Economics Bulletin

Volume 34, Issue 1

Product differentiation and advertising in multiple markets

Wenjiao Che
Graduate School of Economics, Nagoya University

Toshiki Kodera
Graduate School of Economics, Nagoya University

Abstract

We study a Hotelling location game where media platforms compete with the same content in two separate markets. The findings show that media platforms may provide less differentiated content if the non-negativity constraint on prices is binding in at least one market. Moreover, content differentiation is decreasing in the size of market where the constraint is binding.

The author acknowledges the financial support from China Scholarship Council.
Citation: Wenjiao Che and Toshiki Kodera, (2014) "Product differentiation and advertising in multiple markets", *Economics Bulletin*, Vol. 34 No. 1 pp. 400-408.
Contact: Wenjiao Che - wenjiao.s.che@gmail.com, Toshiki Kodera - koder29@yahoo.co.jp.
Submitted: May 20, 2013. **Published:** February 28, 2014.

1 Introduction

Nowadays many media platforms operate business simultaneously in several different markets to maximize benefits or to gain competitive advantage. Taking CNN and NBC as examples, they compete not only in the US but also in other countries. Also, CNBC and Bloomberg TV provide finance programs to many different markets. Each market is heterogeneous with respect to consumer preferences, market size and competitive structure, but it is not always possible for media platforms to tailor their contents to each individual market. In this paper, we investigate how media platforms behave in product positioning when all of them compete with the same content across markets.

Content provision by firms which serve multiple markets has been studied by Loertscher and Muehlheusser (2008). They consider the case in which the firm serving multiple markets competes with local firms in each single market; however, all of our firms compete across markets. Moreover, we include the effect of consumer prices and advertisements. In contrast, they abstract price competition and only consider product choice. There are other papers investigating endogenous content provision within the Hotelling framework, but most focus on the choice in a single market. Gabszewicz et al. (2001, 2002) assume that consumers are indifferent about the level of advertising, and show that the degree of differentiation depends on unit receipt from advertising. When consumers dislike advertising, Gabszewicz et al. (2004) conclude that maximal differentiation arises under ad-supported media (when the disutility from advertising is linear in the advertising level). The paper by Gal-Or and Dukes (2003) offers an explanation for minimum differentiation, which relies on the role of advertising as information about products and as a nuisance to consumers. Peitz and Valletti (2008) consider the content choice and advertising provision under pay-tv and free-to-air, respectively. Their model shares several properties with ours. In particular, the configuration is competitive bottlenecks and consumers dislike ads. They show that pay-tv always maximally differentiates content whereas ad-sponsored media platforms may provide less differentiated contents.

We analyze a Hotelling location game where two media platforms compete with the same content in two separate markets. The platforms choose the intensity of advertising and subscription fee.[1] Our conclusions show how product positioning is affected by market size, competition intensity, and the non-negativity constraint on prices. When there is no restriction with respect to price, media platforms maximally differentiate contents. In each market of our model competition effect dominates demand effect, so even if they compete in different markets, platforms maximize content differentiation. However, if we restrict price to be non-negative, the outcome changes: partial differentiation may arise if the non-negativity constraint is binding. Since advertising is the only revenue source for the market where the constraint is binding, media platforms, if competing only in this market, will choose location that offers maximum advertising revenue, but not necessarily the endpoints. In contrast, competition effect still dominates in the market where the constraint is nonbinding. Therefore, when the former market is sufficiently important in revenue composition, the media platforms competing in multiple markets will choose their contents closer to the location which generates maximum advertising revenues, which may lead to partial differentiation.

The remainder of this paper is organized as follows: section 2 establishes the model, the equilibrium is analyzed in section 3, and section 4 provides the conclusion.

[1] When the non-negativity constraint on prices is binding, (i.e., the media becomes ad-supported), platforms only determine the advertising space.

2 Model

There are two separated media markets $k = 1, 2$. These markets differ in size and it is assumed that the size of market 2 is N times larger than market 1. Consider two media platforms $i = A, B$, each of which serves two distinct groups of agents: consumers who like to consume media content, and advertisers who want to inform consumers about their products via the media. Each group consists of a unit mass of agents. Platforms have fixed costs in serving agents and incur the marginal cost of producing contents and inserting ads. Here, we consider a symmetric cost structure and normalize the fixed and marginal costs to zero. Each platform chooses its own content location which is in the unit interval $[0, 1]$. Parameter d_A denotes the distance between the endpoint 0 and the location of platform A, while parameter d_B is the distance between the endpoint 1 and the location of platform B. Points d_A and $1-d_B$ accordingly represent the respective content choice for platforms A and B. Without loss of generality, we assume that $d_A \leq 1-d_B$. In our model, platforms cannot tailor their products to each individual market where they operate. For example, CNN provides some contents which are made in US to the world.

Consumers in market k are distributed uniformly on the $[0, 1]$-interval with $\beta_k \in [0, 1]$ representing their preferences. When consuming content that does not satisfy his/her taste, a consumer incurs a disutility that is related to the square of the distance of his/her choice from his/her ideal point on the line, namely $\tau_k \left(\beta_k - d_A\right)^2$ or $\tau_k \left(1 - d_B - \beta_k\right)^2$ with $\tau_k > 0$ designating the transportation cost parameter.[2] Assume that the transportation cost parameter in market 1 is higher than that in market 2, i.e., $\tau_1 > \tau_2$, which implies that consumers consider content more substitutable in market 2 than those in market 1. For example, U.S. consumers have strong persistence of political news compared to some other countries. Consumers are assumed to dislike advertising. We use δ to denote the disutility parameter for ads and its domain is $0 < \delta < 1$.[3] If content contains a_{ki} amount of advertising, the utility of type-β_k consumer who chooses platform A in market k is given by

$$U_{kA} = v_k - \delta a_{kA} - \tau_k \left(\beta_k - d_A\right)^2 - p_{kA},$$

where v_k is the intrinsic utility in market k, which is assumed to be large enough to ensure full market coverage.[4] Parameter p_{kA} is the subscription fee for platform A in market k.

Advertisers are characterized by parameter θ, which is uniformly distributed on the interval $[0, 1]$. A type-θ advertiser can obtain profit θ from each consumer who sees the ads. Thus, advertisers will place ads on a platform with acceptable consumer size x_{ki} and advertising price r_{ki} if $\theta x_{ki} \geq r_{ki}$. This implies that advertising quantity in this platform is $a_{ki} = 1 - r_{ki}/x_{ki}$.

Media platforms have two sources of revenue: consumers and advertisers. Therefore,

[2] When platforms endogenously select their locations in the Hotelling model, the specification of quadratic transportation costs can guarantee the existence of an equilibrium, which may not exist with linear transportation costs. We use the specification of quadratic transportation costs to simplify the analysis. Yet, this does not seem to be a very restrictive assumption.

[3] The reason for choosing this domain is to guarantee the existence (i.e., there are solutions for (5)) and positive value of advertising.

[4] Without loss of generality, in the following we assume that v_k is same in both markets, i.e., $v_1 = v_2 = v$.

platform i's profit generated in market 1 and 2 is given by

$$\begin{aligned}\pi_i &= \pi_{1i} + \pi_{2i} = x_{1i}p_{_{1i}} + a_{1i}r_{1i} + Nx_{2i}p_{_{2i}} + a_{2i}r_{2i} \\ &= x_{1i}\left[p_{_{1i}} + a_{1i}\left(1 - a_{1i}\right)\right] + Nx_{2i}\left[p_{_{2i}} + a_{2i}\left(1 - a_{2i}\right)\right].\end{aligned}$$

We consider a three-stage game. At the initial stage, the platforms determine their content locations to maximize the gross profits in these two markets. At the second stage, they choose subscription fees and advertising intensities in market 1. Finally, they make their decisions in market 2.[5]

3 Equilibrium

3.1 Without a non-negativity constraint on prices

We first analyze platform competition in market 2. From the Hotelling specification, the consumer number of platform i in market 2 is given as follows:

$$x_{2i} = \frac{1 + d_i - d_j}{2} - \frac{\delta\left(a_{2i} - a_{2j}\right) + \left(p_{2i} - p_{2j}\right)}{2\tau_2\left(1 - d_i - d_j\right)}. \tag{1}$$

At the third stage, platform i chooses the strategic variables a_{2i} and p_{2i} to maximize π_i. The equilibrium is characterized by the following first-order conditions:

$$\frac{\partial \pi_i}{\partial p_{_{2i}}} = N\left[x_{2i} + \frac{\partial x_{2i}}{\partial p_{_{2i}}}p_{_{2i}} + a_{2i}\left(1 - a_{2i}\right)\frac{\partial x_{2i}}{\partial p_{_{2i}}}\right] = 0, \tag{2}$$

$$\frac{\partial \pi_i}{\partial a_{_{2i}}} = N\left[\frac{\partial x_{2i}}{\partial a_{_{2i}}}p_{_{2i}} + a_{2i}\left(1 - a_{2i}\right)\frac{\partial x_{2i}}{\partial a_{_{2i}}} + \left(1 - 2a_{2i}\right)x_{2i}\right] = 0. \tag{3}$$

Analogous analysis can be applied to market 1. By calculation, the advertising level and subscription fee for each platform in different markets can be expressed as follows:

$$a_{ki} = \frac{1 - \delta}{2};\ p_{ki} = \frac{\left(1 - d_i - d_j\right)\left(3 + d_i - d_j\right)\tau_k}{3} - \frac{1 - \delta^2}{4}. \tag{4}$$

By summing up the profits generated in market 1 and 2, we have the following equilibrium profit:

$$\pi_i = \frac{1}{18}\left(\tau_1 + N\tau_2\right)\left(d_i - d_j + 3\right)^2\left(1 - d_i - d_j\right).$$

By differentiating the above profit function, we can show that media platforms locate at the endpoints, i.e., $d_A = d_B = 0$.[6]

In our model, since market 1 and 2 are independent and almost homogeneous, except for market size and the degree of substitution of content, we focus on market k to interpret the equilibrium prices and location. The term $(1 - \delta^2)/4$ in the subscription fee $p_{_{ki}}$ in (4) denotes the advertising revenue per consumer. The price expression in (4) implies that all the per consumer advertising revenues are passed onto consumers by a form of lower price, namely, that advertising revenues do not affect the profits of platforms.[7]

[5] The results will not change if media platforms make their decisions in market 1 and 2 simultaneously.

[6] In our model, the analysis at the first stage is similar to that in the standard Hotelling model with quadratic transportation costs (D'Aspremont et al., 1979).

[7] According to Peitz and Valletti (2008), this phenomenon is called "profit neutrality". It is surely

In our model, there is no competition for consumers and advertisers across these two markets, therefore, together with the result of "profit neutrality", we can regard each market as the standard Hotelling model. Two counteracting forces affect the location in each market: the increase of captive consumers (i.e., the demand effect) and the intense price competition (i.e., the competition effect) when platforms move closer to each other. With quadratic transportation costs the latter effect always dominates, thus maximum differentiation arises in our model.

3.2 With a non-negativity constraint on prices

The above analysis allows for negative prices, but it is not always possible for platforms to subsidize consumers, due to adverse selection or opportunistic behaviors.[8] Thus from now on we consider the case in which platforms are constrained to set non-negative prices. The case in which the non-negativity constraint is nonbinding is similar to those in section 3.1, and it occurs when content preferences are large compared to the nuisance cost caused by advertising, i.e., $3\left(1-\delta^2\right) < 4\left(1-d_i-d_j\right)\left(3+d_i-d_j\right)\tau_k$. This is because platforms can obtain some degree of market power over consumers to charge non-negative prices by offering differentiated media products. For the case in which the constraint is binding, we have two cases due to $\tau_1 > \tau_2$: one that only the constraint in market 2 is binding and the other where the constraint is binding in both markets. In this paper, we mainly consider the first case.[9] When the above condition is violated, the subscription fee in market 2 becomes negative and thus zero equilibrium price is charged. In this case, the first-order condition to determine the advertising intensity for platform i in market 2 changes as follows:

$$\frac{\partial \pi_i}{\partial a_{2i}} = N\left[a_{2i}\left(1-a_{2i}\right)\frac{\partial x_{2i}}{\partial a_{2i}} + \left(1-2a_{2i}\right)x_{2i}\right] = 0.$$

For symmetric locations, the equilibrium advertising level in market 2 is given by

$$a_2 = a_{2i} = \frac{1}{2} + \frac{\tau_2(1-2d)}{\delta} - \sqrt{(1-2d)^2\frac{\tau_2^2}{\delta^2} + \frac{1}{4}}. \tag{5}$$

This symmetric equilibrium advertising level corresponds to the uniform distribution case of Peitz and Valletti (2008). It can be shown that when consumers do not mind much being exposed to advertising, the advertising level a_2 is decreasing with the nuisance parameter δ. For the first market, the first-order conditions are still analogous to expressions (2) and (3), so in market 1 we can obtain the same results as those in section 3.1 for given locations of platforms.

We now consider the stage where platforms choose the contents. If the first-order

an artifact of the model setup that media platforms choose the intensity of advertising, but this setting simplifies the analysis without loss of generality.

[8] If consumers are paid to get the media products, platforms will attract some non-targeted consumers that have no value to advertisers.

[9] We can derive the similar result when the non-negativity constraint is binding in both markets.

condition at stage 1 holds, we have the following equation:

$$\frac{\partial \pi_i}{\partial d_i} = [p_{1i} + a_{1i}(1-a_{1i})]\left(\frac{\partial x_{1i}}{\partial d_i} + \frac{\partial x_{1i}}{\partial a_{1j}}\frac{\partial a_{1j}}{\partial d_i} + \frac{\partial x_{1i}}{\partial p_{1j}}\frac{\partial p_{1j}}{\partial d_i}\right)$$
$$+Na_{2i}(1-a_{2i})\left(\frac{\partial x_{2i}}{\partial d_i} + \frac{\partial x_{2i}}{\partial a_{2j}}\frac{\partial a_{2j}}{\partial d_i}\right) = 0.$$

For symmetric equilibrium, the above equation can be expressed as

$$-\frac{(1+4d)\tau_1}{6} + Na_2(1-a_2)\left[\frac{1}{2} + \frac{\delta}{2(1-2d)\tau_2}\frac{\partial a_{2j}}{\partial d_i}\Big|_{d_i=d_j=d}\right] = 0, \tag{6}$$

where

$$\frac{\partial a_{2j}}{\partial d_i}\Big|_{d_i=d_j=d} = -\frac{2a_2(1-a_2)\delta\left[\frac{\delta^2}{\tau_2^2}(2-d)a_2(1-a_2) + 2(1-d)(1-2d)^2\right]}{\tau_2\left[-\frac{\delta^4}{\tau_2^4}a_2^2(1-a_2)^2 + \left(2\frac{\delta^2}{\tau_2^2}a_2(1-a_2) + 2(1-2d)^2\right)^2\right]} < 0.$$

The first term of expression (6) is negative, while the second term, which is similar to expression (12) in Peitz and Valletti (2008), is ambiguous. By analyzing the relationship between market size N and the content differentiation, we have the following proposition.

Proposition 1 *In subgame perfect equilibrium, platforms which serve multiple markets will choose contents using the following method when the non-negativity constraint on prices is binding in market 2:*

If $\delta/\tau_2 < \sqrt{2\left(1+\sqrt{2}\right)/a_2(1-a_2)}$, *content differentiation is decreasing in* N, *and reaches maximum for* N *sufficiently small. Otherwise, maximal differentiation arises regardless of the size of* N.

Proof is available in the appendix.

To understand content choice clearly when media platforms compete in multiple markets with the same products, we first consider the case in which platforms only compete in a single market, respectively and then operate in both markets 1 and 2.

Consider that platforms compete only in market 1. When the non-negativity constraint is nonbinding, as mentioned above, there is a full pass-through of advertising revenues into lower subscription fee, implying commercials do not affect equilibrium profits. In this case, the analysis at the stage of content choice reduces to the standard Hotelling model with quadratic transportation costs, so maximum differentiation arises. If platforms compete only in market 2, advertising becomes the only revenue source when the non-negativity constraint on prices is binding. Therefore, platforms will choose the content which offers the highest advertising revenue. In market 2, there are two effects for location decision: the demand effect and the competition effect of advertising, whose relative magnitude is ambiguous. When advertising is not so much of a nuisance (i.e., δ is small) or contents are hardly substitutable (i.e., τ_2 is large), the competition effect is small and thus platforms do not need to differentiate their contents maximally. However, maximal differentiation arises for δ sufficiently large or τ_2 sufficiently small. This occurs because by differentiating contents the media can obtain some degree of market power over their consumers to place ads.

When platforms compete in both markets 1 and 2 with the same content, they trade-off revenues generated from these two markets: the effects in market 1 make maximum differentiation desirable while the advertising revenues in market 2 may induce platforms increase content duplication. For δ sufficiently large or τ_2 sufficiently small, the above analysis implies that platforms which operate in multiple markets will choose the end-points of the line. For small δ or large τ_2, we have the following intuition. When market 2's size N is relatively large, advertising revenue becomes more important. Thus media platforms choose content which is much similar to the case in which they operate only in market 2 (i.e., the content which offers the maximum advertising revenue in market 2). In contrast, when market 2's size is not so large, the revenues from market 1 are relatively important, namely, that platforms maximally differentiate the content for N sufficiently small.[10]

Figure 1 displays the relationships between the program content d and market 2's size N for $\tau_1 = 1$, $\delta = 0.2$ and $\tau_2 = 0.8$, 0.2, 0.1, 0.05, respectively. The horizontal dashed lines correspond to the case where ad-supported media competes only in market 2, while the solid curves represent the case in which platforms operate in two markets. Figure 1 shows that d is increasing in N and $d = 0$ for N sufficiently small.

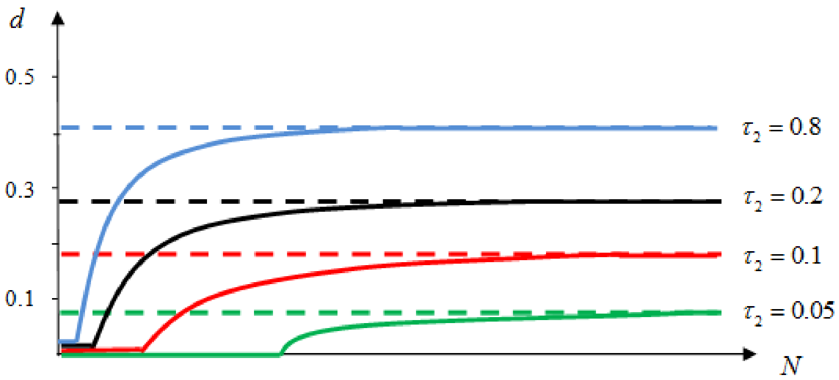

Figure 1: The Relationship Between d and N

Differentiating d with respect to δ, τ_1 and τ_2 yields the following comparative-static results on the equilibrium content.

Corollary 1 *If partial differentiation arises when platforms compete in multiple markets, the equilibrium content d is increasing with τ_2 but decreasing with δ and τ_1.*

As δ increases, consumers become more sensitive to advertising. However, by differentiating content, platforms obtain some degree of market power over consumers, which

[10]Our results also apply to the case of $\delta = 0$, although there are no solutions for advertising in (5). By the same logic mentioned above, if consumers do not mind advertising, platforms would compete for consumers so that content duplication occurs for sufficiently large N. This extends the result of content duplication for sufficiently important advertising provided by Gabszewicz et al. (2001, 2002) in a single market to many markets. Different from ours, Loertscher and Muehlheusser (2011) show that the content provision is not affected by the large enough advertisements in a sequential location game. Here, note that content duplication does not occur for $\delta > 0$. If platforms duplicate content, in market 2 a platform can get all consumers from its competitor by reducing the advertising level. The above situation induces zero revenues. Furthermore, price competition effect always dominates demand effect in market 1. Therefore, platforms have a tendency to differentiate the content to make positive revenues. Mathematically, the L.H.S. of expression (6) reduces to $-(1+4d)\,\tau_1/6 - Na_2\,(1-a_2)\,d/\,(1-2d)$, which is negative as $d \to 1/2$.

allows platforms to place ads without losing their consumers. Therefore, given the relative size of these two markets, platforms differentiate their contents more to obtain their advertising revenues from market 2 if δ becomes large. We can make a similar analysis for τ_2. But platforms' incentive to differentiate content is decreasing as τ_2 increases. This is because platforms' market power over consumers increases as consumers regard contents as hardly substitutable (i.e., large τ_2). Equilibrium content d and τ_1 also have a negative relationship: as τ_1 gets smaller, the competition in market 1 becomes more intense, which makes the profit generated from this market shrink relative to that from market 2. Thus platforms have incentives to move away from the endpoints where the platforms locate when they compete only in market 1.

4 Conclusion

In this paper we investigate a Hotelling model where media platforms compete with the same content in two heterogeneous markets. Our findings are closely related to the non-negativity constraint imposed on the per-consumer price: it shows that if there is no restriction on price, media platforms maximally differentiate their contents; by contrast, less differentiated content may be provided if non-negativity constraint is binding.

We have specified a relatively simple model where there is no competition for consumers and advertisers across markets. Our model can fit some phenomena. However, in some cases there still exists competition for consumers, advertisers, or both. Thus, relaxing this assumption might yield interesting insights, which should be undertaken in future research.

Appendix

Proof of Proposition 1.

The first term of (6) is negative, while the second term is ambiguous. Suppose that $d = 0$. If the second term is negative or equal to zero, platforms differentiate content maximally regardless of the size of N. This case occurs when $\delta/\tau_2 \geq \sqrt{2\left(1+\sqrt{2}\right)/a_2\left(1-a_2\right)}$ holds. If this condition fails, platforms choose their content depending on the size of N. The details are showed in the following.

As $N \to 0$, the L.H.S. of (6) simplifies to $-\left(1+4d\right)\tau_1/6 < 0$, so maximal differentiation arises. If N is infinite, a platform will abandon market 1 and choose its content paying attention to market 2 only.

When N has intermediate values, we consider the effect of market size on content differentiation. We define $\varphi(d, N)$ as the equation (6) divided by N:

$$\varphi(d, N) \equiv -\frac{\left(1+4d\right)\tau_1}{6N} + a_2\left(1-a_2\right)\left[\frac{1}{2} + \frac{\delta}{2\left(1-2d\right)\tau_2}\frac{\partial a_{2j}}{\partial d_i}\big|_{d_i=d_j=d}\right] = 0.$$

Using the implicit function theorem, we have

$$\frac{dd}{dN} = -\frac{\partial\varphi(d, N)/\partial N}{\partial\varphi(d, N)/\partial d} = -\frac{\left(1+4d\right)\tau_1}{6N^2 \cdot \partial\varphi(d, N)/\partial d} > 0.$$

The term $\partial\varphi(d, N)/\partial d$ consists of the second-order condition in stage of content choice, which is negative. Therefore, $dd/dN > 0$, namely, that content differentiation is decreasing in N in the symmetric subgame perfect equilibrium.

References

Armstrong, M. (2006) "Competition in Two-Sided Markets" *RAND Journal of Economics* **37**, 668-691.

Anderson, S. and S. Coate (2005) "Market Provision of Broadcasting: A Welfare Analysis" *Review of Economic Studies* **72**, 947-972.

D'Aspremont, C., J. Jaskold Gabszewicz, and J.-F. Thisse (1979) "On Hotelling's Stability in Competition" *Econometrica* **47**, 1145-1150.

Gabszewicz, J., D. Laussel, and N. Sonnac (2004) "Programming and Advertising Competition in the Broadcasting Industry" *Journal of Economics and Management Strategy* **13**, 657-669.

Gal-Or, E. and A. Dukes (2003) "Minimum Differentiation in Commercial Media Markets" *Journal of Economics and Management Strategy* **12**, 291-325.

Gabszewicz, J., D. Laussel, and N. Sonnac (2002) "Press Advertising and the Political Differentiation of Newspapers" *Journal of Public Economic Theory* **4**, 317-334.

Gabszewicz, J., D. Laussel, and N. Sonnac (2001) "Press Advertising and the Ascent of the 'Pensée Unique'?" *European Economic Review* **45**, 641-651.

Hotelling, H. (1929) "Stability in Competition" *Economic Journal* **39**, 41-57.

Kind, H. J., and F. Stähler (2010) "Market Shares in Two-Sided Media Industries" *Journal of Institutional and Theoretical Economics* **166**, 205-211.

Kodera, T. (2010) "Spatial Competition among Multiple Platforms" *Economics Bulletin* **30**, 1516-1525.

Loertscher, S. and G. Muehlheusser (2011) "Sequential Location Games" *The RAND Journal of Economics* **42**, 639-663.

Loertscher, S. and G. Muehlheusser (2008) "Global and Local Players in a Model of Spatial Competition" *Economics Letters* **98**, 100-106.

Peitz, M. and T. Valletti (2008) "Content and Advertising in the Media: Pay-TV versus Free-To-Air" *International Journal of Industrial Organization* **26**, 949-965.

Sonnac, N. (2000) "Readers' Attitudes towards Press Advertising: Are they Ad-Lovers or Ad-Averse" *Journal of Media Economics* **13**, 249-259.