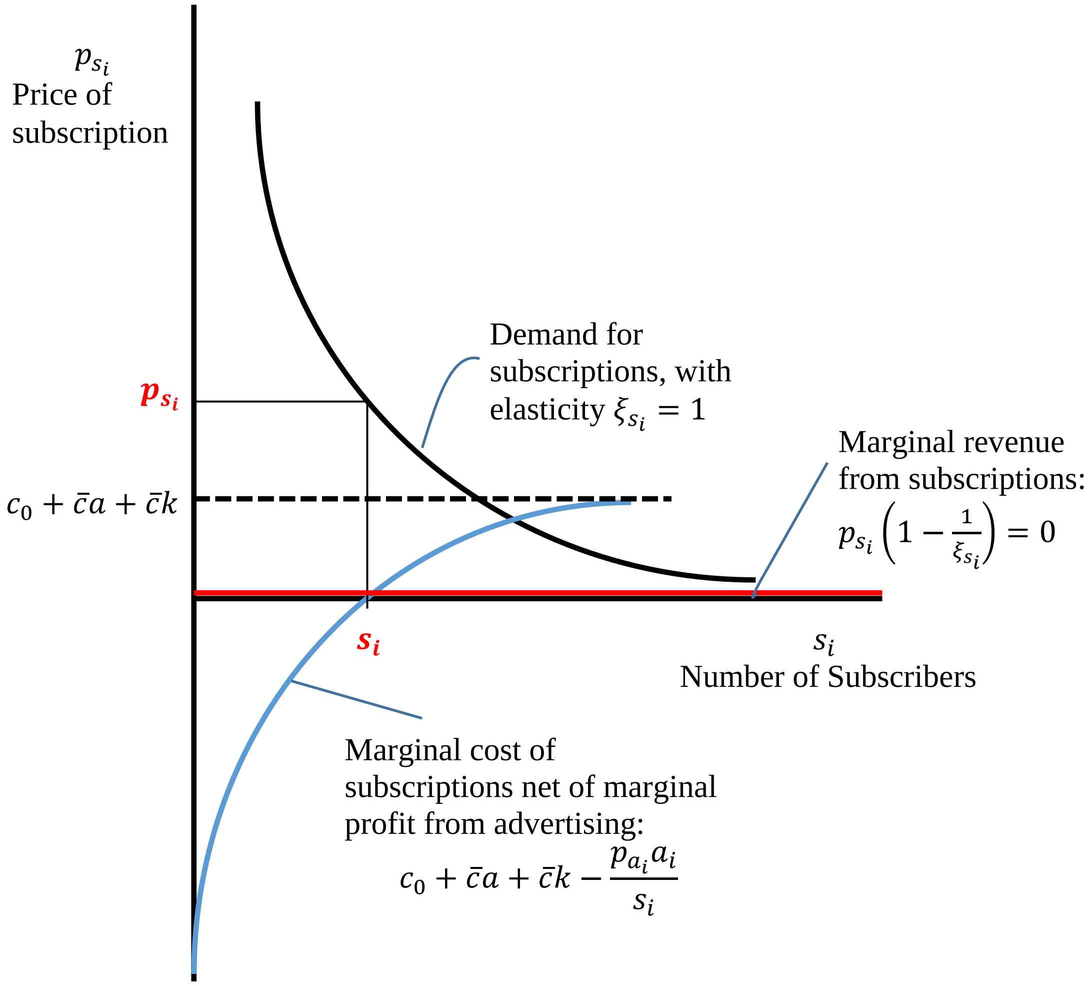
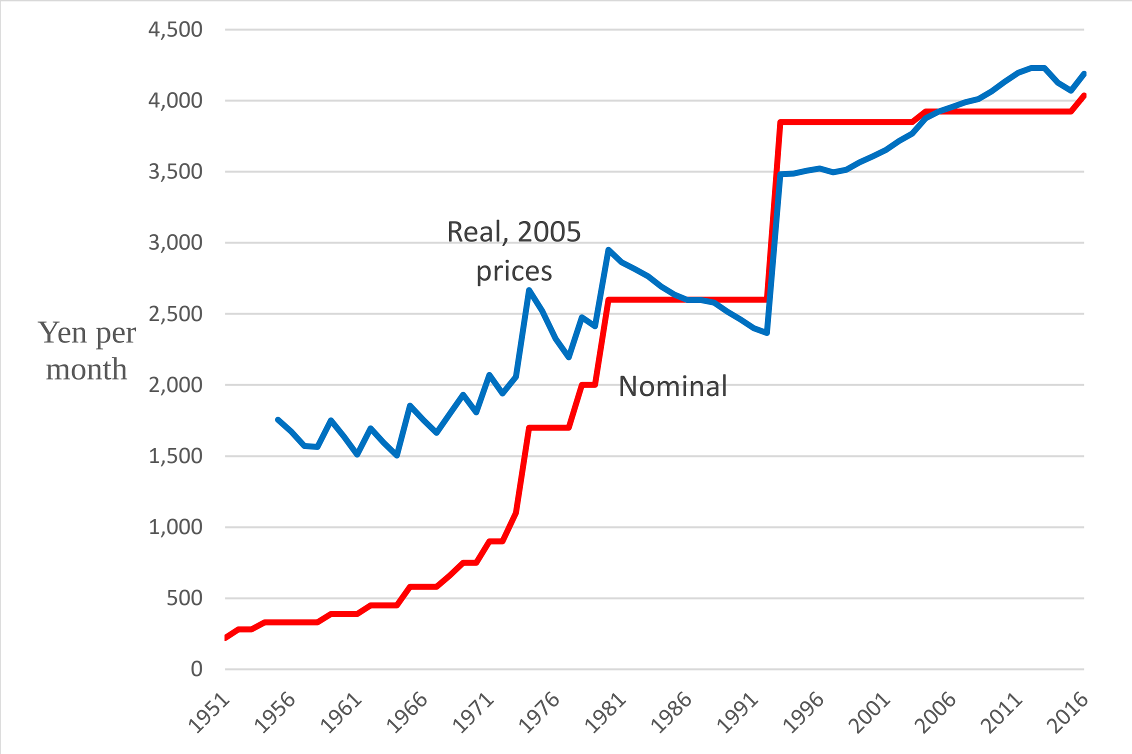
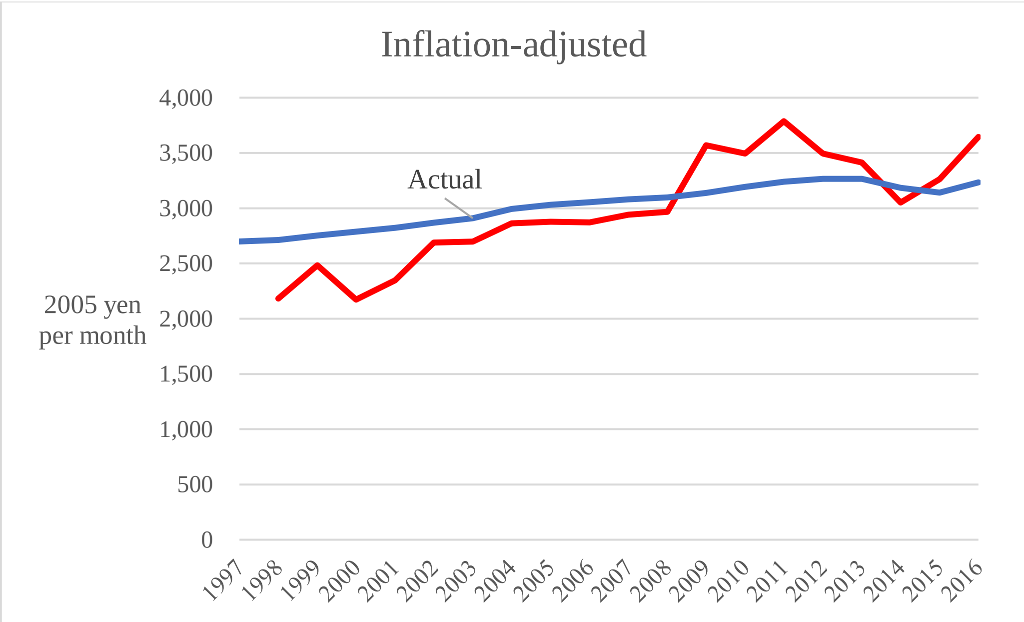


Figure 6. Newspaper subscription price, yen-per-month, morning+evening, 1951-2016, Asahi-Mainichi-Yomiuri.




This shows the nominal monthly subscription price, and real monthly subscription price, 2005 prices, based on GDP deflator.

Figure 7. Average subscription price predicted by regression.



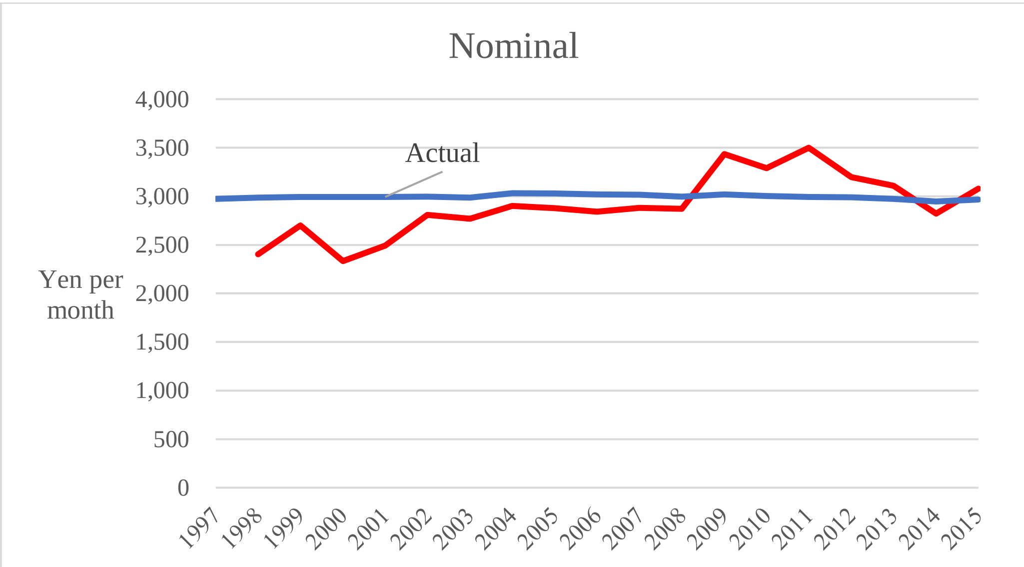



Figure 8. Shift in demand for newspaper subscriptions, 1997 to 2017

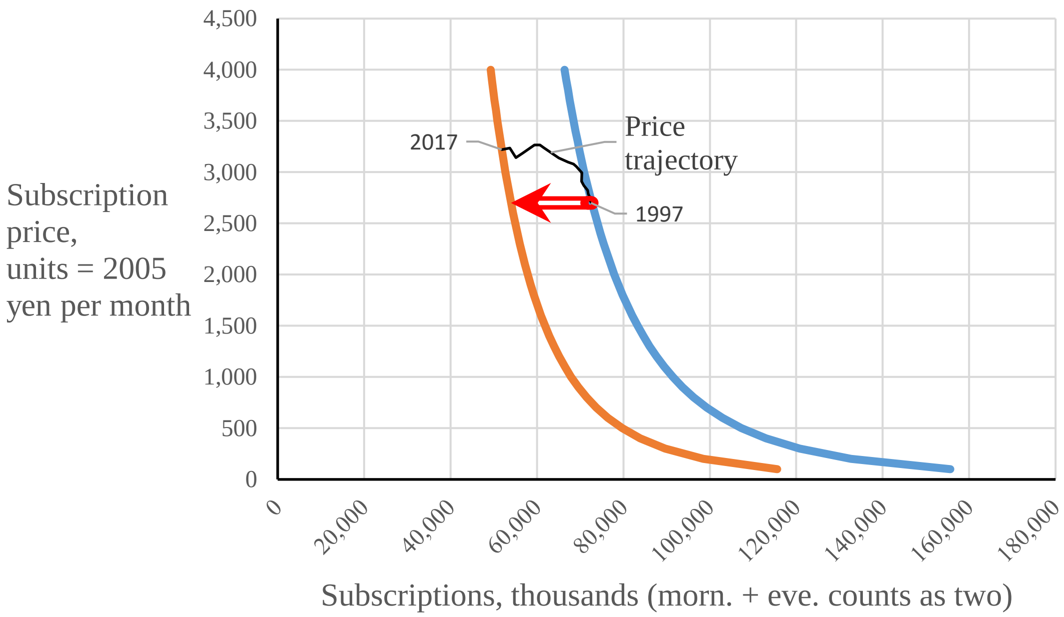


Figure 9. Volume of ads, total pages per year.

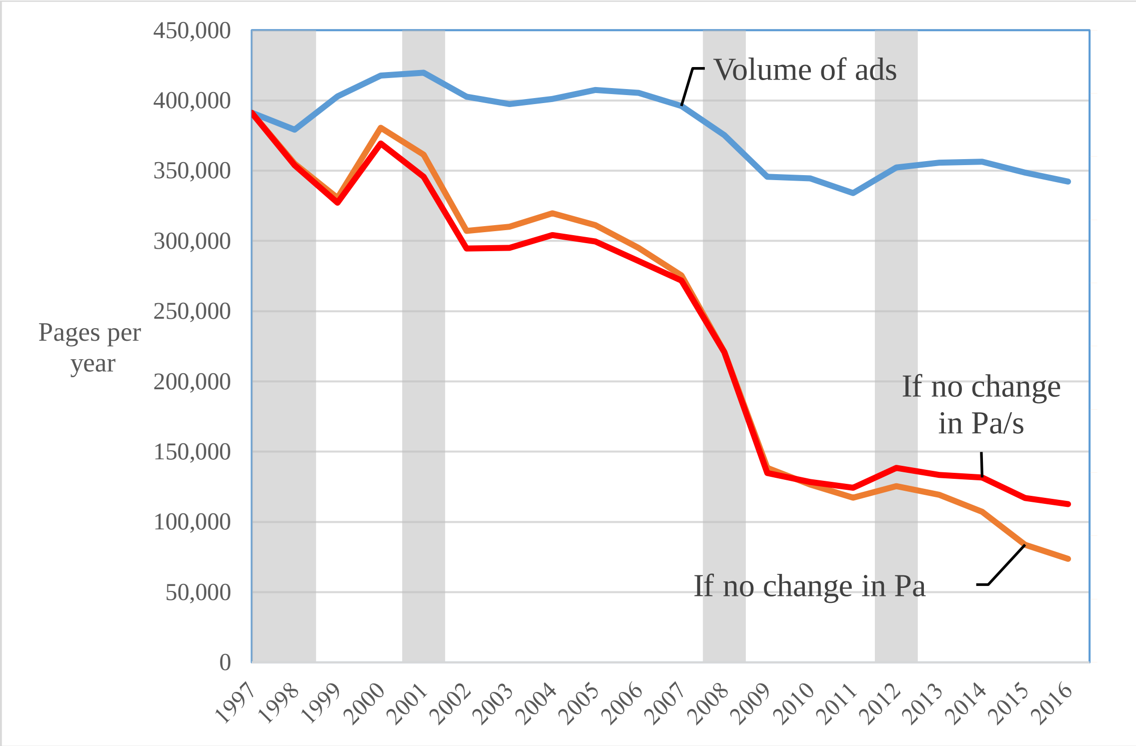


Figure 10. Shift in demand for newspaper ads, 1997 to 2017.

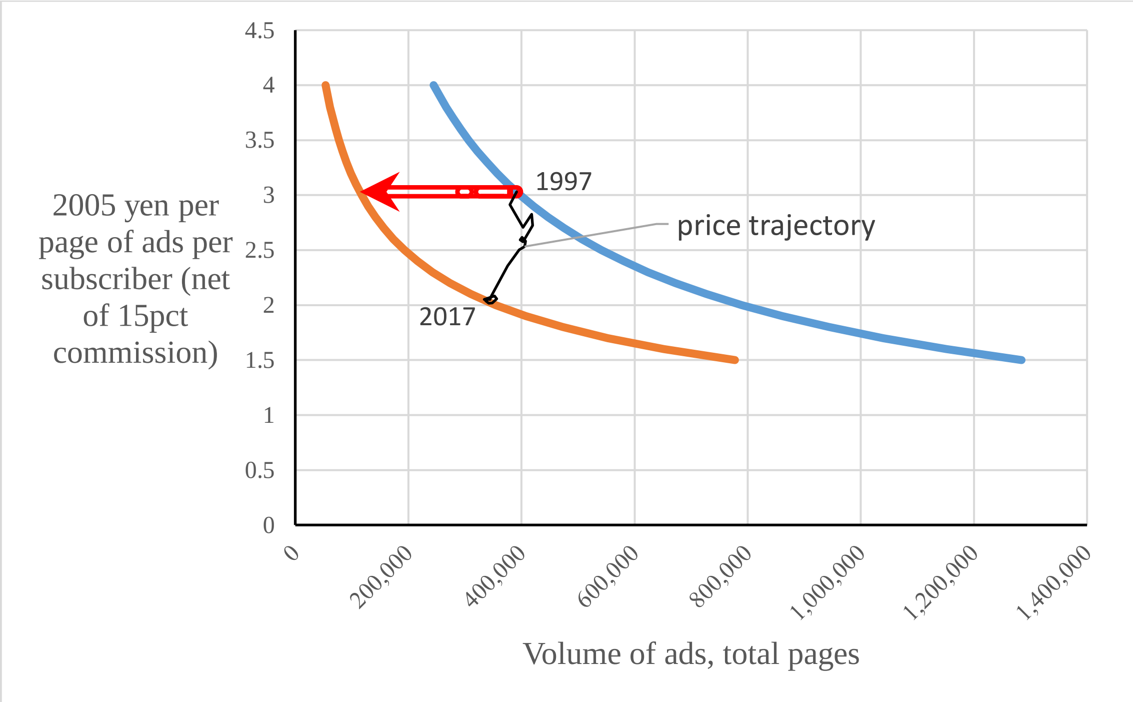


Figure 11. Demand for newspaper ads at 1997 price per page of ads per subscriber, and natural log of inflation-adjusted internet ad expenditures.