Working Paper No 22/06

Two-sided markets with bargaining over content - the monopoly case

by
Tommy Staahl Gabrielsen

SNF project no 1303

"Konvergens mellom IT, medier og telekommunikasjon:
Konkurranse- og mediepolitiske utfordringer"

Funded by the Research Council of Norway

CASE - Centre for Advanced Studies in Economics

INSTITUTE FOR RESEARCH IN ECONOMICS AND BUSINESS ADMINISTRATION
BERGEN, APRIL 2006
ISSN 1503-2140

CASE – CENTRE FOR ADVANCED STUDIES IN ECONOMICS

CASE – Centre for Advanced Studies in Economics – is a joint centre for The Norwegian School of Economics and Business Administration (NHH), The Institute for Research in Economics and Business Administration (SNF) and The University of Bergen (UiB). Research at CASE includes all types of issues based on economic theory and method, and researchers at the Centre have particular expertise within the areas of international trade, industrial economics, labour market economics, factor mobility, economic integration, industrial policy, international macro economics, tax policy, international transport and maritime research.

International Trade and Tax Policy
Research within this area focuses mainly on issues related to international trade and tax policy, and has generally been dominated by projects aiming to provide increased insight into global structural issues and the effect of regional economic integration. The staff have particular expertise within the fields of international real economics (trade, factor mobility, economic integration and industrial policy), international macro economics and international tax policy, but are also actively involved in projects relating to public economics and industrial policy.

Industrial Economics
Industrial economics is another central research area at the Centre, within which SNF has long-standing traditions. A series of individual studies have been carried out through large framework programmes funded by the Research Council of Norway and major Norwegian companies. The focal point of these studies is strategic company behaviour in industries with few players, where competition effects are modelled and analysed. The studies have provided important structural and empirical insights into deregulation effects within industries such as airlines, telecommunications and energy and have provided significant input to Norwegian competition policies. The research group includes a number of researchers at both UiB and NHH and has an extensive international network.

Labour Market Economics
The labour market group focuses on mainly two research areas. One central topic is education and family economics. An important aspect is to analyse the production process for human capital; the importance of family, neighbourhood, preschools and schools for adult education and labour market experience. The other main topic is to analyse firm performance and firm restructuring. These analyses include firm performance, adjustment costs, costs of displacement including health costs, the effect of technological change and international trade, and analysis of organisational change.

Human Resources
CASE is a network-based organisation whose staff consists mainly of professors at Department of Economics at NHH and UiB as well as leading international economists who are affiliated to the centre through long-term relations. Members of the academic staff are among the leading in their fields both nationally and internationally and many have served on important public committees. During the last few years the centre has produced several PhDs and the current staff also includes PhD scholars.

Networks
CASE participates in a Scandinavian Network of Excellence on labour market economics and is involved in a major EU project on international trade. The Centre collaborates with central research and educational institutions all over Europe and has particularly close contact with London School of Economics, University of Glasgow, University of Munich, University of Uppsala, Aarhus Business School, Stockholm School of Economics, The Frisch Centre at University of Oslo and Statistics Norway. The staff members participate in international research networks, including CESifo, CEPR, CEP, IZA and IAME.

Two-sided markets with bargaining over content - the monopoly case.*

Tommy Staahl Gabrielsen

Department of Economics, University of Bergen,

N-5007 Bergen, Norway

April 4, 2006

Abstract

A TV-platform provides content to viewers and viewers to advertising producers. We study platform pricing and the supply of an essential type of content when there are two-sided network effects and the platform bargains over the contract terms with a content supplier. We show that when the content supplier holds all bargaining power in the negotiations with the platform both the level of content as well as the advertising level are set at socially ineffecient levels. Content are generally undersupplied, whereas there may be too much or too little advertising. Relocating the bargaining power from the content supplier to the platform owner will restore an efficient level of content but this may ease or aggravate the ineffciencies related to the amount of commercials. Bundling of content restores efficient levels of content supply, but the inefficiencies related to over- or undersupply of commercials still remain.

JEL classification numbers: D43, L13, L82

Keywords: advertising, media, content, two-sided markets

*This research has been sponsored NFR thourgh the research program KIM organized through the Foundation for Research in Economics and Business Administration.

1 Introduction

Platforms are firms that connect different user groups and that make their profit from charging each group for access to the platform.[1] The role of many platforms is to create a meeting place for firms that want to display their products through advertising on the one side and consumers on the other. Two prominent examples are newspapers that connect advertisers and readers, and TV-stations that connect advertisers and viewers. In these two examples advertisers are attracted to the platform if the platform has many readers or viewers, and ads are often priced by the number of readers and viewers the platform can generate. It has therefore been a central aim for platform owners to make the platform an attractive alternative for readers and viewers, henceforth denoted as consumers. Since most consumers dislike too much ads on TV or too much advertising in newspapers, there is a trade-off for the platform between advertising intensity and the number of consumers that connect too the platform. This trade-off has been investigated thoroughly in the received literature which I will review more in detail below.

A reasonable robust result from this literature is that there is too little advertising when platforms compete harshly and that too much advertising may occur when platform owners have significant market power. The intuition is that competing platforms compete for customers through advertising levels. Hence when platforms are close substitutes for advertisers and consumers, competition induce the platforms to lower advertising levels by increasing the price of ads. In these models advertising usually has a social value since advertising generates demand for the advertised products. However, advertising may be excessive or it may be the case that the platform provide to little advertising. Typically, advertising levels are below the social optimum when platforms are close substitutes, whereas a monopoly platform tends to provide too much advertising from a social point of view.

The analysis presented here adds a new dimension to this problem. From the examples listed above it is clear that consumers that connect to a platform are not merely influenced by the advertising level on the platform. For most consumers

[1] See Armstrong (2004) for an excellent analysis of pricing in two-sided markets.

the maybe most important variable when choosing which newspaper too read or which TV-channel to watch is what type and how much content is offered on the platform.[2] A reader may be attracted to a newspaper by the number of pages devoted to a certain type of material (foreign policy, culture, feature articles, sports etc.). Similarly, TV-viewers may be attracted to a TV-channel by the time (per week, say) devoted to a special type of programs (sitcoms, news, soap operas, quality films, talk shows, sports events etc.). The importance of this dimension is that if a channel's viewers love football matches, the TV-channel may increase its viewers' willingness to sustain more advertising by increasing the number of matches that are aired. This of course have a cost side as well, since increasing the level of a certain type of content will induce costs. These costs in turn, will depend on the platform's bargaining position vice a vice its content suppliers.

TV-channels and newspapers must provide sufficient content on the platform that generates benefits to consumers that more than outweighs the negative impact from advertising. The purpose of this paper is to explore the balance a platform has too make to get the optimal level of advertising and content on the platform and how this level relates to the social optimum. As a first step we consider a monopoly platform in a two-sided market where the platform chooses the level of content on the platform, the price of advertising on the platform, and then the consumers decide whether to join the platform or not. In principle the content on the platform can either be produced by the platform itself (in house production) or it can be purchased by a content supplier. Take a TV-channel as an example. A TV channel may decide to produce a certain number of programs itself or it may purchase programs from an outside supplier of programs. For some types of content the TV-channels has no alternative but to buy the content from outside suppliers. This is for instance the case when it comes to broadcasting rights for certain sports events. In these cases either other TV-stations may have bought exclusive rights to such events, and may resell them to other stations or it may be the case that

[2] Off course customers are also attracted by the the general quality of the content presented. The present paper do not consider the quality dimension of content. For an analysis of the quality aspect of TV-programming, see Kind...

national sports associations hold the legal rights. An example of the latter may be the national football association having the legal rights to football matches, and they may sell a TV station the right to broadcast a certain number of matches during a given time period.

When the platform purchases content from an outside supplier we shall assume that the eventually agreed upon price per unit of content of a certain type is determined by negotiations between the platform and the content supplier. Obviously, the supply of content over the platform will be determined by the degree to which consumers value content and the price the platform will have to pay for the type of content in question. The price in turn, will depend crucially on the bargaining power of the platform vice a vice the content supplier. Hence, the relative bargaining positions between the platform and the content suppliers will influence welfare in a non-trivial way.

There are several articles that analyze advertising in the TV-market. Kind et. al (2005), Barros et al. (2004) and Anderson and Coate (2005) analyze the advertising market when two TV-channels compete for viewers. As in our model advertising enhance producer sales but lowers audience. They find that the closer substitutes the channels are the less advertising there will be in equilibrium. The channels compete for viewers through advertising levels, and since viewers dislike advertising, channels will lower advertising when the channels are close substitutes. Comparing this with the social optimum, the industry provides too little advertising when channels are close substitutes. When the channels are further apart in the product space there are too much advertising. These articles do not consider the option each platform has to increase consumers' ability to sustain more advertising by putting more relevant content on each platform, a central element of our model.

There are also some contributions to this literature that analyze TV channels choice of programming profile (Anderson and Coate (2005), Peitz and Valletti (2004), Dukes and Gal-or (2003) and Gabszewicz et al. (2001, 2002, 2004)). However, their focus is distinctly different from ours. All these papers focus on the choice of programming profile of different platforms (sitcoms or news profile for instance). This amounts to the question of whether platforms will choose to be similar in their pro-

gramming profile or very horizontally differentiated. An important distinction is that TV channels can choose a specific programming profile without incurring any costs in doing so. Nilssen and Sørgard (2003) on the other hand, considers the platforms' choice of location in the vertical product space, i.e. the choice of programming quality. In this model platform owners can invest in increasing the programming quality of their programs, but they can not choose programming profile. Our focus is not on a costless choice programming profile per se or in the quality of such a profile, but rather on how increasing or decreasing the number of programs (for a given programming profile) can be used to make consumers tolerate higher levels of advertising. Moreover, we also consider how the platform's supply of programming relates to the bargaining position of the platform, an issue not present in any of the contributions above.

We show that when the content supplier holds all bargaining power in the negotiations with the platform both the level of content as well as the advertising level are set at socially inefficient levels. For a given programming profile content is generally undersupplied, whereas there may be too much or too little advertising. Relocating the bargaining power from the content supplier to the platform owner will restore an efficient level of content supply but this may ease or aggravate the inefficiencies related to the amount of commercials. If a content supplier having all bargaining power would result in too much advertising, a shift in the bargaining power to the platform would aggravate the problem of oversupply of ads. On the other hand, if a content supplier with all bargaining power would involve too few ads on the platform, a similar shift in the bargaining position would improve efficiency and move the level of ads closer to the social optimum. Finally, bundling of content restores the efficient level of content supply, but the inefficiencies related to over- or undersupply of commercials still remain.

2 The model

The market consist of a representative producer, a content supplier and the consumers that can interact over a monopoly platform. For expositional reasons we

will stick to the commercial TV example in what follows. Producers may affect consumers in two fundamental ways. First an increased exposure to ads will increase the consumers willingness to pay for the producers' products. Second, more ads placed on the platform, all else equal, will reduce the number of consumers on the platform.

The viewers 'pay' for content on the platform by having to watch commercials which they dislike. The net utility of a representative viewer is represented by a quadratic utility function of the form

$$u(n_c, n_a) = k + \psi\left(n_c - n_c^2\right) - \gamma n_a.$$

The parameter k represents the general utility derived from watching TV, normalized to zero from now on. The TV channel has a given programming profile that can be reinforced or weakened by varying the number of programs corresponding to the profile the channel has chosen. The number of ads per time period is denoted by n_a, and n_c denotes the number of programs or events (football matches, sitcoms etc.) broadcasted over the platform per unit of time. We assume that there is a total of one unit of content available, hence $n_c \in [0, 1]$. We see that a viewers' marginal utility from content is $u'(n_c) = \psi(1 - 2n_c)$ which is positive when n_c is small ($n_c < \frac{1}{2}$) and negative when $n_c > \frac{1}{2}$. Hence, this specific formulation involves consumer saturation, i.e. too much football matches on TV reduces the utility from watching TV for a representative consumer. We also see that consumers dislike advertising, where $\gamma > 0$ measures the degree to which the consumer dislikes advertising per unit of advertising.

The number of consumers that joins the platform n_v is a strictly increasing function of the utility received by a consumer, hence $n_v(u)$, where $n_v'(u) > 0$. To implement this we simply assume that $n_v = u(n_c, n_a)$. Clearly, maximal viewer utility (and therefore maximum audience) is obtained when no commercials are broadcasted and when

$$\begin{aligned} \frac{\partial\left(\psi\left(n_c - n_c^2\right)\right)}{\partial n_c} &= 0 \\ &\Updownarrow \\ n_c &= \frac{1}{2} \end{aligned}$$

in which case $\frac{1}{4}\psi$ viewers will join the platform, i.e. $n_v = \frac{1}{4}\psi$.

A representative producer chooses $n_a \in [0,1]$ given the price p_a of ads. The value per viewer for the producer of an ad is $\theta = \varphi n_a$. More ads increase the willingness to pay for each viewer that are exposed to the ad, or alternatively increases the probability of a purchase. The parameter φ measure each consumer's marginal increase in willingness to pay when exposed to more ads, or a producers' marginal value per viewer of an extra ad. The producer chooses n_a to maximize producer profit π_p, i.e.

$$\begin{aligned} &\max_{n_a} \pi_p = \max_{n_a} \varphi n_a n_v - p_a n_a \\ &\Updownarrow \\ &\max_{n_a} \varphi n_a \left(\psi\left(n_c - n_c^2\right) - \gamma n_a\right) - p_a n_a \end{aligned}$$

The first-order condition to this problem yields

$$\begin{aligned} \varphi\left(\psi\left(n_c - n_c^2\right) - \gamma n_a\right) - \varphi n_a \gamma - p_a &= 0 \\ &\Updownarrow \\ n_a(n_c, p_a) &= \frac{1}{2\varphi\gamma}\left(\psi\varphi\left(n_c - n_c^2\right) - p_a\right) \end{aligned}$$

representing the producers's demand for commercials. Comparative statics yield

$$\begin{aligned} \frac{\partial n_a(n_c,p_a)}{\partial \gamma} &= -\frac{1}{2\gamma^2\varphi}\left(\psi\varphi\left(n_c - n_c^2\right) - p_a\right) < 0 \\ \frac{\partial n_a(n_c,p_a)}{\partial p_a} &= -\frac{1}{2\varphi\gamma} < 0 \\ \frac{\partial n_a(n_c,p_a)}{\partial \varphi} &= \frac{1}{2\gamma\varphi^2} p_a > 0 \end{aligned}$$

Demand for commercials is decreasing in price and in viewers disutility of ads and increasing in the effectiveness of advertising, φ. When viewers respond heavily to increased advertising on TV by leaving the platform, the producers respond by demanding less ads. Intuitively, if the effect on consumers' willingness to pay from increased advertising increases, producers would want to place more ads on the platform.

Now look at the platform's profit. The platform maximizes the difference between revenues from advertising and the cost of providing content on the platform.

The strategic variables for the platform is the price per ad, p_a, and the amount of content n_c. Channel profit equals

$$\pi_p = p_a n_a - p_c n_c$$

and when inserting for the producers' demand for commercials is written

$$\pi_p = p_a \left(\frac{1}{2\varphi\gamma} \left(\psi\varphi \left(n_c - n_c^2 \right) - p_a \right) \right) - p_c n_c$$

Maximizing this with respect to p_a and n_c yields the first-order conditions

$$\begin{aligned} \frac{\partial \pi_p}{\partial p_a} &= \frac{1}{2\gamma\varphi} \left(\psi\varphi n_c - p_a - \psi\varphi n_c^2 \right) - \frac{1}{2\gamma\varphi} p_a = 0 \\ \frac{\partial \pi_p}{\partial n_c} &= \frac{1}{2\gamma} \left(\psi p_a - 2\psi n_c p_a \right) - p_c = 0 \end{aligned}$$

By reformulating we have

$$\begin{aligned} p_a &= \frac{1}{2}\psi\varphi \left(n_c - n_c^2 \right) \\ n_c &= -\frac{1}{4}\frac{\gamma}{p_a} \left(p_c - \frac{2}{\gamma} p_a \right) \Longleftrightarrow p_c = \frac{\psi}{2\gamma} p_a \left(1 - 2n_c \right) \end{aligned}$$

Which when inserting for p_a in the expression for p_c the platform's inverse demand function for content

$$\begin{aligned} p_c &= K n_c (1 - n_c) \left(1 - 2n_c \right) \text{ where } K = \frac{\psi^2 \varphi}{4\gamma} \\ p_c' &= K \left(1 - 6n_c + 6n_c^2 \right) \\ p_c'' &= K(-6 + 12n_c) < 0 \text{ when } n_c < \frac{1}{2} \end{aligned}$$

The inverse demand function for the channel has a peculiar form. It is non-negative for $n_c \leq \frac{1}{2}$, meaning that the marginal willingness to pay for content in excess of $\frac{1}{2}$ is negative. Moreover, the marginal willingness to pay is first increasing and then decreasing as n_c approaches $\frac{1}{2}$. The parameter ψ measures the value that viewers attach to content and scales up and down the audience. As ψ increases, viewers utility of a given amount of content increases. The fraction $\omega = \frac{\varphi}{\gamma}$ is the producers' marginal value per viewer divided by the marginal viewer disutility of viewing an extra ad. The parameter ω captures the pros and cons for the producers of advertising; more ads increases viewers' willingness to pay but reduces the number of

viewers. The higher ω is, the higher the positive effect is relative to the negative effect.

To illustrate the demand for content Figure 1 below plots the inverse demand curve for $K = 1$.

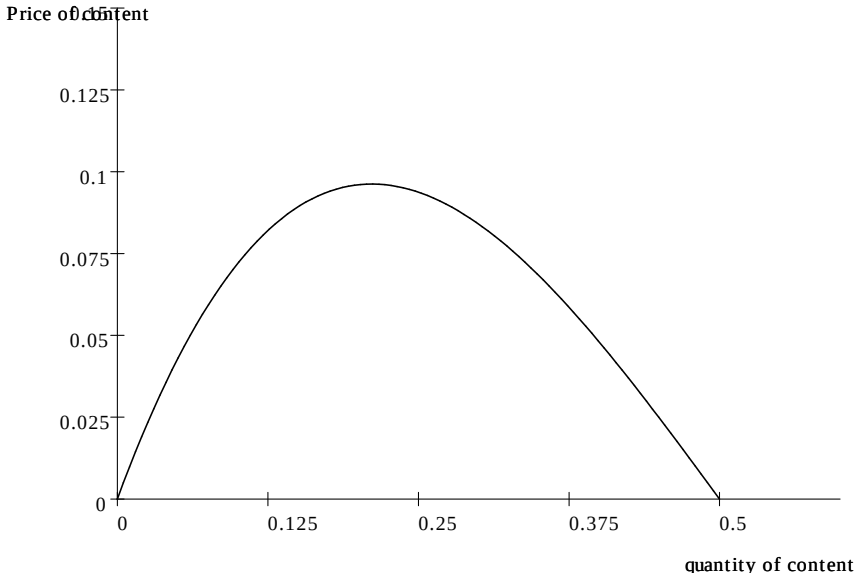

Figure 1: The platform's demand for content when $K = 1$.

We see that the channel's willingness to pay for content in this example is positive and concave when $n_c < \frac{1}{2}$, increasing in n_c when $n_c < \frac{1}{2} - \frac{1}{6}\sqrt{3}$ and decreasing in n_c when $n_c \in \left[\frac{1}{2} - \frac{1}{6}\sqrt{3}, \frac{1}{2}\right]$.

To get nice interior solution where all the variables $n_c, n_v, n_a \in [0, 1]$ we invoke the following assumptions:

A1. $\psi = 4 \Longleftrightarrow n_v \leq 1$

A2. $\omega \geq 2 \Longleftrightarrow n_a \geq 0$

Assumption A1 ensures that the maximum audience is exactly 1. The second assumption ensures that the social optimum involves a non-negative amount of commercials on the platform. To have this, $\omega \geq 2$, meaning that the fraction between the producers' marginal value per viewer and the viewers' marginal disutility of viewing an extra ad is sufficiently high. The intuition is that if the viewers' disutility from watching commercials is too high, it would be optimal to shut down the platform.

Before characterizing the profit maximizing solution we solve for the social optimum.

2.1 The social optimum

Social surplus in this model consists of the sum of producer profit, viewers utility, the platform's profit and the profit of the content supplier π_c. Hence, welfare W is given by

$$\begin{aligned} W &= \pi_p + u + \pi_p + \pi_c \\ &= (\varphi n_a n_v - p_a n_a) + n_v u_v + (p_a n_a - p_c n_c) + p_c n_c \\ &= (\varphi n_a + u_v)\, n_v \\ W &= \left(\varphi n_a + \psi\left(n_c - n_c^2\right) - \gamma n_a\right)\left(\psi\left(n_c - n_c^2\right) - \gamma n_a\right) \end{aligned}$$

Welfare consists of the benefit for producers per viewer plus the benefit for a viewer times the number of viewers on the platform. Transfers between the platform on the one side and the advertisers and the content supplier on the other cancel out and do not affect welfare. Then we can show the following:

Proposition 1 *The social optimum is characterized by*

$$\begin{aligned} n_a^* &= \frac{\psi}{8}\frac{\varphi - 2\gamma}{\gamma(\varphi - \gamma)} = \frac{1}{2}\frac{\omega - 2}{\omega - 1}\,|_{\psi=4} \\ n_c^* &= \frac{1}{2} \end{aligned}$$

Moreover, the maximum level of advertising is $\overline{n_a^*} = \frac{1}{2}$, *i.e.*

$$\lim_{\omega\to\infty} \frac{1}{2}\frac{\omega - 2}{\omega - 1} = \frac{1}{2}$$

Proof: Maximizing W with respect to n_a and n_c yields the first-order conditions

$$\begin{aligned} \frac{\partial W}{\partial n_a} &= n_c\psi\left(\varphi - 2\gamma + 2\gamma n_c\right) + 2\gamma^2 n_a - \psi\varphi n_c^2 - 2\gamma\varphi n_a = 0 \\ \frac{\partial W}{\partial n_c} &= \psi\varphi n_a - 2\gamma\psi n_a + 4\gamma\psi n_a n_c - 2\psi\varphi n_a n_c + 2\psi^2 n_c - 6\psi^2 n_c^2 + 4\psi^2 n_c^3 = 0 \end{aligned}$$

and by solving these simultaneously we get

$$\begin{aligned} n_a^* &= \frac{\psi}{8}\frac{(\omega - 2)}{(\omega - 1)} = \frac{1}{2}\frac{\omega - 2}{\omega - 1}\,|_{\psi=4} \\ n_c^* &= \frac{1}{2} \end{aligned}$$

Clearly, n_a^* is strictly increasing in ω and approaches $\frac{1}{2}$ as ω increases. QED.

Note that we must have that $n_a^* = \frac{\psi}{8}\frac{(\omega-2)}{(\omega-1)} \geq 0$, which is the case when either $\omega \geq 2$ or $\omega \leq 0$. The latter gives no economic meaning, hence assumption A2. The social optimum trades off the benefits of the commercial agents with viewer utility. The amount of content is set at a level that maximizes consumers' utility from watching this type of content. This creates a maximum buffer to stand against the negative impact from advertising. Note that without any advertising, no transactions would take place over the platform, hence the social optimum involves a positive amount of advertising. The exact number of ads in the social optimum depends on the parameters ψ and ω in the following way

$$\begin{aligned} \frac{\partial n_a^*}{\partial \psi} &= \frac{\omega - 2}{8(\omega - 1)} \geq 0 \\ \frac{\partial n_a^*}{\partial \omega} &= \frac{1}{8}\frac{\psi}{(\omega - 1)^2} \geq 0 \end{aligned}$$

The parameter ψ measures the weight consumers put on content supply and determines how large the maximum audience can be. Hence an increase in ψ increases the optimal level of advertising on the platform. The effect of advertising on consumers is twofold. It increases their willingness to pay once they are exposed to an ad, but it reduces their willingness to be exposed to ads. The parameter ω represents the relative impact of these two opposing effects. An increase in ω means that the benefits to the producers from advertising increases more than the disutility for viewers from viewing more ads. If so the social optimal level of advertising shall increase.

2.2 The privately optimal solution

In the present model the situation between the content supplier and the platform is one of a bilateral monopoly. In these settings the division of bargaining power between the two parties may significantly influence the outcome. When the content supplier has all the bargaining power he will behave as a monopolist and hold back the quantity of content by charging a high price. If the platform holds the bargaining power, content should be supplied at marginal cost. However with consumer saturation, the platform may still choose to hold back quantity to enhance viewer

participation.

In this section we investigate how the division of bargaining power and the price structure of the contract between the content supplier and the platform will influence the outcome. First we look at the situation where the contract is a simple linear price p_c, and first we suppose that the content supplier holds all bargaining power. If so, the maximization problem of the content supplier is

$$\begin{aligned} &\max_{n_c} \pi_c = \max_{n_c} p_c n_c \\ \Updownarrow& \\ &\max_{n_c} (K n_c (1-n_c)\,(1-2n_c)) n_c \end{aligned}$$

Proposition 2 *Suppose the content supplier has all bargaining power and uses a linear price. If so the profit maximizing outcome is:*

$$\begin{aligned} n_c &< n_c^* \\ n_a &\geq n_a^* \ \textit{if}\ \omega \leq \omega_1 \\ n_a &< n_a^* \ \textit{if}\ \omega > \omega_1 \end{aligned}$$

Proof. The first-order condition is

$$n_c \left(8n_c^2 - 9n_c + 2\right) K = 0$$

which yields three solutions of which only one is a valid optimum. Solving the content supplier's first-order condition yields three candidate solutions:

$$n_c \in \left\{0, -\frac{1}{16}\sqrt{17} + \frac{9}{16}, \frac{1}{16}\sqrt{17} + \frac{9}{16}\right\}.$$

Clearly, $n_c = 0$ gives zero profits. The second-order condition is written

$$12n_c^2 - 9n_c + 1 \leq 0$$

Inserting for the two remaining candidates reveals that $n_c = \frac{1}{16}\sqrt{17} + \frac{9}{16}$ constitutes a minimum and $n_c = -\frac{1}{16}\sqrt{17} + \frac{9}{16}$ is a maximum. It is easy verified that profit

is positive in this solution and we have that $n_c = -\frac{1}{16}\sqrt{17} + \frac{9}{16} < \frac{1}{2} = n_c^*$ which proves the first part of the proposition. The price per unit of content then is $p_c = (Kn_c(1-n_c)(1-2n_c)) = \left(\frac{11}{512}\sqrt{17} - \frac{3}{512}\right)K$, and we can in turn derive the price of an ad, advertising demand and the equilibrium number of viewers as below

$$\begin{aligned}
n_c &= \frac{1}{16}(9-\sqrt{17}) = 0.304\,81 \\
p_c &= \left(\frac{11}{512}\sqrt{17} - \frac{3}{512}\right)K \\
p_a &= \frac{1}{2}\psi\varphi\left(n_c - n_c^2\right) = \psi\varphi\left(\frac{1}{256}\sqrt{17} + \frac{23}{256}\right) \\
n_a &= \frac{1}{2\varphi\gamma}\left(\psi\varphi\left(n_c - n_c^2\right) - p_a\right) = \frac{1}{\gamma}\psi\left(\frac{1}{512}\sqrt{17} + \frac{23}{512}\right) \\
n_v &= \psi\left(n_c - n_c^2\right) - \gamma n_a = \left(\frac{3}{512}\sqrt{17} + \frac{69}{512}\right)\psi
\end{aligned}$$

We have that the advertising level in the privately optimal solution is too high from a welfare point of view whenever

$$\begin{aligned}
\frac{1}{\gamma}\psi\left(\frac{1}{512}\sqrt{17} + \frac{23}{512}\right) &\geq \psi\frac{1}{8}\frac{\varphi - 2\gamma}{(\varphi - \gamma)} \\
\frac{1}{\gamma}\left(\frac{1}{512}\sqrt{17} + \frac{23}{512}\right) &\geq \frac{1}{8}\frac{\varphi - 2\gamma}{(\varphi - \gamma)} \\
&\Updownarrow \\
\frac{\varphi}{\gamma} &= \omega \leq \frac{1}{26}\left(\sqrt{17} + 67\right) \equiv \omega_1 = 2.\,735\,5
\end{aligned}$$

Hence when $\omega \leq \omega_1$, $n_a \geq n_a^*$ and when $\omega > \omega_1$, $n_a < n_a^*$. QED.

It is interesting to note that when the content supplier has all bargaining power a profit maximizing platform will have too little content broadcasted. The amount of commercials can either be too low or too high. For low values of ω too much advertising occur. When deciding on how much adverting the platform should have, the platform takes into account how viewer utility and platform profit is affected. However, the platform does not take into account how the level of advertising affects the producers' profit. Therefore, when the effectiveness of advertising is low or the disutility for viewers is high the platform tend to broadcast too many ads, and when the effectiveness is high or viewer disutility is low too little advertising occur.

The profit of the content supplier is plotted in the figure below ($K = 1$)

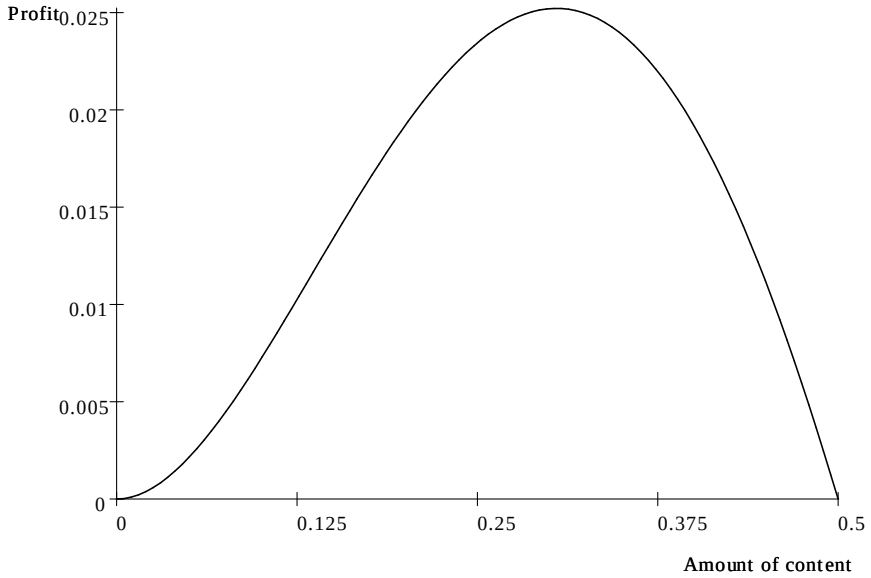

Figure 2: Profit of the content supplier.

Now consider the case where the platform holds all bargaining power. In this case we can show

Proposition 3 *Suppose the platform has all bargaining power and uses a linear price. If so the profit maximizing outcome is:*

$$\begin{aligned} n_c &= n_c^* \\ n_a &\geq n_a^* \text{ if } \omega \leq \omega_2 \text{ where } \omega_2 > \omega_1 \\ n_a &< n_a^* \text{ if } \omega > \omega_2 \end{aligned}$$

Proof. If the platform has all the bargaining power and could choose the price of the content we clearly would have that $p_c = 0$ and the platform chooses the social optimal level $n_c = n_c^* = \frac{1}{2}$. By inserting this in the expressions for p_a, n_a and n_v we get.

$$\begin{aligned} p_a &= \frac{1}{2}\psi\varphi\left(n_c - n_c^2\right) = \frac{1}{8}\psi\varphi \\ n_a &= \frac{1}{2\varphi\gamma}\left(\psi\varphi\left(n_c - n_c^2\right) - p_a\right) = \frac{1}{16\gamma}\psi \\ n_v &= \psi\left(n_c - n_c^2\right) - \gamma n_a = \frac{3}{16}\psi \end{aligned}$$

The advertising level is too high compared to the social optimum when

$$\begin{aligned}
\frac{\psi}{8}\frac{\varphi-2\gamma}{\gamma(\varphi-\gamma)} &\leq \frac{1}{16\gamma}\psi \\
\frac{1}{8}\frac{\varphi-2\gamma}{(\varphi-\gamma)} &\leq \frac{1}{16} \\
\frac{\varphi}{\gamma} &= \omega \leq 3 \equiv \omega_2
\end{aligned}$$

QED.

When the platform has all the bargaining power he will internalize the content externality and will provide the social optimum level of content. However, the advertising externality remains and the platform may end up by providing too much or too little advertising. As before, the platform will provide too little ads when the effectiveness from viewing and ad is high or the viewer disutility is low, and vice versa when the opposite is true. However, the cutoff between these two regimes are different from the case where the content supplier had all bargaining power. This means that relocating bargaining power from the content supplier to the platform will improve efficiency when it comes to the amount of content over the platform, but the inherent inefficiency when it comes to advertising may be larger or smaller depending on the parameters of our model.

Consider for example a situation where the content supplier has all bargaining power and has too much ads, $n_a \geq n_a^*$ which happens when $\omega \leq \omega_1$. The suppose a regulator takes an action that transfers all bargaining power to the platform. If so, we now that since $\omega_1 < \omega_2$ and that n_a^* is strictly increasing in ω, the platform is now further away from social optimum level of advertising than it was before. Alternatively, suppose that when the content supplier has all bargaining power and has too little ads, $n_a < n_a^*$ which happens when $\omega > \omega_1$. In this case a shift in bargaining power from content suppliers to the platform will bring the level of ads closer to the social optimum. In the latter case, a transfer of bargaining power will improve welfare along both dimensions, whereas in the former case the effect of the proposed shift in the bargaining position will imply a trade-off between the positive effect on content supply and the negative effect from advertising is distorted further away from the social optimal level. These findings are summarized in the following

corollary.

Corollary 1 *Consider the case of linear pricing and a shift in the bargaining power from the content supplier to the platform. Such a shift will internalize the content externality, the monopoly platform will now provide the social optimal level of content. The effect on advertising from such a shift is the following: If* $\omega \leq \omega_1$ *too much advertising occurs and the shift aggravates the inefficiency related to oversupply of ads. If* $\omega > \omega_1$ *too little advertising occurs and the shift reduces the inefficiency related to the undersupply of commercials on the platform.*

With other pricing mechanisms the possibility of yet other outcomes arises. Consider now the case where the parties agrees on a bundle of size n_c at a price f for the bundle. Suppose first that the content supplier can set the terms unilaterally. The problem of the content supplier then is to find the appropriate bundle size so that the platform would wish to broadcast the bundle, and then charge a price f such that the platform just break even, i.e. equal to the revenues generated by the sale of commercials.

$$\max_{n_c, f} f = p_a n_a$$

Inserting for p_a in the expression for n_a we can rewrite this as

$$\max_{n_c} \left(\frac{1}{2} n_c \varphi \psi \left(1 - n_c\right) \right) \left(\left(\frac{1}{4} \right) \gamma^{-1} \left(1 - n_c\right) \psi n_c \right)$$

Proposition 4 *With bundling, content supply is always set at an efficient level. The level of advertising is the same as when the platform has all bargaining power and a linear content price are set.*

Proof: The first-order condition to the problem above is

$$\begin{aligned} \frac{1}{4} \gamma^{-1} \left(n_c - 1\right) \left(2n_c - 1\right) \psi^2 \varphi n_c &= 0 \\ &\Updownarrow \\ n_c &= \frac{1}{2} \end{aligned}$$

If so, the resulting level of ads is

$$n_a = \left(\left(\frac{1}{4} \right) \gamma^{-1} (1 - n_c) \psi n_c \right) = \frac{1}{16\gamma} \psi$$

, i.e. the same result as in proposition 3. If the platform holds all bargaining power it simply requires $n_c = \frac{1}{2}$ at zero price, hence the same outcome as before except that the content supplier earns no profit. QED.

When content can be sold in bundles, the content supplier will sell the bundle that maximizes the platform's profit and then charge a bundle price that makes the platform break even. This makes the content supply efficient. However, the platform may still choose a too low or too high level of advertising.

3 Discussion and extensions

We have conducted the analysis above in a framework with a monopoly platform aiming at maximizing profits by balancing the interests of advertisers, consumers and a content supplier. Consumers value content and dislike advertising, and advertisers value consumers visiting the platform. The basic question addressed is whether the platform will supply an optimal level of content and advertising on the platform.

The results show that the platform sometimes will internalize the externality from content supply and provide a level of content that maximizes consumer utility and the platform audience. This happens either when the platform has a strong bargaining position vis-à-vis the content supplier or when content comes in bundles. In these cases content supply is chosen at the social optimal level which is the level that maximizes visitors to the platform, all else equal. In other cases the platform provides too little content from the society's point of view. When it comes to advertising the platform either allows too much or too little commercials on the platform. Whether the platform under- or oversupplies advertising depends on how advertising influences consumers. In this model more advertising on the one hand increases viewers probability of a purchase, but on the other hand decreases the audience on the platform. If the relative strength in these two effects are high, i.e. that either the effect from advertising on the purchase probability is high or

the disutility effect on the audience is low, too little advertising occurs. When the opposite is true, the platform tends to put too much commercials on the platform. The reason is the basic externality that the platform only considers the effect on its own profit when deciding on programming choices and advertising levels and hence tends to ignore the effect this has on producers' profits.

In our modelling of the consumers we have pursued a representative consumer approach. An objection to this might be that consumers have heterogeneous preferences and that introducing this would change the results. If consumers have different preferences over the type of content we consider and other types of programming the platform needs to balance the effects on one group versus the other. The basic intuition is that the median viewer would be the one that gets to decide on the level of content and advertising on the platform. Certainly there will now be viewers on the platform having the opinion that too much content (soccer matches, say) are broadcasted, but their dislike will be outweighed by the joy of the lovers of this type of content. Hence, the conjecture is that introducing heterogeneous consumers would not change our qualitative results.

The assumption of a monopoly platform is crucial, however. A next step could be to introduce platform competition. This opens for an array of new and interesting questions. First, competition opens the possibility that platforms may not only specialize in different types of programming (as in Anderson and Coate (2005)), but also in the degree of specialization. For instance, one of the platform may specialize in sports and the other in culture, and the number of sports and culture programs on each channel can be adjusted to make consumers endure more advertising. Alternatively, the platform may decide to compete along both dimensions. One aspect of this issue is basically the question about competing platforms' location choice in the product spectrum. Will competing commercial platforms in two-sided markets generate maximum or minimum differentiation, and again how does these choice feed back into the equilibrium structure of the industry? From the literature on two-sided markets we know that some minimum level of product differentiation is needed to stop the market from tipping in favour of only one of the platforms. In this literature however, location choices are given exogenously. Hence, endogenising

platforms' location choices may yields new insights.

With competing platforms the question of exclusive rights to content appears as one of the most important issues to be analyzed. For instance, in the TV-industry the rights to broadcast special sports events, TV-series etc. are almost always sold as exclusive rights to one specific TV-channel. This practice raises many interesting questions. What are the private motives for adopting exclusivity in these markets? Is this a way for platforms to differentiate themselves from other platforms, or is it just the profit maximizing way to handle sales for the content providers? Are the private incentives for exclusive programming of the type mentioned above in line with the social incentives? These and other issues are left for future research.

References

Anderson, S. P. and S. Coate (2005): "Market Provision of Public Goods: the Case of Broadcasting," Review of Economic Studies, forthcoming.

Armstrong, M. (2005): "Competition in Two-sided Markets," unpublished manuscript.

Barros, P., Kind, H.J., Nilssen, T. and L. Sørgard (2004): "Media Competition on the Internet." Topics in Economic Analysis & Policy 4 (1); 2004, 1-32.

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

Gabszewicz, J., Laussel, D. and N. Sonnac (2001): "Press Advertising and the Ascent of the 'penseé unique'?" European Economic Review 45, 645-651.

Gabszewicz, J., Laussel, D. and N. Sonnac (2002): "Press Advertising and the Political Differentiation of Newspapers?" Journal of Public Economic Theory 4, 249-259.

Gabszewicz, J., Laussel, D. and N. Sonnac (2001): "Programming and Advertising Competition in the Broadcasting Industry," forthcoming in Journal of Economics and Management Strategy.

Kind, H.J., T. Nilssen and L. Sørgard (2005): "Advertising on TV: Under- or Over-provision?" mimeo, Norwegian School of Economics and Business Administration.

Nilssen, T. and L. Sørgard (2003): "TV-advertising, Programming Investments and Product-Market Oligopoly," mimeo, Norwegian School of Economics and Business Administration.

Peitz, M and T. Valletti (2004): "Content and advertising in the media: pay-tv versus free-to-air," unpublished manuscript.