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Product differentiation and advertising in multiple markets

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Abstract

A study of the Hotelling location game where media platforms compete on two separate markets with the same content has been carried out. The findings show that media platforms may provide less differentiated content if non-negative price constraint binds in at least one market. Content differentiation decreases in the size of market where the constraint binds.

Keywords: Two-sided markets; Multiple markets; Product differentiation

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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 serve their programs in the US and also operate in other countries. Besides, CNBC and Bloomberg TV provide finance programs to both US and international audiences. They both have an Asia branch, and Bloomberg TV Asia broadcasts its programs almost for free in China. Each market is heterogeneous with respect to consumer preferences, market size and competitive structure; therefore, it is important to satisfy each market according to unique characteristics. However, sometimes media platforms that are active in multiple markets are unable to tailor content (or political view in the strict sense) to each market. So, to investigate how media platforms behave in product positioning when operating in several heterogeneous markets is an interesting topic, and is the purpose of this paper.

The Hotelling location game is analyzed where two media platforms compete in two separate markets, but with the same content. The platforms choose the intensity of advertising and/or subscription fee. 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 content. In each market of our model competition effect dominates demand effect, so even if they operate in different markets, platforms maximize differentiation (just as the standard Hotelling model) with quadratic transportation costs. However, if we restrict price to be non-negative, the outcome changes: partial differentiation may arise if the non-negative constraint binds. Since advertising revenue is the only revenue source for the market where the constraint binds, media platforms, if competing only in this market, will choose content that offers maximum advertising revenue, but not necessarily endpoints. In contrast, competition effect still dominates in the market where the constraint unbinds, thus yielding maximal differentiation. Therefore, when the former market is sufficiently important in revenue composition, the media platforms competing in multiple markets will choose their content closer to the location to generate maximum advertising revenues, which may lead to partial differentiation.

There are several papers related to the present analysis. Gabszewicz et al. (2001; 2002) assume that viewers are indifferent about the level of advertising, and show that the degree of differentiation depends on unit receipt from advertising. When viewers 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 location and advertising provision under pay-tv and free-to-air. Their model shares several properties with ours. In particular, the configuration is competitive bottlenecks and viewers dislike ads. They show that pay-tv always maximally differentiates content whereas ad-sponsored media platforms may provide less differentiated content. The above papers analyze the endogenous content in a single market within the Hotelling framework. However, none of them consider the media decisions regarding content choice when competition occurs in several heterogeneous markets. This is important because, with technology development and the information expansion, many media platforms compete across many markets. Our model includes this impact and thereby allows us to provide an explanation to the program diversity across markets. Of course, Loertscher and Muehlheusser (2008) also analyze a similar question. However, our models differ in several aspects. First, in their model the media platforms are active in several markets but only compete with local media in each single market with the same product, while in ours all the media platforms compete across markets. Second, our results depend on advertising revenues and content revenues, which are omitted by Loertscher and Muehlheusser (2008). In addition, they show that product homogeneity arises due to such multiple-market media, which is in contrast to our result of content differentiation.

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

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 $i = A, B$ that serve two types of agents: viewers who like to watch content, and advertisers who want to inform consumers about their products via the media. Media platforms provide the same content for both markets which are in the interval $[0, 1]$.

Viewers in each market are distributed uniformly on the interval $[0, 1]$ with $\beta_k \in [0, 1]$ representing their preferences. When consuming content that does not satisfy his or her taste, a viewer incurs a disutility that is related to the square of the distance of his or her chosen platform from their location on the line, namely $\tau_k (\beta_k - d_A)^2$ (or $\tau_k (1 - d_B - \beta_k)^2$) with $\tau_k > 0$ designating the transportation cost parameter and d_A (or $1-d_B$) the location of media platform A (or B).[1] 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 viewers consider content more substitutable in market 2 than that in market 1.[2] For example, viewers in the US have strong persistence of political news, compared to viewers in other countries. Viewers are assumed to dislike ads, so if content contains a_{ki} amount of advertising, the utility of type-β_k viewer who chooses platform A in market k is given by

$$U_{kA} = v_k - \delta a_{kA} - \tau_k (\beta_k - d_A)^2 - p_{kA}, \ {}_{k=1,2}$$

where v_k is the intrinsic utility in market k, which is assumed to be large enough to ensure full market coverage.[3] p_{kA} is the subscription fee for platform A in

[1] 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.

[2] Please note that market size N has opposing effects when $\tau_1 < \tau_2$ is assumed.

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

market k and δ the disutility parameter for advertising. Here, $0 < \delta < 1$ is needed to guarantee non-negative advertising levels.

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

Media platforms have two sources of revenue: viewers and advertisers. So, platform i's profit generated in market 1 and 2 is given by:

$$\begin{aligned}\pi_i &= \pi_{1i} + \pi_{2i} = x_{1i} p_{1_i} + a_{1i} r_{1i} + N x_{2i} p_{2_i} + a_{2i} r_{2i} \\ &= x_{1i} \left[p_{1_i} + a_{1i} (1 - a_{1i})\right] + N x_{2i} \left[p_{2_i} + a_{2i} (1 - a_{2i})\right], \; {\scriptstyle i=A,B.}\end{aligned}$$

We consider a 3-stage game. Media platform A and B first determine their content locations to maximize the gross profits in these two markets. Then A and B choose a subscription fee and advertising intensity in both market 1 and market 2.[4]

3 Equilibrium

3.1 Without non-negative constraint

We first derive the viewer number of media platform i in market 2, which is given as follows:

$$x_{2i} = \frac{1 + d_i - d_j}{2} - \frac{\delta (a_{2i} - a_{2j}) + (p_{2i} - p_{2j})}{2\tau_2 (1 - d_i - d_j)}, \; {\scriptstyle i \neq j, \; i,j=A,B.} \tag{1}$$

Platform i chooses the strategic variables a_{2i} and p_{2i} to maximize π_i.The first-order conditions are as follows:

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

$$\frac{\partial \pi_i}{\partial a_{2_i}} = N \left[\frac{\partial x_{2i}}{\partial a_{2_i}} p_{2_i} + a_{2i} (1 - a_{2i}) \frac{\partial x_{2i}}{\partial a_{2_i}} + (1 - 2a_{2i}) x_{2i}\right] = 0, \; {\scriptstyle i=A,B.} \tag{3}$$

Analogous analysis can be applied to market 1. The subscription fee and advertising level for each platform in different markets are thus given as follows:

$$a_{_{ki}} = \frac{1 - \delta}{2}; \; p_{_{ki}} = \frac{(1 - d_i - d_j)(3 + d_i - d_j)\tau_k}{3} - \frac{1 - \delta^2}{4}, \; {\scriptstyle i \neq j, \; i,j=A,B, \; k=1,2.} \tag{4}$$

Sum up the profits generated in market 1 and 2, and the equilibrium profit is given by:

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

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

By differentiating the profit function, we can show that media platforms locate at the endpoints, i.e., $d_1 = d_2 = 0$.[5]

In our model, since market 1 and 2 are independent and almost homogeneous, except for market size and the degree of substitution, 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 viewer. The price expression in (4) implies that all the per viewer advertising revenues are passed onto viewers by a form of lower price, namely advertising revenues do not affect the profits of platforms.[6] In our model, there is no competition for viewers and advertisers across these two markets, so, together with the result of "profit neutrality", we can regard each market as a 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 non-negative constraint

The above analysis allows for negative prices, but in some cases platforms do not subsidize viewers. This may be due to huge transaction costs, technical reason or platforms' unwillingness to do so. Thus from now on we consider the case in which platforms only charge zero price when non-negative constraint binds. Since $\tau_1 > \tau_2$, there are two cases: one that only the constraint in market 2 binds and the other where the constraint binds in both markets. In this paper, we mainly consider the first case.[7] To consider the case where the subscription fee in market 2 is negative, suppose that δ is sufficiently small given platform locations, i.e., $\delta^2 < 1 - 4(1-d_i-d_j)(3+d_i-d_j)\tau_2/3$. In this case, the first-order condition to determine the advertising intensity for platform i in market 2 changes as follows:

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

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

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

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

[5] In our model, the first-order condition at stage 1 is similar to that in the standard Hotelling model.

[6] According to Peitz and Valletti (2008), this phenomenon is called "profit neutrality". It is surely an artifact of the model setup that media platforms choose the intensity of advertising, and this setting simplifies the analysis without loss of generality.

[7] It can be derived that platforms may locate partially on the line when the non-negative constraint binds in both markets.

We now consider the stage where platforms choose the content. If the first-order condition at stage 1 holds, we have the following equation:

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

For symmetric equilibrium, the above equation can be expressed as

$$-\frac{(1+4d)\,\tau_1}{6} + Na_2\left(1 - a_2\right)\left[\frac{1}{2} + \frac{\delta}{2\,(1-2d)\,\tau_2}\frac{\partial a_{2j}}{\partial d_i}\,|_{d_i=d_j=d}\right] = 0. \quad (5)$$

By analyzing the relationship between market size N and the content differentiation, we have the following proposition.

Proposition 1 *When non-negative price constraint binds in market 2, for small δ, the symmetric equilibrium content differentiation decreases in N, and for sufficiently small N maximal differentiation arises.*

Proof is available in the appendices.

When the non-negative constraint on prices binds in market 2, advertising revenue becomes the only revenue source. So, if platforms compete only in this market, then the location is chosen at the point where the advertising revenue is maximized. In market 2, there are two effects for location decision: demand effect and competition effect of advertising level, whose relative magnitude is ambiguous.[8] As for market 1, the non-negative constraint does not bind. Thus, the analysis in the last section can be applied here: competition effect dominates demand effect, thus the principle of maximum differentiation arises. When competing in multiple markets with the same content, media platforms 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 incentives to increase content duplication. When market 2's size is relatively large, advertising revenue becomes more important. So media platforms choose content which is much closer to the advertising-revenue-maximizing point. When market 2's size N is sufficiently large, media platforms decrease the differentiation between contents: the larger N, the closer the location to the case where media platforms operate only in market 2. In contrast, when market 2's size is not so large, the revenues from market 1 are relatively important than those from market 2, namely platforms maximally differentiate the content when N is small. Figure 1 displays the relationship between the program content d and market 2's size N for $\tau_1 = 1$, $\delta = 0.2$ and $\tau_2 = 0.2$. The horizontal dashed line corresponds to the case where ad-supported media competes only in market 2, while the solid curve represents the case where platforms operate in two markets. Figure 1 shows that d is increasing in N and for small N, $d = 0$.

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

[8] According to Peitz and Valletti (2008), when advertising is not so much of a nuisance (i.e., δ is small), platforms provide less differentiated content if competing only in market 2.

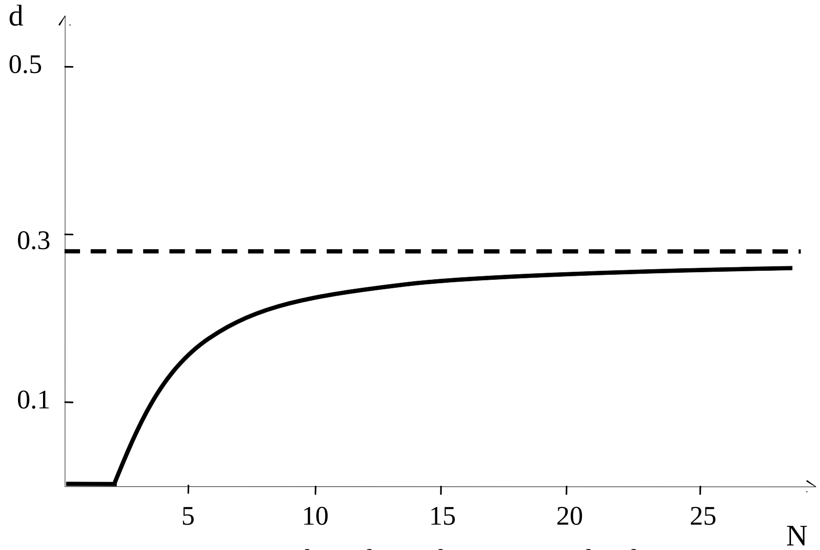

Figure 1: The Relationship Between d and N

Corollary 1 *If market 2's size N is sufficiently large (i.e., partial differentiation arises when platforms compete in multiple markets), the equilibrium content d increases with τ_2 but decreases with δ and τ_1.*

As the nuisance cost parameter δ increases, platforms differentiate more. This is due to high value of δ that makes viewers become more sensitive to advertising. In market 2, platforms, by differentiating content, obtain some degree of market power over their viewers. This allows them to place ads without losing viewers. In market 1, the parameter δ does not have impact on the location choice. Thus, with the same argument as above, platforms, when competing in those two markets, differentiate more as δ increases. We can make a similar analysis for τ_2. But platforms' incentive to differentiate content decreases as τ_2 increases. The fact that viewers regard content as hardly substitutable (large τ_2) makes platforms' market power over viewers increase. 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, which can be explained by the same reason previously mentioned.

4 Conclusion

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

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

Appendix

Proof of Proposition 1.

In equation (5), the effect of a change in content of platform i on advertising intensity of platform j in market 2 can be expressed as

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

We focus on the second term of (5) to consider location choice in market 2. The second term of (5) is similar to equation (12) in Peitz and Valletti (2008), therefore it is easy to show that platforms never duplicate content for $\delta > 0$ and differentiate content maximally if $\delta > \tau_2\sqrt{2\left(1+\sqrt{2}\right)/a_2(1-a_2)}$ in market 2. For lower values of δ, a platform has an incentive to partially differentiate from the other platform in market 2. If we consider the case which δ is small and platforms compete in both market 1 and 2, the content choice at the first stage depends on the relative size of these two markets, i.e., N. If N is close to infinite, a platform chooses its content paying attention to market 2 only, whose analysis is similar to Peitz and Valletti (2008). At $N \to 0$, the LHS of (5) is negative, namely

$$\lim_{N\to 0}\frac{\partial \pi_i}{\partial d_i}\left|_{d_i=d_j=d}\right. = -\frac{(1+4d)\tau_1}{6} < 0,$$

so maximal differentiation arises.

Next, when N has intermediate values, we consider the effect of a larger market size on content differentiation. We define $\varphi(d,N)$ as the equation (5) divided by N:

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

Using the implicit function theorem,

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

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

References

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

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

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

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

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 (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.

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

Kind, Hans Jarle; Stähler, Frank (2010) "Market Shares in Two-Sided Media Industries" *Journal of Institutional and Theoretical Economics* 166(2), 205 -211.

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

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.