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Media Diversity, Advertising and Net Neutrality

Armando J. Garcia Pires

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by

Armando J. Garcia Pires

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Media Diversity, Advertising and Net Neutrality

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Abstract

In this paper, we analyze the effects of net neutrality on media diversity. We show that in the net neutrality regime, media firms always provide media diversity, whereas in the no net neutrality regime, the equilibrium of the model depends on the relation between network capacity and network traffic. If the network capacity is large relatively to network traffic, the equilibrium of the no net neutrality regime is similar to the one under the net neutrality regime. However, if network capacity is small relative to network traffic, under the no net neutrality regime media firms do not provide media diversity. The reason is that when network capacity is small relative to network traffic, the no net neutrality regime hinders competition. In other words, with no net neutrality, the media firm with priority sees its hinterland more protected from its rival than under net neutrality, and the contrary for the firm with no priority. As a result, while the media firm with priority has less need to provide media diversity to attract demand and as such advertising revenues, the media firm with no priority finds it more difficult to use media diversity to attract demand and advertising revenues.

Keywords: Media Diversity, Advertising, Two-Sided Markets, Net Neutrality.

JEL Classification: L13, L51, L82, L86.

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1 Introduction

One of the most debated topics concerning the Internet is net neutrality. With net neutrality, all content provided by Content Providers (CPs) has in theory the same priority. This means that consumers have the same speed of access to any content available in the Internet. Under no net neutrality, Internet Service Providers (ISPs) can give priority to some CPs in exchange of a payment. This in practice means that consumers can access contents from CPs with network priority faster than contents from CPs with no priority. In other words, with net neutrality, ISPs should treat all traffic equally, the so-called non-discrimination rule, while with no net neutrality they can give traffic priority to some CPs[1]. In this sense, one of the issues that the net neutrality debate has raised concerns the diversity of content that is provided in the Internet. Some defend that net neutrality promotes the provision of more diversified content, since all content has equal treatment and therefore all CPs have equal chances to win consumers. Others defend that no net neutrality is the only way to promote investment in content by the most innovative CPs, since CPs can have higher returns on investment. For a discussion of these issues, see Schuett (2014). In this paper, we analyze this question of the effects of net neutrality regime on the diversity of contents provided by CPs in the Internet.

Media diversity is said to be important, because is believed to promote innovation and competition[2]. The literature on media diversity however shows that media diversity in media markets cannot be taken for granted. In fact, media diversity may be affected by a series of factors such as the concentration of the media industry (Kaitatzi-Whitlock, 1996; and George, 2007 and Roger, 2009); advertising (Gabszewicz et al., 2001, 2002; Argentesi and Filistrucchi, 2007; Ellman and Germano, 2009; Affeldt et al., 2013; and Garcia Pires, 2013); the diversity of readers' political preferences (Garcia Pires, 2013); market structure (Steiner, 1952; George and Waldfogel, 2003; and George and Oberholzer-Gee, 2011); subsidies (Lerocha and Wellbrock, 2011);

[1] Net neutrality also implies a zero-price rule, in the sense that ISPs should not collect fees from CPs. Here, we focus more on the non-discrimination rule.

[2] Another benefit of media diversity, particularly relevant for instance in the news market, is that media diversity can be central to the democratic process. Accordingly, if media diversity is low, in the sense that few political actors control which news and political opinions are broadcasted, this can affect political choices, political freedom and in the end also economic freedom and property rights.

party political competition (Noam, 1987; and Schulz and Weimann, 1989); and technology (Gentzkow, 2007; and George and Hogendorn, 2012).

To the best of our knowledge, the net neutrality literature has not yet looked at the effects of the net neutrality regime on media diversity. For a review of the economic literature on net neutrality, see Schuett (2014). For instance, Choi and Kim (2010) analyze the effects of net neutrality on the investment incentives of ISPs. They find that no net neutrality can have negative effects on the investment incentives of ISP. Economides and Hermalin (2012), in turn, argue that since the no net neutrality regime allows ISPs to price discriminate among CPs, investment in bandwidth can increase. The social welfare effects are ambiguous, though, due to the inefficiencies that arises with price discrimination.

Lee and Wu (2009) defend that net neutrality facilitates the entry of CPs. In addition, they argue that net neutrality avoids the problem of Internet fragmentation, since CPs can access all consumers and consumers can access all CPs. Kraemer and Wiewiorra (2012) argue that the most efficient regime is the one that provides higher incentives to infrastructure investment by the ISPs. They argue that the no net neutrality regime can better allocate network capacity in both the short and the long run, since it increases demand for priority by new CPs that enter the market. Cheng et al. (2008), on the other hand, argue that the gains of the no net neutrality regime are distributed asymmetrically between ISPs and CPs, ISPs have the most to gain and CPs the most to lose. They further argue that under net neutrality, ISPs invest in capacity at the social optimum level, while they over- or under-invest in relation to the social optimum with the no net neutrality regime.

Hermalin and Katz (2007) instead look at quality incentives for CPs under the two regimes. They show that the no net neutrality regime negatively affects quality provision and that as a result welfare might be reduced. This is so since, while low quality providers exit the market, and medium quality providers upgrade quality, the high quality providers reduce quality investments. Musacchio et al. (2009), in turn, argue that the choice between the two regimes depends on the relation between advertising rates and end-user price sensitivity. In particular, the no net neutrality regime is preferable when this relation is either low or high. Reggiani and Valletti (2014) on the other hand, defend that the two regimes have asymmetric impacts on large and small CPs. In the short run, the regime with no net neutrality leads to increased content provision by small CPs, but to reduced content provision by large CPs. In the long run, ISPs reduce network capacity, but small CPs

increase content at the expenses of large CPs. Finally, Bourreau et al. (2012) analyze the case with more than one ISPs and with several CPs. Under this scenario, they find that the no net neutrality regime is preferable, although CPs can lose.

In this paper, we analyze the incentives of CPs to provide media diversity. Our focus is not ISPs since, as we have just seen, this has received most of the attention of the literature on net neutrality. We show that under the net neutrality regime, CPs always follow a strategy to diversify content. Under the no net neutrality regime, the decision to diversify content will depend on the relation between network capacity and network traffic. When network capacity is small relative to network traffic, CPs maximally differentiate their content, but do not provide media diversity. When network capacity is large relative to network traffic, CPs minimally differentiate their content, but they do provide media diversity. The reason why CPs do not provide media plurality when network capacity is small relatively to network traffic, is that the no net neutrality regime reduces competition. In particular, under the no net neutrality regime, the media firm with priority sees its hinterland more protected from the rival than under the net neutrality regime, and the reverse for the firm with no priority. As a result, on the one hand, the media firm with priority has less need to provide media diversity in order to attract demand and therefore advertising revenues; on the other hand, the media firm with no priority finds it more difficult to use media diversity to attract demand and advertising revenues.

The rest of the paper is organized as follows. In the next section, we present the base model. We then analyze the equilibrium of the net neutrality case. Thereafter, we look at the equilibrium of the no net neutrality regime. We conclude by discussing our main findings.

2 The Model

The model considers one Internet Service Provider (ISP) and two Content Providers (CPs), CP 1 and CP 2. The paper focuses on the CPs; the ISP is exogenous to the model. We denote by P the price of network connection charged by the ISP to end users. Under net neutrality, the ISP does not charge CPs for sending information to end users. In turn, under no net neutrality, the ISP can give priority (higher speed) to one CP for sending information to end users. We denote by F the price of giving priority to one

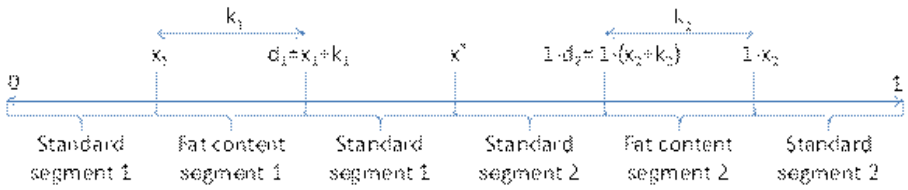

Figure 1: Fat Content

CP.

We adopt the Hotelling (1929) model, and as a result, each consumer demands content from just one CP. We have that λ is the content request rate for each consumer (Poisson process); μ is the network capacity; and $\frac{1}{\mu}$ is the service time to deliver contents. The mass of consumers is normalized to one and they have heterogeneous preferences in the Hotelling manner. In other words, as in Hotelling (1929), consumers are uniformly distributed on a line of length one, $[0, 1]$. The line represents consumers' preferences, which are ordered in the usual fashion as in the Hotelling type of models from 0 to 1 (see figure 1).[3] Similarly, the location of a media firm on the line indicates the media firm's location on the product variety spectrum. As in Hotelling (1929), we consider a duopoly market structure, where the two media firms are labeled as $i = 1, 2$. Where media firm 1 chooses location on the left side of the line, and media firm 2 chooses location on the right side of the line.

The intensity of consumers' preferences, i.e.: transport costs in the Hotelling model, are represented by t. Consumers patronize only one outlet, i.e.: consumers have unit demands. In this way, x^* represents the consumer that is indifferent between accessing CP 1 and CP 2. This means that the framework adopted in this paper is an ideal variety model, given that consumers incur a disutility cost when exposed to content that differs from their preferred variety.

With the exception of Garcia Pires (2013, 2014), a common assumption in the media diversity literature is that media firms can only supply the media market with one variety, i.e.: single-variety media firms. In this way, media firms sell the same variety of content to different consumers. The current paper differs from this approach by allowing media firms to adapt content to consumers' preferences. In particular, in our model, media firms can become

[3]Note that figure 1 does not necessary show the equilibrium of the game.

multi-content media firms by covering different types of content.

To model multi-content media firms, i.e.: media firms that adapt content to consumers' preferences, the model in this paper follows the approach by Alexandrov (2008) to "fat products." With fat products, a firm offers just one product that contains a set of characteristics amongst which consumers can choose at no extra cost. An example of a fat product is a software program where consumers can choose between different applications. In other words, fat products are defined as access products: when consumers pay to access a given product, they can choose amongst what is offered "inside" the product. In the context of the media market, "fat content" refers to the case where a media outlet caters to different preferences by providing different content for instance on its website, and consumers can choose to consume from this set of content offerings.[4]

The CPs' media diversity scope, which equals the length of the Hotelling line covered, is denoted by k_i (with $i = 1, 2$). Media firms can decide to adopt a single-content strategy or a multi-content strategy. A single-content strategy corresponds to a single point on the line, while a multi-content strategy corresponds to a line segment. In the multi-content strategy, the line segment has a start point and an end point (in the single-content strategy the start and the end points are the same). Consider that for media firm 1, the start point of the multi-content strategy is x_1 and the end point is d_1. Then $d_1 = x_1 + k_1$ (see figure 1). In turn, for media firm 2, the start point of the multi-content strategy is $1 - x_2$ and the end point is $1 - d_2$. Therefore $1 - d_2 = 1 - (x_2 + k_2)$. In the single-content strategy (i.e.: $k_1 = k_2 = 0$) it results that $d_1 = x_1$ and $1 - d_2 = 1 - x_2$.

In the multi-content strategy the fat content segments of media firms 1 and 2 are $[x_1, x_1 + k_1 = d_1] \leq x^*$ and $[1 - (x_2 + k_2) = 1 - d_2, 1 - x_2] \geq x^*$. The restrictions in relation to x^*, the consumer who is indifferent between

[4] Dewan et al. (2003) have a similar set-up to Alexandrov (2008). The difference is that Dewan et al. (2003) model product customization. Customization and fat products are related but not identical concepts. With customization, a firm adapts a standard product and transforms it into several customized products. A customized product can be acquired at an additional price to that of the standard product. An example of a customized product is a personal computer, where consumers can choose between different components at different prices. Then, under customization, and contrary to fat products, price discrimination is central. In the case of the internet media market, it seems more appropriate to think in terms of fat products than customization, since for instance an internet website is always just one product and price discrimination, in spite of some attempts, is not the standard business practice in the industry.

consuming content from outlets 1 and 2, are needed so that the fat segments of the two media firms do not overlap.

In this way, consumer x then pays $t(x-d_1)^2$ to consume from CP 1 and $t(1-x-d_2)^2$ to consume from CP 2. The parameter t represents the transport costs, which capture the degree of product differentiation, i.e.: the intensity of consumers' preferences.

We further denote $u(\lambda) = v$ as the consumers' gross utility. Where v is the reservation price. We assume that v is sufficiently large to ensue that the market is covered.

CPs derive revenues only from advertising. The demand for ads for the media firm i is:

$$r_i = \alpha - \beta a_i,\ i = 1, 2, \tag{1}$$

where r_i is the price of advertising per consumer (revenue stream, click through); a_i is the advertising volume. In turn, the parameters α and β represent the size of the advertising market.

Gross advertising income is then:

$$A_i = ((\alpha - \beta a_i)\, a_i)\, \lambda D_i,\ i = 1, 2, \tag{2}$$

where D_i is the demand for content from media firm i, with $D_1 = x^*$ and $D_2 = 1 - x^*$; x^* is the consumer who is indifferent between consuming content from CP 1 and CP 2. As we have seen above, λ is the content request rate for each consumer (Poisson process).

Profits for CP i, with $i = 1, 2$, can then be defined as:

$$\pi_i = A_i - C_i,\ i = 1, 2, \tag{3}$$

where C_i is the cost of adapting content to consumers' preferences. Media firms are profit-maximizing organizations and, as a result, the multi-content decision depends on the costs and benefits of this strategy. The costs, C_i, include the search and adaptation costs associated with finding consumers' preferences and adapting content accordingly. In turn, the benefits accrue through higher demand, since consumers do not incur transportation costs to consume content, i.e.: they consume their preferred variety of content.

Now assume that in order to adopt a multi-content strategy, media firms have to incur adaptation costs, C. In particular, when a media firm follows a multi-content strategy it must bear the additional fixed costs of processing

information related to the consumers' tastes and of acquiring production flexibility to adapt content to these preferences. The fixed costs follow a positive relationship with the size of the multi-content segment, i.e.: the higher the variety of content offered, the higher the fixed costs. For instance, the media firm needs to hire more staff as the content segment that it covers increases. The idea is that, since consumers are uniformly distributed on the line, the amount of data and flexibility needed to adapt content to consumers' preferences increases with the size of the multi-content scope. The adaptation costs C then equal:

$$C_i = \frac{\gamma k_i^2}{2},\ i = 1, 2, \tag{4}$$

where γ represents the search and flexibility costs pertaining to adapting to consumers' preferences. In this sense, the costs associated with a multi-content strategy increase with the width of the fat content segment offered.

In addition, as in Alexandrov (2008), it is assumed that a media firm's location determines where on the line it can provide a multi-content strategy. Accordingly, a media firm's multi-content segment is contiguous on the line (see figure 1). The reason for this might be that providing content further way from the core of the media firm's core business might increase costs exponentially. For example, when a media firm offers content very close to its core business, it can reap economies of scope that reduce costs and increase content quality. While if the media firm offers content far away from its core business, it needs to incur extra costs, like hiring extra staff specialized in the new segment. In addition, a content provider can alienate consumers if it also provides content that is far away from the preferences of the core group of loyal consumers. In both cases, we can think of for instance a CP of sports related content and a CP of culture related content. Staff specialized in sports issues would not be qualified to cover culture issues, and consumers that like culture could shy away from a culture CP that also distributes sports content.

The timing of the game is the following. In stage 1, the CPs choose location, x_i, and the level of media diversity k_i. In stage 2, the CPs decide on advertising rates a_i. In stage 3, users choose CP. We derive the equilibrium of the model under the net neutrality and the no net neutrality regimes. The main difference is that under the no net neutrality regimes, one of the CPs pays the ISP for priority at price F.

We follow the literature on net neutrality in assuming a M/M/1 queuing

system. Under this system, the waiting time, w, under net neutrality equals:

$$w = \frac{1}{\mu - \lambda}, \tag{5}$$

where λ again is the gross content request rate, with $\mu > \lambda$. In this sense, the M/M/1 queuing system has the property that w increases with λ, but decreases with μ.

In turn, the waiting time with no net neutrality is somewhat different due to the fact that one CP has priority (i.e. higher velocity). Assume, without loss of generality, that CP 1 has priority. In this case, the waiting time is the following:

$$w_1 = \frac{1}{\mu - \lambda_1}, \tag{6}$$

where λ_1 is now the total amount of traffic from consumers who request the content with the first priority.

The waiting time for consumers who request content from the CP without priority is:

$$w_2 = \frac{\mu}{\mu - \lambda} w_1 = \frac{\mu}{\mu - \lambda} \frac{1}{\mu - \lambda_1}. \tag{7}$$

The M/M/1 queuing system then implies that for $\mu > \lambda$, $w_2 > w > w_1$. In other words, the CP with no priority has longer waiting time. Furthermore, since $\frac{\partial(w_2 - w_1)}{\partial \mu} < 0$, then quality access differences between CPs become smaller as capacity increases.

In this way, the utility of consumers under net neutrality equals[5]:

$$\begin{aligned} U_1 &= v - \frac{1}{\mu - \lambda} - t\left(\hat{x} - d_1\right)^2 - P \\ U_2 &= v - \frac{1}{\mu - \lambda} - t\left(1 - \hat{x} - d_2\right)^2 - P. \end{aligned} \tag{8}$$

In turn, with no net neutrality, noting that $\lambda_1 = \tilde{x}\lambda$, we have:

$$\begin{aligned} U_1 &= v - \frac{1}{\mu - \tilde{x}\lambda} - t\left(\tilde{x} - d_1\right)^2 - P \\ U_2 &= v - \frac{\mu}{\mu - \lambda} \frac{1}{\mu - \tilde{x}\lambda} - t\left(1 - \tilde{x} - d_2\right)^2 - P. \end{aligned} \tag{9}$$

[5] For simplicity, we disregard nuisance costs of advertising. The introduction of nuisance costs of advertising would not change the results qualitatively.

Under net neutrality, the indifferent consumer, $\hat{x}$, is the one that equalizes:

$$v - \frac{1}{\mu - \lambda} - t\left(\hat{x} - d_1\right)^2 - P = v - \frac{1}{\mu - \lambda} - t\left(1 - \hat{x} - d_2\right)^2 - P. \tag{10}$$

Under no net neutrality, the indifferent consumer, $\tilde{x}$, is the one that equalizes:

$$v - \tfrac{1}{\mu - \tilde{x}\lambda} - t\left(\tilde{x} - d_1\right)^2 - P = v - \tfrac{\mu}{\mu - \lambda}\tfrac{1}{\mu - \tilde{x}\lambda} - t\left(1 - \tilde{x} - d_2\right)^2 - P. \tag{11}$$

The profits of CP under net neutrality are just:

$$\pi_{iN} = A_i - C_i. \tag{12}$$

Under no net neutrality, we have instead:

$$\begin{aligned} \pi_{iNN} &= A_i - C_i - F, \text{ if firm buys priority} \\ \pi_i &= A_i - C_i, \text{ otherwise.} \end{aligned} \tag{13}$$

3 Equilibrium of the Net Neutrality Game

In this section, we analyze the equilibrium of the net neutrality game. The model is solved by backward induction. We first have to find the indifferent consumer. Solving equation 10 for $\hat{x}$, we can show that the indifferent consumer is the one that equalizes:

$$D_1 = \tfrac{(1-d_2-d_1)(1-d_2+d_1)}{2(1-d_1-d_2)}, \text{ with } i, j = 1, 2 \text{ and } i \neq j \tag{14}$$

And $D_2 = 1 - D_1$. We turn now to advertising rates. The first order conditions (FOCs) for advertising rates (a_i) equal:

$$\begin{aligned} \tfrac{d\pi_1}{da_1} &= \tfrac{1}{2}\lambda\left(2\beta a_1 - \alpha\right)\left(d_2 - d_1 - 1\right) \\ \tfrac{d\pi_2}{da_2} &= -\tfrac{1}{2}\lambda\left(2\beta a_2 - \alpha\right)\left(d_2 - d_1 + 1\right) \end{aligned} \tag{15}$$

Solving equation 15 for a_1 and a_2, we obtain:

$$a_1 = a_2 = \frac{1}{2}\frac{\alpha}{\beta} \tag{16}$$

In stage 1, media firms choose location and the level of media plurality. We can show that the FOCs for d_i (with $i = 1, 2$) are:

$$\begin{aligned} \frac{d\pi_1}{dd_1} &= \frac{\lambda\alpha^2}{8\beta} > 0 \\ \frac{d\pi_2}{dd_2} &= \frac{\lambda\alpha^2}{8\beta} > 0 \end{aligned} \tag{17}$$

The CPs then locate in the center of the line:

$$d_1 = d_1 = \frac{1}{2}. \tag{18}$$

In terms of content competition, there is minimum differentiation. However, if the end point of the fat content segment is $d_1 = d_2 = \frac{1}{2}$, this means that both $k_1 \neq 0$ and $k_2 \neq 0$ are possible. To confirm this, it is necessary to analyze the FOCs for k_i (with $i = 1, 2$):

$$\begin{aligned} \frac{d\Pi_1}{dk_1} &= \frac{\partial\pi_1}{\partial d_1} - \gamma\left(k_1\right) \\ \frac{d\Pi_2}{dk_2} &= \frac{\partial\pi_2}{\partial d_2} - \gamma\left(k_2\right). \end{aligned} \tag{19}$$

Solving for k_L and k_R, we obtain:

$$k_1 = k_2 = \frac{1}{8}\frac{\alpha^2}{\beta}\frac{\lambda}{\gamma} > 0. \tag{20}$$

Media firms thus choose to adapt content, $k_L = k_R > 0$.

The difference of the game here relative to Gabszewicz et al. (2001, 2002) is that in our paper media firms compete on advertising and media diversity, while in Gabszewicz et al. (2001, 2002) media firms compete on advertising and prices. Advertising competition, as shown in Gabszewicz et al. (2001, 2002), conduces to minimum differentiation, since media firms want to attract more demand in order to also attract more advertising revenues. Price competition, on the contrary, conduces to maximum differentiation, since media firms want to relax price competition by locating far away from the rival. Our model must be seen under this prism. If we introduce price competition, we would also have an equilibrium with maximum differentiation (see Garcia Pires, 2014). For the purpose of the topic analyzed in this paper, i.e. net neutrality, price competition is in our view not central, since very few media firms compete on prices on the Internet; competition is more focused on advertising and content.

4 Equilibrium of the No Net Neutrality Game

In this section, we analyze the equilibrium of the no net neutrality game. We follow the same strategy as in the net neutrality game. First, we find the indifferent consumer. To do this, we solve equation 11 for $\tilde{x}$ to obtain:

$$D_1 = \frac{(2\mu+\lambda(1-d_2+d_1))-\sqrt{(2\mu-\lambda(1-d_2+d_1))^2-\frac{8\lambda^2}{t(\mu-\lambda)(1-d_1-d_2)}}}{4\lambda}. \tag{21}$$

Again $D_2 = 1 - D_1$. To find the advertising rates, we solve the FOCs for a_i. We obtain the same advertising rates as in the net neutrality game, see equation 16, i.e.: $a_1 = a_2 = \frac{1}{2}\frac{\alpha}{\beta}$.

In turn, the FOCs for d_1 and d_2 equal:

$$\begin{gathered}\frac{d\pi_1}{dd_1} = \\ \frac{\alpha^2\lambda\left(4\lambda+t(1-d_1-d_2)^2(\mu-\lambda)(2\mu-\lambda(1-d_2+d_1))\right)}{16(1-d_1-d_2)\beta\sqrt{t(\mu-\lambda)(1-d_1-d_2)\left(t(\mu-\lambda)(1-d_1-d_2)(2\mu-\lambda(1-d_2+d_1))^2-8\lambda^2\right)}} + \frac{\alpha^2\lambda}{16\beta} \\ \frac{d\pi_2}{dd_2} = \\ \frac{\alpha^2\lambda\left(t(1-d_1-d_2)^2(\mu-\lambda)(2\mu-\lambda(1-d_2+d_1))-4\lambda\right)}{16(1-d_1-d_2)\beta\sqrt{t(\mu-\lambda)(1-d_1-d_2)\left(t(\mu-\lambda)(1-d_1-d_2)(2\mu-\lambda(1-d_2+d_1))^2-8\lambda^2\right)}} + \frac{\alpha^2\lambda}{16\beta}\end{gathered} \tag{22}$$

And the FOCs for k_1 and k_2 are:

$$\begin{aligned}\frac{d\pi_1}{dk_1} &= \frac{d\pi_1}{dd_1} - \gamma\left(k_1\right) \\ \frac{d\pi_2}{dk_2} &= \frac{d\pi_2}{dd_2} - \gamma\left(k_2\right)\end{aligned} \tag{23}$$

We can now show that if μ (network capacity) is much larger than λ (gross content request rate) then $\frac{d\pi_1}{dd_1} > 0$ and $\frac{d\pi_2}{dd_2} > 0$, i.e. minimum differentiation. In this case, we obtain the same equilibrium as in the net neutrality game: $d_1 = d_2 = \frac{1}{2}$ and $k_1 = k_2 = \frac{1}{8}\frac{\alpha^2}{\beta}\frac{\lambda}{\gamma} > 0$.

On the contrary, if μ (network capacity) is not much larger compared to λ (gross content request rate) then $\frac{d\pi_1}{dd_1} < 0$ and $\frac{d\pi_2}{dd_2} < 0$, i.e.: maximum differentiation. Then:

$$d_1 = d_2 = 0. \tag{24}$$

Since the end point of the fat content segment is $d_1 = d_2 = 0$, this means that also $k_L = k_R = 0$.

We then have that the equilibrium of the no net neutrality game depends on the relation between network capacity and network traffic. If network traffic is too large relative to network capacity, in the no net neutrality regime there will be lower media diversity than in the net neutrality regime. The reason for this is that under the no net neutrality game, the CP with priority is more protected from the rival's competition than in the net neutrality case. This is especially true when network capacity is low in relation to network traffic, which penalizes the CP with no priority to a greater extent.

5 Discussion

In this paper, we have analyzed the effects of net neutrality on media diversity. We have considered a model where media firms compete for advertising revenues. This gives a two-sided nature to our model. On the one hand, advertisers prefer media firms that have larger audience, since in this way advertisers can communicate their message to more consumers. On the other hand, media firms want to increase demand in order to attract more advertisers.

In what concerns media diversity, we have allowed for media firms to follow two strategies: media uniformity and media diversity. With media uniformity, media firms only provide one type of content (a point in the line, single-content strategy). With media diversity, media firms supply the market with different types of content (a segment in the line, multi-content strategy). The media diversity strategy is costly, since media firms have to incur extra costs to provide media diversity. However, the advantage is that it can lead to more demand, since consumers do not incur disutility costs to consume content, as they can consume their preferred content variety.

We then have considered two regimes: the net neutrality regime and the no net neutrality regime. In the net neutrality regime, CPs do not pay the ISP to send content to consumers. In the no net neutrality regime, the ISP gives priority to one CP in exchange for a payment.

In this set up, we show that under the net neutrality regime, CPs always follow a media diversity strategy. Under the no net neutrality regime, the equilibrium depends on the relation between network capacity and network traffic. If network capacity is large relative to network traffic, the equilibrium is similar to the one under the net neutrality regime, in that media firms provide media plurality. If network capacity is small relatively to network

traffic, under the no net neutrality regime the media firms do not provide media plurality.

The reason for media firms do not provide media diversity when network capacity is small relative to network traffic is that under the no net neutrality regime, competition between media firms is weakened. In other words, in the no net neutrality regime, the media firm with priority is protected from competition from the rival. The reverse occurs for the firm with no priority, which is more exposed to competition from the rival with priority. As a result, while the media firm with priority has less need to provide media diversity in order to attract demand and advertising revenues, the media firm with no priority finds it more difficult to use media diversity to attract demand and therefore advertising revenues. As a result, both the media firm with priority and the media firm with no priority have fewer incentives to provide media diversity.

To sum up, our model indicates that one of the focuses that regulators must have in mind with regard to the net neutrality debate is network capacity. In particular, regulators must ensure that network capacity is large relatively to network traffic.

References

[1] Alexandrov, A. (2008), Fat Products, Journal of Economics and Management Strategy, 17, 67-95.

[2] Affeldt, P.; Filistrucchi, L. and Klein, T. (2013), Upward Pricing Pressure in Two-Sided Markets, forthcoming, Economic Journal.

[3] Argentesi, E. and Filistrucchi, L. (2007), Estimating Market Power in a Two-Sided Market: the Case of Daily Newspapers in Italy, Journal of Applied Econometrics, 22, 1247–1266.

[4] Bourreau, M.; Kourandi, F. and Valletti, T. (2012), Net Neutrality with Competing Internet Platforms, Mimeo.

[5] Cheng, H.; Bandyopadhyay, S. and Guo, H. (2008), The Debate on Net Neutrality: A Policy Perspective, Information Systems Research, Forthcoming

[6] Choi, J. and Kim, B.-C. (2010), Net Neutrality and Investment Incentives, RAND Journal of Economics, 41, 446–471.

[7] Dewan, R.; Jing, B. and Seidmann, A. (2003), Product Customization and Price Competition on the Internet, Management Science, 49, 1055–1070.

[8] Economides, N. and Hermalin, B. (2012), The Economics of Network Neutrality, RAND Journal of Economics, 43, 602–629.

[9] Ellman, M. and Germano, F. (2009), What do the Papers Sell? A Model of Advertising and Media Bias, Economic Journal, 119, 680–704.

[10] Gabszewicz, J.; Laussel, D. and Sonnac, N. (2001), Press Advertising and the Ascent of the Pensée Unique, European Economic Review, 45, 641-651.

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

[12] Garcia Pires, A. (2013), Media Plurality and the Intensity of Readers' Political Preferences, Journal of Media Economics, 26, 41-55.

[13] Garcia Pires, A. (2014), Media Diversity, Advertising, and Adaptation of News to Readers' Political Preferences, Information Economics and Policy, 28, 28–38.

[14] Gentzkow, M. (2007), Valuing New Goods in a Model with Complementarity: Online Newspapers, American Economic Review, 97, 713–744.

[15] George, L. (2007), What's Fit to Print: The Effect of Ownership Concentration on Product Variety in Daily Newspaper Markets, Information Economics and Policy, 19, 285–303.

[16] George, L. and Waldfogel, J. (2003), Who Affects Whom in Daily Newspaper Markets?, Journal of Political Economy, 111, 765–784.

[17] George, L. and Oberholzer-Gee, F. (2011), Diversity in Local Television News, Federal Communications Commission.

[18] George, L. and Hogendorn, C. (2012), Aggregators, Search and the Economics of New Media Institutions, Information Economics and Policy, 24, 40–51.

[19] Hermalin, B. and Katz, M. (2007), The Economics of Product-Line Restrictions with an Application to the Network Neutrality Debate, Information Economics and Policy, 19, 215-248.

[20] Hotelling, H. (1929), Stability in Competition, Economic Journal, 39, 41–57.

[21] Kaitatzi-Whitlock, S. (1996), Pluralism and Media Concentration in Europe, European Journal of Communication, 11, 453–483.

[22] Kraemer, J. and Wiewiorra, L. (2012), Network Neutrality and Congestion Sensitive Content Providers: Implications for Content Variety, Broadband Investment and Regulation, Information Systems Research, 23, 1303-1321.

[23] Lee, R. and Wu, T. (2009), Subsidizing Creativity Through Network Design: Zero Pricing and Net Neutrality, Journal of Economic Perspectives, 23, 61-76.

[24] Lerocha, M. and Wellbrock, C. (2011), Saving Newspapers with Public Grants – The Effects of Press Subsidies on the Provision of Journalistic Quality, Information Economics and Policy, 23, 281–286.

[25] Musacchio, J.; Schwartz, G. and Walrand, J. (2009), A Two-Sided Market Analysis of Provider Investment Incentives with an Application to the Net-Neutrality Issue, Review of Network Economics, 8, 1-18.

[26] Noam, E. (1987), A Public and Private-Choice Model of Broadcasting, Public Choice, 55, 163–187.

[27] Roger, G. (2009), Media Concentration With Free Entry, Journal of Media Economics, 22, 134–163.

[28] Schuett, F (2010), Network Neutrality: A Survey of the Economic Literature, TILEC Discussion Paper No. 2010-014.

[29] Schulz, N. and Weimann, J. (1989), Competition of Newspapers and the Location of Political Parties, Public Choice, 63, 125–147.

[30] Steiner, P. (1952), Program Patterns and Preferences, and the Workability of Competition in Radio Broadcasting, Quarterly Journal of Economics, 66, 194–223.

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In this paper we analyze the effects of net neutrality on media diversity. We show that in the net neutrality regime, media firms always provide media diversity, whereas in the no net neutrality regime, the equilibrium of the model depends on the relation between network capacity and network traffic. If the network capacity is large relative to network traffic, the equilibrium of the no net neutrality regime is similar to the one under the net neutrality regime. However, if network capacity is small relative to network traffic, under the no net neutrality regime media firms do not provide media diversity. The reason is that when network capacity is small relative to network traffic, the no net neutrality regime hinders competition. In other words, with no net neutrality, the media firm with priority sees its hinterland more protected from its rival than under net neutrality, and the contrary for the firm with no priority. As a result, while the media firm with priority has less need to provide media diversity to attract demand and, as such, advertising revenues, the media firm with no priority finds it more difficult to use media diversity to attract demand and advertising revenues.

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