The Regulation of Audiovisual Content: Quotas and Conflicting Objectives[±]

by

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Abstract

Governments use a range of instruments to influence television content. The paper finds that under conditions that are hardly exceptional, content measures ostensibly designed to increase the production of certain programs may, paradoxically, reduce the size of the audience watching them. As well, quota's seemingly intended to boost the audience of certain programs, may in fact reduce their production and lower the number of viewers of these programs.

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1. Introduction

Regulators shape the content of radio and television programming in a number of ways. They sometimes set an upper limit to the number of hours broadcasters may devote to programs such as sports and variety shows. They may also require that a minimum number of hours be allocated to news and current affairs. They could set quotas in regard to regional diversity, original content and local productions and limit the number and duration of commercial interruptions.[1]

As well, regulators may constrain the freedom of cable distributors to choose the composition of the bundles they offer subscribers. They may for example compel distributors to incorporate all local channels, or a minimum number of local channels in the basic package taken by all subscribers. In Canada, all cable operators must include the English and French public networks, local and regional stations, and the provincial educational services in their basic package.[2] In the United States, local franchise authorities may mandate that public, educational, and governmental channels be included in the basic package.[3]

Content rules have been rationalized on a variety of grounds. The paternalistic defence of quotas builds on the contention that the audience's tastes are not up to scratch and that intervention by a well-meaning regulator is a fitting response to that shortcoming.[4] A related argument is that broadcasters devote excessive time to content with mass-appeal, and that the latter calls for corrective action to encourage programming that caters to more refined tastes. A third argument rests on the claim that externalities are significant in television. Certain programs –public affairs for instance- are said to make a positive contribution to society, whereas others –those

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[1] Details about content regulation in 13 countries appear in OECD (2007)
[2] The Canadian Radio-television and Telecommunications Commission gives the following reason: "Culturally, Canadian programs and music give voice to Canadians, to their talent and their shared experiences. Economically, it means jobs for thousands of Canadians – from creation to production and distribution on the airwaves" (see www.crtc.gc.ca/eng/INFO_SHT/b306.htm). Allens Arthur Robinson (2004) and www.dfat.gov.au/trade/negotiations/us_fta/backgrounder/audiovisual.html provide some detail on Australian practices.
[3] Also, the Federal Communications Commission sets so-called safe harbor hours during which adult programming can be shown. Wiley and Secrest (2005) discuss the evolution of content rules in the US. An economic analysis of must-carry rules as they apply to the US can be found in Chae (1998) and Vita (1997). In The European Union firms may be subject to a combination of national language and European content rules. The regulation in seven countries is summarized in Machet *et al.* (2002). Hansen and Kyhl (2001) examine the effects of a ban on pay-per-view broadcast of certain events in the EU. The current European regulation of TV content –the "Television without Frontiers" directive- is under revision; see europa.eu/scadplus/leg/en/lvb/l24101a.htm.

which display violent behaviour– make a negative contribution.[5] The implication is that "good" programming deserves public support. Similar arguments are made in support of policies that favour domestically produced programs. Local productions are touted as merit goods for the reason that they promote the local culture and strengthen national identity.[6]

Occasionally, the economic objectives of content regulation are stated in forthright economic terms. In France for example, the declared objective for limiting the showing of films by over-the-air broadcasters is to support cinema attendance.[7]

Opponents of regulation argue that content rules are primarily designed to benefit favoured groups. Some view these rules as make-work measures designed to support home-based producers and artists.[8]

The debates about content regulation are often passionate. They tend to revolve around the following issues: (i) Are the policy goals of content rules as spelled out in law sensible from a welfare point of view? (ii) Do the specific rules set out by regulators perform satisfactorily in terms of achieving the intended goals, regardless of the merits of the goals?

This paper is concerned with the latter question. It starts from the premise that much content regulation is inspired by the following objectives: 1) To increase the production of programs deemed to have particular merit; 2) To increase the size of the audiences that watch these programs. It is in terms of these declared objectives -which transpire from official European, Canadian and Australian documents[9]- that this paper assesses the impact of two content rules. It establishes that content quotas designed to increase the production of certain types of programs may, paradoxically, reduce the

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[4] This is particularly true as for programs targeted at children. In the UK, Ofcom limits children's exposure to television advertising of food and drink products high in fat, salt and sugar.; see www.ofcom.org.uk/media/news/2006/11/nr_20061117.

[5] This is the position of the European Council (1998) which supports a code that "protects minors and human dignity" See europa.eu/scadplus/leg/en/lvb/l24030b.htm and ec.europa.eu/avpolicy/reg/minors/index_en.htm. Similarly, European legislation clearly prohibits broadcasts inciting to hatred for reasons of race, sex, religion or nationality (Art. 22 a of the "Television without Frontiers" Directive).

[6] As P. Krugman (1999) writes: "Boston residents who indulge their taste for Canadian divas do undermine the prospects of local singer-songwriters and might be collectively better off if local radio stations had some kind of cultural content rule", from www.slate.com/?id=56497. On the of the protection of the diversity of cultural contents, see Unesco (2004).

[7] Terrestrial over the air broadcasters are not allowed to show more than 192 films a year, of which 104 must be shown between 8:30pm and 10:30pm. Films may not be shown on Wednesday and Friday evenings (except cinema-club films after 10:30pm), at any time on Saturdays, and before 8:30pm on Sundays. (see Machet *et al.* (2002)).

[8] See e.g. Stanbury (1996).

[9] Australian television regulation is examined in Brown and Cave (1992); Canadian domestic content rules are discussed in Schultz (1996) and Stanbury (1996).

size of the audiences likely to watch them. It also determines that quotas ostensibly designed to boost the audience of certain programs may in fact reduce them. In addition they could lower the production of such content.

The paper is organised as follows. Section 2 sets out the basic assumptions of a model in which all television is subscriber-supported.[10] A monopolistic firm - cable or satellite operator - faces the following problems: (1) How to allocate a given number of channels to different types of content; (2) how to bundle these channels into packages targeted at subscribers; specifically how many optional packages to offer in addition to the basic service, and how many channels to include in each package; (3) how much content of each type to include in each package; (4) how to price each package. Sub-sections 2.2 and 2.3 presents the answers to these questions for the case where the firm is not constrained by content regulation. These subsections establish the baseline against which the paper subsequently sets the quota-constrained equilibrium.

Section 3 explores the effects of two content rules. Under the first rule the distributor must devote a minimum number of channels to programming of a particular type. Under the second rule distributor is required to place a minimum number of channels dedicated to specific content in the basic package taken by all subscribers. The section shows that these content requirements, ostensibly imposed to encourage the production and the audience of certain programs, may in fact have the opposite effect. The section discusses under what circumstances such outcomes are most likely. A final section discusses the results and looks at possible extensions.

2. Programming, bundling and pricing

First, we set out the hypotheses about technology and subscribers' preferences. Then, we determine for the benchmark case in which there is no content regulation, how the firm allocates channel capacity to different types of content and how it bundles the channels that it makes available to subscribers.

[10] Subscriber-support rather than advertising-support is an important aspect with respect to which this paper differs from Richardson (2004a and 2004b) who explores how a quota on domestic content affects product differentiation among radio stations. The major difference though is that our model allows the firm which distributes programming to target a different product at different consumer classes; it better describes the problem confronted by a cable or a satellite firm.

2.1. The model

A single cable or satellite operator distributes programming via x channels. The number of channels is a technological given. Each channel is devoted entirely to one of two program types: sports and documentaries. The cost of acquiring and distributing programs is zero[11].

The audience, whose size is given, appreciates variety in programming. Specifically, viewers' utility from access to x channels is higher when some channels are devoted to sports and others to documentaries, than when all channels are dedicated to the same type of content. Individual viewers are indexed θ, where $\theta \in [0,1]$. The parameter θ encapsulates the viewer's liking for sports relative to documentaries. Individual preferences have the form

$$V[\theta; s(\theta), d(\theta)] = \theta u(s(\theta)) + (1\text{-}\theta)\, u(d(\theta))$$

where $s(\theta)$ and $d(\theta)$ respectively denote the number of sports and documentary channels to which viewer θ has access. The function $u(.)$ is strictly increasing and concave, and $u(0) = 0$. These assumptions imply the following:[12]

- $sign \dfrac{\partial V}{\partial \theta} = sign[s(\theta) - d(\theta)]$ (1a)
- $V[\theta; s(\theta), d(\theta)]$ attains a maximum when $s^*(\theta)$ and $d^*(\theta)$ satisfy $u'(s^*(\theta))/u'(d^*(\theta)) = (1-\theta)/\theta$ where $s^*(\theta) + d^*(\theta) = x$ (1b)
- $F(\theta) \equiv V\left[\theta; s^*(\theta), d^*(\theta)\right]$ is convex, and is smallest for $\theta = 1/2$ (1c)

Condition (1a) states that a viewer who is more (resp. less) inclined towards sports than documentaries obtains a higher utility than viewers with a greater proclivity for documentaries when $s(\theta) - d(\theta) > 0$ $(\text{resp. } < 0)$. Condition (1c) states that a viewer with a stronger bias towards a particular type of program obtains a higher utility from a channel allocation tailored to his or her preferences than a viewer with a lesser bias towards a specific program type.

From now on, we assume that there are two classes of viewers/subscribers: Class 1 and class 2 with preference indices θ_1 and θ_2 respectively, where $\theta_1 > \theta_2$. The proportion of the audience belonging to class 1 is α. The firm knows the

[11] These assumptions are not critical but facilitate reasoning and presentation.
[12] See Crampes and Hollander (2005), Lemma 1 p. 8.

values θ_1, θ_2 and α, but is not informed about the class to which an individual viewer belongs.[13]

With p_1 and p_2 denoting the prices of access to the bundles of channels targeted at classes 1 and 2, profits can be written $\Pi = \alpha p_1 + (1-\alpha) p_2$. The seller's problem is then to determine the following: How many channels to allocate to sports and how many to documentaries? Whether to sell the same bundle to the two groups of viewers, or to target a different bundle at each group? In the latter case, how many sports channels and how many documentary channels to include in each bundle. Finally, how to set the price of a single bundle, or of two bundles?

Denoting by s and d the total number of channels allocated to sports and documentaries, and by s_i and d_i the number of channels of each type contained in the bundle targeted at group i $(i = 1,2)$, the constraints under which the firm maximizes profits are given by (2)-(4) below:

- Technical constraints

$$s + d \le x, \qquad s_i \le s, \qquad d_i \le d, \qquad i = 1,2 \tag{2}$$

- Individual rationality constraints

$$V[\theta_i; s_i, d_i] - p_i \ge 0 \qquad i = 1,2 \tag{3}$$

- Self-selection constraints

$$V[\theta_i; s_i, d_i] - p_i \ge V\left[\theta_i; s_j, d_j\right] - p_j, \qquad i, j = 1,2 \text{ and } i \ne j \tag{4}$$

Conditions (2) state that the total number of sports and documentary channels is bounded by capacity, and that the number of channels of a particular type contained in a bundle cannot exceed the number of channels dedicated to that program type. The constraints (4) and (3) state that subscribers must derive at least as large a surplus from the bundle targeted at them than from the other bundle, and that their surplus from the bundle targeted at them ought to be non-negative.[14]

To solve the maximization problem we proceed in two stages. First, we determine the optimal number of bundles, as well as their composition and prices, for

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[13] Assuming that the firm knows the class to which individual viewers belong but cannot technically or legally prevent viewers belonging to one class from subscribing to a bundle targeted at another class would give the same result.

[14] The maximization of profit does not assume that the seller offers two distinct bundles. Indeed, $s_1 = s_2, d_1 = d_2$ and $p_1 = p_2$ is a feasible equilibrium. Also, there is no obligation to sell to both classes; no constraint is violated by setting $s_i = d_i = p_i = 0$.

a *given* channel allocation (s, d). Then, we establish the optimal allocation of channel capacity.

This baseline equilibrium presents some interesting features that distinguish it from standard results found in the literature. First, a specification problem arises at the level of bundle composition and that of channel allocation. Second, and more importantly, the presence of a capacity constraint entails that the specification of the product targeted at one class cannot always be chosen independently of the specification of the bundle targeting the other group. For example, the firm cannot increase the number of documentary channels in order to earn larger profit from class 2 unless it lowers the number of sports channels and possibly earns less from class 1 subscribers.

2.2. Bundle composition and pricing for a given channel allocation.[15]

This section shows two results. It sets out the conditions that determine the number of bundles the firm offers, and it determines the prices and the composition of the bundles for a give channel allocation.

When the number of channels allocated to the two program types is not the same, the maximum price that the firm obtains by offering a single bundle equals the willingness to pay of the subscribers less inclined toward the program type to which the majority of channels have been allocated. If so, all potential viewers get access to all channels and the class with the stronger preference for the programs shown on the majority of channels obtains a positive surplus.

The alternative is to offer two bundles. The larger bundle which would include all channels would be targeted at the class with the stronger preference for the programs shown on the majority of channels and would be offered at a price equal to the willingness to pay of that class. A smaller bundle would be targeted at the other class and its price and composition would be chosen to ensure that the class targeted by the large bundle derive no positive surplus by subscribing to it.

The question whether the profits would be larger under 2-bundle offer depends on the relative size of the two classes and on the disparity in their reservation prices for the bundle that contains all channels. A larger disparity and a larger relative size of

[15] Crampes and Hollander (2005) provide a rigorous proof of the results derived in this section. This paper provides a more intuitive analysis.

the class with the stronger preference for the programs shown on the majority of channels increase the profits of a 2-bundle offer compared to a 1-bundle offer.

Upon defining[16]

$$\theta_v \equiv 1-(1-\alpha)(1-\theta_2) \tag{5}$$

$$\theta_w \equiv \alpha\theta_1 \tag{6}$$

we can state the following proposition:

Proposition 1

i) For a channel allocation $s<d$, the firm targets a single bundle at the reservation price $p=V[\theta_1;s,d]$ of class 1 if $\theta_v \geq \theta_1$. Otherwise, it offers 2 bundles, placing *s* sports and *d* documentary channels in the large bundle and *s* documentary channels and *s* sports channels in the small bundle. Class 2 subscribes to the large bundle at its reservation price $p_2=V[\theta_2;s,d]$; class 1 subscribes to the small bundle at the reservation price $p_1=V[\theta_1;s,s]=u(s)$.

ii) For a channel allocation $s=d$, the firm makes a 1-bundle offer at the price $p=u(x/2)$

iii) For a channel allocation $s>d$, the firm targets a single bundle at the reservation price $p=V[\theta_2;s,d]$ of class 2 if $\theta_2 \geq \theta_w$. Otherwise, it offers two bundles, placing *s* sports and *d* documentary channels in the large bundle, and *d* sports and *d* documentary channels in the small bundle. Class 1 subscribes to the large bundle at its reservation price $p_1=V[\theta_1;s,d]$; class 2 subscribes to the small bundle at its reservation price $p_2=V[\theta_2;d,d]=u(d)$.

Proof:

We provide the proof for the case $s<d$.[17] Because class 2 viewers love documentaries more than class 1 viewers, they are willing to pay more for a bundle that contains all the channels. For that reason, it is natural to take as a starting point the hypothetical offer under which a bundle containing all the channels is targeted at class 2, and an empty bundle containing zero channels is targeted at class 1. The profit maximizing prices associated with such hypothetical offer are $p_1=V[\theta_1;0,0]=0$ and

[16] We interpret these two parameters below.

[17] The proof for the case $s>d$ proceeds along similar lines

$p_2 = \theta_2 u(s) + (1-\theta_2)u(d) \equiv V[\theta_2; s, d]$. These prices, which satisfy conditions (2)-(4), yield a profit $(1-\alpha)p_2$.

Consider now the perturbation of this hypothetical offer which maintains bundle composition and price in regard to class 2, but targets at class 1 an amended bundle that includes z sports channels and z documentary channels ($z \le s < d$). Because $V[\theta_1; z, z] = V[\theta_2; z, z] = u(z) < V[\theta_2; s, d]$ the offer of the smaller bundle at price $p_1 = u(z)$ does not prompt class 2 consumers to switch to that bundle.[18] The extra profits generated by the perturbation are $\alpha p_1 = \alpha u(z)$, and because $u'(z) > 0$, profits are highest when the largest feasible z is chosen, i.e. $z = s$.

We now show that the profits derived by offering an equal number of sports and documentary channels to class 1, exceed the profits from any combination $d_1 \ne s_1$. To see why, we start from a hypothetical solution where $s_1 = d_1 > 0$ and we determine that profits fall when d_1 is lowered while s_1 is left unchanged. Note first that by virtue of (3) a lower d_1 calls for a lower p_1. A similar change in p_2 is not required because class 2 consumers –who love documentaries more than class 1 consumers– would derive negative surplus from the bundle targeted at class 1 even if they got that bundle at the lower p_1. With p_1 smaller and p_2 unchanged, profits must be lower than for $s_1 = d_1$.

We now examine how profit is affected by setting s_1 lower than d_1. Clearly, p_1 must fall in response to the lower s_1. Because the bundle which has shrunk contains fewer sports channels than documentary channels, the lower p_1 would bring forth a switch to that bundle by class 2 viewers if p_2 were left unchanged. Indeed, because class 1 has greater appreciation for sports than class 2, p_1 must fall by an amount larger than the loss in utility that class 2 would suffer by switching to the smaller bundle. To avoid the switch, p_2 must also be lowered. If so, both prices are lower than under $s_1 = d_1$ and so are profits. Thus, a 2-bundle offer with $s_1 = d_1 = s$ and $s_2 = s < d_2 = d$ yields higher profits than any alternative offer with $s_1 < s$ or $d_1 < s$.[19]

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[18] Class 2 viewers obtain zero surplus regardless of the bundle they subscribe to.

[19] Note that under this 2-bundle offer, the self-selection constraint of class 2 and the rationality constraints of *both* classes hold with equality.

A remaining question is whether profits can be made larger yet by expanding the bundle targeted at class 1, i.e. by setting $d_1 > s = s_1$. In this regard we note first that since the participation constraint of class 1 binds, the response of p_1 to an increase in d_1 is $\Delta p_1 = (1-\theta_1)u'(d_1)\Delta d_1$. Because Δp_1 is smaller than the gain in utility that class 2 members derive from switching to the smaller bundle – a gain of $\Delta V[\theta_2; s_1, d_1] = (1-\theta_2)u'(d_1)\Delta d_1$ – the price p_2 must be lowered by an amount $\Delta p_2 = [(1-\theta_1)-(1-\theta_2)]u'(d_1)\Delta d_1$ to prevent the switch. Using (5), we can write the joint effect of the two price changes on profits as

$$\Delta\Pi = [\alpha(1-\theta_1)+(1-\alpha)[(1-\theta_1)-(1-\theta_2)]]u'(d_1)\Delta d_1 = (\theta_v - \theta_1)u'(d_1)\Delta d_1 \quad (7)$$

We can see that setting d_1 above s_1 reduces profits when $\theta_v - \theta_1 < 0$, and increases profits when $\theta_v - \theta_1 > 0$. This means that when $\theta_v - \theta_1 > 0$ profits are highest when $d_1 = d$, i.e. when a single bundle is targeted at both classes.

Yet to be established is the fact that when $s < d$ it is indeed optimal to target group 2 with a bundle that contains all the channels. To see that it is, consider an alternative offer that has $s_2 < s$ and/or $d_2 < d$. Clearly p_2 must be smaller for such offer than for the offer $s_2 = s$ and $d_2 = d$. The implication is that targeting class 2 with a bundle that contains fewer than the total number of channels can be more profitable than targeting that class with a bundle that contains all channels only if it allows a higher p_1.

To examine whether the latter is indeed possible, consider first the offer $d_2 < d$ and $s_2 = s$. The lower p_2 such offer requires may –if d_2 is significantly smaller than d – bring about a decrease in p_1 but it can never yield an increase in p_1. The upshot is that for all channel allocations where $s < d$, total profits must be lower when $d_2 < d$ than when $d_2 = d$. A similar argument shows that the bundle $d_2 = d$ and $s_2 < s$ cannot be as profitable as the bundle $s_2 = s$ and $d_2 = d$.

Thus, we have shown that for channel allocations with $s < d$, the solution is either a 1-bundle offer with $s_1 = s_2 = s$ and $d_1 = d_2 = d$, or a 2-bundle offer with $s_1 = s_2 = s = d_1$ and $d_2 = d$. We also know that a 1-bundle offer profit and price are

$$\Pi = p = \min\left\{V\left[\theta_1; s, d\right], V\left[\theta_2; s, d\right]\right\} = V\left[\theta_1; s, d\right]^{20}$$

while a 2-bundle offer yields a profit

$$\Pi = \alpha u(s) + (1-\alpha)\left[\theta_2 u(s) + (1-\theta_2)u(d)\right] = \theta_v u(s) + (1-\theta_v)u(d) = V[\theta_v; s, d].$$

The term $V[\theta_v; s, d]$ has an interesting interpretation: when a 2-bundle offer is specified optimally, the profits it generates are the same as those that would be earned from the sale of a single bundle containing d documentary channels and s sports channels to a "virtual consumer" whose preference index for documentaries is $1-\theta_v = (1-\alpha)(1-\theta_2)$. This means that in order to compare the profits from a 2-bundle offer to the profits from a 1-bundle offer, it is sufficient to set the reservation price of class 1 for the single bundle against the virtual consumer's reservation price for the very same bundle.[21] In fact the virtual consumer's preference for documentaries equals the product of the preference of the class with the stronger liking for documentaries, times the proportion of viewers belonging to that class. We also note that the question whether a 1-bundle yields a higher profit than a 2-bundle offer does not depend on whether d is much larger or only slightly larger than s.

For the case $s > d$ the virtual consumer has preference index $\theta_w \equiv \alpha\theta_1$. The profits from a 1-bundle sale containing all channels to that virtual consumer equal the profits from selling the small bundle ($s_2 = d_2 = d < s$) to class 2, and the large bundle ($d_1 = d$, $s_1 = s$) to class 1.

Figures 1a and 1b display the relationship between the profits from a 2-bundle offer (based on the tastes of the virtual viewer) and the profits from a 1-bundle offer (based on the willingness-to-pay of group 1) when $s < d$ and $\theta_2 < \theta_1 < \frac{1}{2}$. In Figure 1a which is drawn on the assumption that $\theta_v > \theta_1$, profits are higher with a 1-bundle offer priced at class 1's reservation value. In Figure 1b, the opposite is true; profits are higher when the firm offers two bundles.

[insert Figure 1]

[20] This is due to the fact that class 1 has a lower willingness-to-pay for a bundle that contains more documentary channels than sports channels.

[21] The comparison is based on condition (1a) which shows that for $s < d$, the profits from a 2-bundle offer are larger (smaller) than profits from a single bundle when $1-\theta_v$ is larger (smaller) than $1-\theta_1$.

Having determined the optimal bundle composition and prices for *any* given channel allocation, we turn to the question how the firm allocates channels to program types.

2.3. Choosing a capacity allocation

We already know that for $d > s$ the firm will offer 1 or 2 bundles depending on the sign of $\theta_1 - \theta_v$. We also know that when a 2-bundle is optimal, the profit will be equal to the reservation price of the virtual consumer. This implies that depending on the sign of $\theta_1 - \theta_v$, the channel allocation is chosen to maximize the reservation price of the virtual consumer, or of the consumer less inclined towards documentaries.

There are three cases to consider. Figure 1 shows that for the case $\theta_2 < \theta_1 < \frac{1}{2}$, the optimal number of sports channels is

$$s^* = \begin{cases} \arg\max V\left[\theta_1; s, x-s\right] & \text{for } \theta_v \geq \theta_1 & \text{[Fig.1a]} \\ \arg\max V\left[\theta_v; s, x-s\right] & \text{otherwise} & \text{[Fig. 1b]} \end{cases}$$

Similarly, for the case $\frac{1}{2} < \theta_2 < \theta_1$, the optimal number of sports channels is

$$s^* = \begin{cases} \arg\max V\left[\theta_2; s, x-s\right] & \text{for } \theta_2 \geq \theta_w. \\ \arg\max V\left[\theta_w; s, x-s\right] & \text{otherwise} \end{cases}$$

The remaining case is $\theta_2 < .5 < \theta_1$. Clearly the firm earns a profit $u(x/2)$ when it offers a single bundle with $s = d = x/2$. To determine whether a 1-bundle offer is optimal when $\theta_2 < .5 < \theta_1$, $u(x/2)$ must be set against the profits from the following channel allocations:

(i) $s > d$ and a 2-bundle offer specified to maximize $V\left[\theta_w; s, x-s\right]$

(ii) $s < d$ and a 2-bundle offer specified to maximize $V\left[\theta_v; s, x-s\right]$.

But, condition (1c) implies that $\theta_v < .5$ is both necessary and sufficient to insure that the solution given by (ii) yields profits larger than $u(x/2)$ [22]. Similarly, the allocation required by (i) yields higher profits than $u(x/2)$ when $\theta_w > .5$.

The following proposition summarizes these findings:

Proposition 2

i) For $\theta_2 < \theta_1 < .5$, the optimal channel allocation has $s^* < d^* = x - s^*$ where

$$u'(s^*)/u'(d^*) = \begin{cases} (1-\theta_1)/\theta_1 & \text{for } \theta_v \geq \theta_1 \quad \text{(1–bundle offer)} \\ (1-\theta_v)/\theta_v & \text{otherwise} \quad \text{(2–bundle offer)} \end{cases}$$

ii) For $.5 < \theta_2 < \theta_1$ the optimal channel allocation has $s^* > d^* = x - s^*$ where

$$u'(s^*)/u'(d^*) = \begin{cases} (1-\theta_2)/\theta_2 & \text{for } \theta_2 \geq \theta_w \quad \text{(1–bundle offer)} \\ (1-\theta_w)/\theta_w & \text{otherwise} \quad \text{(2–bundle offer)} \end{cases}$$

iii) For $\theta_2 < .5 < \theta_1$, the optimal channel allocation has

$$\frac{u'(s^*)}{u'(d^*)} = \begin{cases} (1-\theta_w)/\theta_w & \text{for } \theta_w > .5 \quad \text{yielding } s^* > d^* \quad \text{(2–bundle offer)} \\ 1 & \text{for } \theta_v > .5 > \theta_w \quad \text{yielding } s^* = d^* \quad \text{(1–bundle offer)} \\ (1-\theta_v)/\theta_v & \text{for } .5 > \theta_v \quad \text{yielding } s^* < d^* \quad \text{(2–bundle offer)} \end{cases}$$

Note that the virtual consumer's preference parameters θ_v and θ_w are different from the parameters of classes 1 and 2. They are functions of the parameter of the class purchasing the larger bundle, *and* the proportion of the viewing public represented by that class. This finding is in striking contrast to standard models [e.g. Maskin and Riley (1984) and Corts (1995)] in which the specification of the product targeted at the group with the highest willingness to pay is chosen to maximize that group's contribution to total profits.[23]

[22] Note that whenever an allocation $s < d$ yields higher profits than $s = d = x/2$ with $\theta_v < .5$, it also yields higher profits than an allocation where $s > d$.

[23] A result usually referred to as "non-distortion at the top".

The distribution of viewers across classes matters because there is a capacity constraint. This means that when the number of documentary channels is increased to satisfy viewers who like one type of program, there is less capacity available for the other type. The implication is that the relative size of the group with the highest preference for a particular type determines whether it pays to increase the number of channels devoted to that type. This is in contrast to standard models with no constraint linking the quality targeted at one group to the quality aimed at another group.

Figure 2 displays the equilibria associated with different values of θ_1, θ_2 and α. For parameter values that lie in areas I_a, I_b and I_c, the firm offers a single bundle to both groups. In area I_a the channel allocation is $s^* > d^*$ and programming is tailored to the tastes of group 2. In area I_b, the allocation is $s^* < d^*$ and programming is tailored to the tastes of group 1. In area I_c the allocation has $s^* = d^* = \frac{x}{2}$. For parameter values in area II the allocation is determined by the preferences of the virtual viewer θ_w; class 2 subscribes to the small bundle and class 1 buys the large bundle. Finally, for parameter values in area III, the channel allocation is determined by the preferences of the virtual viewer θ_v where the large bundle targets class 2 and the small one targets class 1.

[Insert figure 2]

3. Content regulation

This section looks at the effects of two regulations. The first regulation forces the distributor to allocate at least d^r channels to documentaries. The second regulation requires that each subscriber get access to a minimum number d^r of documentary channels.[24]

Specifically this section examines how each regulation affects the number of bundles that the firm offers and how it determines the *actual* number of documentary channels to which subscribers have access.

3.1. Regulation 1: *At least d^r channels must be allocated to documentaries*

The key to examine the effects of regulation 1 is Proposition 1 which tells us how the number of bundles and their composition respond to changes in channel allocation. The latter can only change when $d^r \geq x/2 > d^*$ or $d^r > x/2 = d^*$. The total number of documentary channels that viewers subscribe to may fall under regulation 1 when the latter forces the firm to expand the number of documentary channels, and when the profit maximizing bundling regime requires that the larger bundle contain extra documentary channels. The reason is that expanding the number of documentary channels forces the firms to reduce the number of sports channels. And when the latter falls, the firm responds optimally by reducing the number of documentary channels in the small bundle so that it equals the number of sports channel. Therefore, those who value documentaries less and acquire the small bundle have access to fewer documentaries while those with the greater preference for documentaries have access to a large number of documentary channels. Total access to documentaries by subscribers in general therefore depends on the relative sizes of the two groups.

The conditions which determine the bundling policy under regulation 1 whether access to documentaries is improved or worsened are stated in Proposition 3

Proposition 3

a) The requirement that a minimum number of channels be allocated to documentaries *may* bring about a change in the number of bundles offered to subscribers.

b) When the firm maintains a 1-bundle offer or switches to a 1-bundle offer, viewers subscribe to a larger number of documentary channels.

c) When the firm maintains a 2-bundle offer, or switches to such offer, the number of documentary channels subscribed to may increase or decrease. The latter outcome is more likely when the content requirement is more severe, and when the share of subscribers with the greater inclination toward documentaries is smaller.

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[24] In practice the latter may translate into the obligation to include a minimum number of documentaries in the basic service all subscribers take.

Proof: [25]

It is clear that imposing the content requirement increases access to documentary channels by all subscribers when the firm offers a single bundle in the non constrained equilibrium and maintains a 1-bundle offer under the constraint. It is obvious as well that access to documentary channels by all subscribers increases when in response to the content requirement the firm switches from a 2-bundle offer to a 1-bundle offer. The reason is that under the latter *both* classes subscribe to all channels and more channels are now allocated to documentaries

Under the remaining cases where the constraint brings about a switch from a 1-bundle to a 2-bundle offer, class 2 gains access to a bundle containing all channels, a larger number of which are allocated to documentaries. The number of sports channels is now smaller and, by virtue of Proposition 1, the number of documentary channels contained in the bundle acquired by class 1 is also smaller. Therefore, the change in the total number of documentary channels viewers subscribe to –denoted $\Delta D -$ may increase or decrease, depending on the relative size of the two classes.

To get a clearer idea of the effect on access to documentary channels we decompose $\Delta D \equiv \alpha \Delta d_1 + (1-\alpha)\Delta d_2$ where Δd_1 and Δd_2 are the changes in the number of documentary channels contained in the bundles purchased by classes 1 and 2 respectively. We use Figure 2 to examine how the constraint perturbs the equilibrium described in section 2.

i) Start from area $\mathrm{I_a}$ - where the unconstrained solution calls for a single bundle having $s^* > x/2 > d^*$. Note that the line $\theta_v - \theta_1 = 0$ segments area $\mathrm{I_a}$. To the left of the line we have $\theta_v > \theta_1$*;* to the right $\theta_v < \theta_1$. Therefore Proposition 1 implies:

a) for $d^r < x/2$, the firm maintains its 1-bundle policy and channel allocation is $d^r < x/2 < s^r = x - d^r$. Because all consumers have access to a larger number of documentary channels, we have that $\Delta D > 0$.

b) for $d^r > x/2$, the firm switches to a channel allocation $s < x/2 < d$. For preference parameters to the left of the line $\theta_v - \theta_1 = 0$ it maintains the 1-bundle offer so that $\Delta D > 0$. However, for preference parameters to the right of $\theta_v - \theta_1 = 0$ it switches to a 2-bundle offer with ambiguous effect on ΔD. To see

[25] We take a more intuitive approach in the body of the text, and we relegate the more systematic analysis to appendix A1.

why the net effect on the dissemination of documentaries is ambiguous, note that $\Delta d \equiv d^r - d^* = \Delta_1 d + \Delta_2 d$, where $\Delta_1 d \equiv (x/2) - d^*$ and $\Delta_2 d \equiv d^r - (x/2)$. The effect of $\Delta_1 d$ alone must be to increase access to documentaries because the firm stays with a single bundle as long as $d^r < x/2$. The effect of $\Delta_2 d$ is to increase access when $\alpha < 1/2$ and to lower it when $\alpha > 1/2$. The reason is that when the firm offers 2 bundles, it lowers the number of documentary channels contained in the small bundle whenever it allocates more channels to documentaries.[26] But then, it is immediately apparent that the total effect of the constraint may be to lower dissemination of documentaries when α is sufficiently large, and when $\Delta_2 d$ is significantly larger than $\Delta_1 d$.

ii) For parameter values in area $\mathrm{I_b}$, the unconstrained equilibrium is a single bundle with $s^* < d^*$. By virtue of Proposition 1(i) the firm continues to offer a single bundle under the constraint. Therefore $\Delta D > 0$.

iii) Area $\mathrm{I_c}$ is also segmented by the line $\theta_v - \theta_1 = 0$. For preference parameters to the left of the line the firm stays with a single bundle when it is subject to the constraint, and $\Delta D > 0$ for the same reasons as above. For preference parameters to the right of the line it switches to a 2 bundle offer and $\Delta d = \Delta_2 d$. Therefore, $\Delta D > 0$ for $\alpha < 1/2$, and $\Delta D < 0$ for $\alpha > 1/2$.

iv) For parameters in area II the unconstrained solution calls for a 2-bundle offer and $s^* > d^*$. The firm maintains the 2-bundle policy under the constraint with more channels devoted to sports as long as $d^r < x/2$. Because all subscribers get the same additional number of documentary channels it must be true that $\Delta D > 0$. For $d^r > x/2$, the firm switches either to a 1-bundle offer or to a 2-bundle regime in which the large bundle contains more documentary channels than the small bundle. It switches to the 1-bundle regime for parameter values to the left of the line $\theta_v - \theta_1 = 0$ and to the alternative 2-bundle regime to the right of it. In the former case $\Delta D > 0$ as all subscribers have access to a larger number of documentary channels. However, when the firm switches to the 2-bundle regime the sign of ΔD is ambiguous. The reason is the same as under case *i*) above. The subscribers to the bundle in which the number of documentary channels increases in response to the constraint are fewer in

[26] Recall that the number of documentary channels in the small bundle equals the number of sports

numbers than the subscribers to the bundle where the number of documentary channels falls.

v) For parameter values in area III, the unconstrained solution calls for $s^* < d^*$ and a 2-bundle offer. The firm maintains the 2-bundle offer under the constraint. Because $\alpha < 1/2$ we have that $\Delta D > 0$.

The conclusion is that setting a minimum quota on the number of channels devoted to documentaries may produce a fall in the audience that watches that particular content because the firm reacts to regulation by switching to a 2-bundle offer with fewer documentaries in the basic bundle.

3.2. Regulation 2: *No subscriber should have access to fewer than d^r documentary channels*[27].

To meet regulation 2, the firm can be obliged to drastically change the channel allocation. The only situation where it is not necessary to reallocate channels is $d_2^* > x/2 \geq d^r > d_1^*$. Indeed, the constraint can be met by simply adding documentary channels already sold to type 2 consumers to the smaller bundle. However, this will not necessarily increase total access to documentaries. The reason is now that in response to the forced increase in the number of channels in the basic bundle, the firm will optimally respond by expanding the number of sports channel in that bundle. However this requires that fewer channels be allocated to documentaries. Therefore the viewers with the greater inclination for documentaries who subscribe to the large bundle containing all the channels will have access to fewer documentary channels. Again, total access to documentary channels will depend on the relative size of the two groups. The effects of regulation 2 can be summarized below:

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channels, and that the latter number must decline when more channels are allocated to documentaries.

[27] Or equivalently, the basic bundle should contain at least d^r documentary channels.

Proposition 4

The requirement that no subscriber have access to less than a set number of documentary channels has the following effects on bundling and access to documentary content:

a) The firm offers a single bundle for all parameter values for which it offers a single bundle absent the constraint; the constraint increases access to documentary content.
b) The firm offers either one or two bundles where the non constrained equilibrium calls for a 2-bundle offer with more channels allocated to sports. The constraint increases total access to documentary channels.
c) The firm offers either one or two bundles where the non constrained equilibrium calls for a 2-bundle offer with more channels allocated to documentaries. Total access to documentary content falls when the documentary requirement under the constraint is not much in excess of the amount included in the small bundle in the non constrained equilibrium. For a more severe constraint access to documentary content may increase or decrease.

Proof: [28]

It is clear that regulation 2 increases dissemination when the equilibrium under the constraint has all viewers subscribing to all documentary channels. This situation arises when the firm offers a single bundle and when it offers two bundles with the larger bundle containing extra sports channels. However, when the constraint can be met by simply expanding the number of documentary channels in the smaller bundle we cannot rule out the possibility that regulation 2 would lower access to documentary channel. The reason is as follows: The increase in documentary channels in the small bundle may up to some point be accompanied by an increase of sports channels in that bundle. The reason – as has been shown in section 2.2 - is to allow the firm to charge a sufficiently higher price for the small bundle to make it unattractive for class 2 members. But, adding sports channels means that fewer channels can be allocated to documentaries.[29] This means that class 2 which

[28] We give a more formal proof in appendix A2.

[29] Recall than when $d > s$ both classes subscribe to all sport channels.

subscribes to all channels will have access to fewer documentary channels. The implication is that total access to documentary channels may fall when the size of class 2 is larger relative to the size of class.

For greater precision it is useful to refer again to Figure 2, noting that both consumer classes subscribe to the same number of documentary channels under a 1-bundle offer when parameter values are in area I, and that the firm makes a 2-bundle offer having $s^* > d^*$ when parameter values are in area II. For parameter values in these areas the firm must change its channel allocation when $d^r > d^*$, increasing the number of documentary channels at the expense of sports channels. Such change in capacity allocation is not required for parameter values in area III of Figure 2 for which $d_2^* = d^* > d^r > d_1^* = s^*$. We conduct the analysis for each area separately.

Parameter values in area I:

Recall that under regulation 1 the firm maintains a 1-bundle offer for parameter values to the left of the line $\theta_v - \theta_1 = 0$, and that it switches to a 2- bundle offer for parameter values to the right of that line. Such switch is ruled out under regulation 2. The number of documentary channels in the small bundle would not satisfy the constraint if the switch was made. Hence, the firm maintains a 1- bundle policy when it is subject to regulation 2. The same reasoning applies when parameters are in area I_c. For parameter values in area I_b the 1-bundle policy is maintained as the whole area is to left of the line $\theta_v - \theta_1 = 0$. Because the 1-bundle offer is maintained for parameters values in areas I, we obtain $\Delta D > 0$.

Parameter values in area II

For $d^r < x/2$ the analysis is the same as for regulation 1. The firm maintains a 2-bundle offer. Because both classes now have access to a larger number of documentary channels it must be true that $\Delta D > 0$. For $d^r \geq x/2$ the firm switches to a single bundle containing d^r documentary channels and $x - d^r$ sports channels; consequently $\Delta D > 0$.[30]

Parameter values in area III

[30] It clearly does not pay to make a 2-bundle offer with $s < x - d^r$ as the majority of viewers are sports lovers ($\alpha > .5$).

This is the most interesting case because it forces the firm to consider drastic changes in bundling regime. It breaks down as follows: Case (i) where $d_2^* > x/2 \geq d^r > d_1^*$ and case (ii) where $d^r > x/2 > d_1^*$. In case (i) the constraint can be met without changing the channel allocation of the non-constrained solution whereas in case (ii) it cannot.

Case (i): $d_2^* > x/2 \geq d^r > d_1^*$

Recall from Proposition 2 that for parameter values in area III the firms makes a 2-bundle offer in the non constrained case with channel allocation $d^* > s^*$. The constraint can clearly be met by increasing the number of documentary channels in the small bundle without changing the composition of the larger bundle. However, doing so would call for a lower price of the large bundle, for otherwise class 2 would switch to the expanded small bundle. The question is therefore how to change the composition of the larger bundle and the channel allocation in order to minimize the adverse effect on profits from a lower priced large bundle.

As illustrated in Figure 3, there are two possible adjustments to the constraint:

1) “square basic bundle”: Lower the number of channels allocated to documentaries to allow an increase in the number of sports channels in order to maintain the equality between the number of sports and documentary channels in the small bundle $s_1 = d_1 = d^r$.

2) “rectangular basic bundle”: Increase the number of documentary channels in the small bundle to meet the constraint but do not change channel allocation: $d_1 = d^r > s_1$;

[insert Figure 3]

The trade-off between these adjustments is as follows: Maintaining the equality between the number of sports and documentary channels allows the firms to continue to extract the entire surplus from both consumers classes for any given channel allocation (see Proposition 1). However, it also entails fewer documentary channels being available for class 2 which has the greater preference for such content and is the majority.

The firm's response to the constraint is therefore to maintain the equality between the sports and documentary channels as long as d^r is slightly larger than the number of documentary channels contained in the small bundle in the absence of regulation. Specifically, the firm stays with a "square" small bundle for d^r smaller than a critical value $\bar{d}^r$. Beyond the threshold $\bar{d}^r$, it meets a further increase in d^r by increasing the number of channels in the small bundle without further change in channel allocation. Appendix A2 shows how to calculate that threshold.

The effect on access to documentary channels is as follows. When $d^r < \bar{d}^r$ it must be true that $\Delta D < 0$ as documentary channels available to class 1 increase by the same quantity as documentary channels available to class 2 decrease, and class 2 is larger.[31]

When $d^r > \bar{d}^r$, the effect of the quota on dissemination of documentary channels is ambiguous. Specifically, when d^r is sufficiently close to $\bar{d}^r$ the effect described above dominates, so that $\Delta D < 0$. However, for larger d^r the regulation may produce $\Delta D > 0$ because increases in d^r beyond $\bar{d}^r$ lead to an increase in the number of documentary channels in the small bundle without changing the composition of the large bundle.

Case (ii): $d^r > x/2 > d_1^*$

The analysis is similar to Case (i) except that a 2-bundle solution with square basic bundle can never meet the constraint because $d^r > x/2$. The following responses to the constraint are *a priori* possible:

1) a 2-bundle offer with $s_1 = s_2 = \bar{d}^r < d_1 = d^r < d_2 = x - \bar{d}^r$ and

2) a 1-bundle offer with $s_1 = s_2 = x - d^r < d_1 = d_2 = d^r$.

For $\theta_1 > 1 - \theta_v$, we show in Appendix A2 that $\bar{d}^r > x/2$. Because the latter is not compatible with $d^r > x/2$, the 1-bundle offer remains the only possible response. The reason is that the inclination towards sports of class 1 is stronger than the inclination towards documentaries of the virtual class. Therefore, it is more profitable to comply with the regulation by proposing a single bundle containing the maximum

[31] Also, because the number of channels allocated to documentaries is lower we must presume that fewer documentaries are being produced.

number of sports channels allowed under the constraint, namely $x - d^r$. The effect on dissemination of documentary channels is ambiguous for the very same reasons as set out for Case (i).

For $\theta_1 < 1 - \theta_v$, response 1) is feasible but it yields a lower profit than response 2) because it is too costly to prevent a switching by class 2 to the small bundle. The effect of the switch to a single bundle on dissemination is ambiguous when $d_1^* < d^r < d_2^*$ as the number of documentary channels subscribed to by the majority group falls. However, for $d^r > d^*$ it is clear that $\Delta D > 0$. In summary,

4. Concluding remarks

The rules and regulations which in many countries shape the content of television programming and the composition of bundles offered by cable and satellite operators indicate a desire to boost the production of certain types of programs and to increase the audiences that watch these programs. Some rules apply equally to all firms in the audiovisual industry while others may be tailored to individual firms. This paper has looked at the effects of two simple content requirements imposed on a single firm which come close in spirit to schemes applied by regulatory bodies.

The key result is that content policies that take the form of quotas may well produce results that run afoul of declared objectives. Specifically, the paper finds that setting a minimum quota on the number of channels devoted to one type of content may produce a fall in the audience that watches that particular content.

This *a priori* counterintuitive outcome may arise when the firm targets different bundles to different classes of viewers and it is more likely to arise when the minimum quota applies to a type of programming which is not the type favoured by the group of subscribers that is in the majority. It comes about because when channel capacity is limited, increasing the number of channels devoted to the type of programming under quota compels a reduction in the number of channels devoted to other programs. The latter, however, entails that the majority group, which subscribes to an equal number of channels of each type, will have access to a smaller number of channels that provide content which the regulation ostensibly aims to encourage. If that group constitutes a sufficiently strong majority, the overall access to the type of programming the regulation ostensibly intends to boost falls.

The paper has also determined that a content rule which requires that the basic service taken by all subscribers contain a minimum number of channels devoted to a particular type of content, may in fact reduce the size of the audience that watches such content. It may also bring about a fall in the total number of channels devoted to that specific content. This can happen when absent the content requirement the firm targets a different bundle to each subscriber class, and when the required minimum is smaller than the total number of channels allocated to that programming, but larger than the number of such channels contained in the basic bundle acquired by all subscribers.

The paper has also established a link between the literature on product specification and the literature on bundling. By endogenizing both the number and the composition of the bundles offered to subscribers we have produced a model that is more complex than the standard models. The assumption that channel capacity is limited constrains the specification of "products" and adds a twist to the problem that is not found in earlier literature. More pointedly, the specification of the "product" sold to the group with the highest willingness to pay depends not only on the preferences of that group but also on its relative size.

Within the framework of the paper, the counterintuitive outcomes resulted from the hypothesis of limited channel capacity. The latter implied that the quota-constrained firm could only devote more channels to one program type if it reduced the number of channels devoted to another type. However, similar counterintuitive outcomes need not hinge on constrained capacity constraint. To see why consider the case where there is no capacity constraint. In such set-up, the profit maximizing number of channels of each type would be determined by a condition that sets the additional utility from an extra channel against the cable distributor's cost of acquiring the extra channel. The basic trade-offs between the option of targeting the same bundle to all, and the option of targeting different bundles to different groups would remain available, although the criteria for choosing between them would be different.

Assume that under the non constrained equilibrium the firm offered 2 bundles, and that the larger bundle included more channels devoted to programs the regulation is designed to encourage. We must expect that a content rule requiring that a minimal *proportion* of channels be devoted to a specific program type will then be met in part by reducing the number of channels devoted to other programs.[32] If so, the firm may reduce the number of channels devoted to the regulated content that it includes in the smaller bundle. It would do so in order to make that bundle less attractive to the group targeted by the large bundle. And, if the group targeted by the small bundle is sufficiently large, total access to the regulated content may fall.

A number of other assumptions −most importantly that all programs belong to one of two possible types and that the market is served by a single firm− were made to insure tractability. Additional work will determine the extent to which the results found in this paper carry over to environments with competition among several service providers. The intuition gained from the paper suggests that when competition intensifies, the number of channels subscribed to "à la carte" should increase relative to the number of subscriptions for entire menus.

References

Allens Arthur Robinson (2004), "The FTA and Pay-TV, Local Content Regulation: Quotas to Increase" at http://www.aar.com.au/pubs/cmt/ftamar04.htm

Brown A. and M. Cave (1992), "The Economics of Television Regulation: A Survey with Application to Australia", *The Economic Record*, vol. 68 (202), 377-394.

Chae S. (1998), "A Bargaining Model of Retransmission Consent and Must-Carry Rule", *Information Economics and Policy*, 10, 369-387.

Corts, K.S. (1995), “Regulation of a Multi-Product Monopolist: Effects on Pricing and Bundling”, *Journal of Industrial Economics* 43(4), 377-398.

Crampes C. and A. Hollander (2005), “Product Specification, Multi-product Screening and Bundling: the case of Pay TV, *Information Economics and policy* 17, 35-59

Dunbar L.E. and C. Leblanc (2007), “Review of the Regulatory Framework for Broadcasting Services in Canada, Report to Canadian Radio-television and Telecommunication Commission, available at http://www.crtc.gc.ca/eng/publications/reports/dunbarleblanc.pdf

European Commission (1998), "Audiovisual Policy of the European Union", DG X, Brussels; see ec.europa.eu/avpolicy/index_en.htm.

European Council (1998), "Council Recommendation of 24 September 1998 on the development of the competitiveness of the European audiovisual and

[32] Such a requirement is similar to a linkage constraint under which cable distributors are given the right to include a channel they want – for example a foreign channel- in a basic bundle on condition they also include a number of channels favored by the regulator. The use of linkages in Canada is described in Dunbar and Leblanc (2007)

information services industry by promoting national frameworks aimed at achieving a comparable and effective level of protection of minors and human dignity", 98/560/EC, *Official Journal of the European Communities* L 270/48 7.

Hansen C.T. and S. Kyhl (2001), "Pay-per-view Broadcasting of Outstanding Events: Consequence of a Ban", *International Journal of Industrial Organization*, 19, 589-609.

Machet E., E. Pertzinidou and D. Ward (2002), "A Comparative Analysis of Television Programming Regulation in Seven European Countries: A Benchmark Study", *The European Institute for the Media*.

Maskin, E. and J. Riley (1984), "Monopoly with Incomplete Information", *Rand Journal of Economics* 15, 171-196.

OECD (2007), "Policy considerations for audio-visual content distribution in a multiplatform environment", *Working Party on Telecommunication and Information Services Policies*, (DSTI/ICCP/TISP(2006)3/FINAL), available at www.oecd.org/dataoecd/21/41/37868139.pdf

Richardson M. (2004a), "Cultural quotas in broadcasting I: a model", *School of Economics, Faculty of Economics and Commerce*, Australian National University, ecocomm.anu.edu.au/research/papers/pdf/wp442.pdf

Richardson M (2004b), "Cultural quotas in broadcasting II: policy", *School of Economics, Faculty of Economics and Commerce*, Australian National University, ecocomm.anu.edu.au/research/papers/pdf/wp443.pdf

Schultz, R. (1996), "Canadian Content and the I-Way", *Policy Options*, October, 7-11.

Stanbury, W.T. (1996), "Cancon Rules Should be Canned", *Policy Options*, October, 25-28;available at www.media-awareness.ca/english/resources/articles/sovereignty_identity/cancon_rules.cfm

Vita M.G. (1997), "Must Carry Regulations for Cable Television Systems: An Empirical Analysis", *Journal of Regulatory Economics*, 12:1, 159-172.

Unesco (2004), "Preliminary draft of a convention on the protection of the diversity of cultural contents and artistic expressions", CLT/CPD/2004/CONF-201/2, Paris, www.incd.net/docs/UNESCOdraft04.pdf

Wiley R.E. and L.W. Secrest (2005), "Recent Developments in Program Content Regulation", *Federal Communications Law Journal*, vol.57(2), 235-242.

Appendix

A1. The effects of Regulation 1: $d \geq d^r$

The following table shows the different possibilities faced by the firm when it would choose an unconstrained solution with less, as many or more than half the number of channels (columns) whereas the regulation is light or severe (lines).

	$d^* < \frac{x}{2}$	$d^* = \frac{x}{2}$	$d^* > \frac{x}{2}$
$d^r < \frac{x}{2}$	**case A**	**not binding**	**not binding**
$d^r = \frac{x}{2}$	**case B**	**not binding**	**not binding**
$d^r > \frac{x}{2}$	**case C**	**case D**	**case E**

Clearly, there are four cases where the constraint is not binding. The five remaining cases are examined hereafter:

Case A: The unconstrained equilibrium can be either in zone I_a (see Figure 2) where the best offer is one bundle based on the preferences of type 2 or in zone II where the best offer is made of two bundles, the large one containing a sports option targeted at type 1. When the constraint is binding, the firm can choose either to sell one bundle which yields a profit $\Pi^{1B} = \theta_2 u(x - d^r) + (1 - \theta_2) u(d^r)$, or to sell 2 bundles which yields

$$\Pi^{2B} = \alpha\left(\theta_1 u(x - d^r) + (1 - \theta_1) u(d^r)\right) + (1 - \alpha) u(d^r) = \theta_w u(x - d^r) + (1 - \theta_w) u(d^r)$$

upon using (6) in the text. Therefore $\Pi^{1B} - \Pi^{2B} = (\theta_2 - \theta_w)\left(u(x - d^r) - u(d^r)\right)$ and $sign\left(\Pi^{1B} - \Pi^{2B}\right) \equiv sign\left(\theta_2 - \theta_w\right)$. Since $\theta_2 - \theta_w = 0$ is the line that separates zones I_a and II, imposing the content requirement does not change the firm's choice: it remains one bundle when the firm starts from zone I_a and it remains two bundles when the firm starts from zone II.

Case B: The only way to sell two bundles would be to propose a documentaries option on top of the basic bundle, which is obviously suboptimal since type 1 who prefers sports has the higher willingness-to-pay. Therefore, the firm will adopt the required programming offering a single bundle. Half of the channels will be devoted to sports, half documentaries.

Case C: This case (as well as cases D and E**)** requires that the number of channels devoted to documentaries be larger than the number of channels devoted to sports. Therefore, the choice is between a 1- bundle offer based on the preferences of type 1 which yields a profit $\Pi^{1B} = \theta_1 u(x-d^r) + (1-\theta_1)u(d^r)$ and a 2-bundle offer where the larger bundle contains additional documentary channels and is targeted at type 2. The latter yields a profit s $\Pi^{2B} = \alpha u(x-d^r) + (1-\alpha)\left(\theta_2 u(x-d^r) + (1-\theta_2)u(d^r)\right)$.

Using (5) in the text, we find that $\Pi^{2B} = \theta_v u(x-d^r) + (1-\theta_v)u(d^r)$. Therefore, $\Pi^{1B} - \Pi^{2B} = \left(\theta_v - \theta_1\right)\left(u(d^r) - u(x-d^r)\right)$ and $sign\left(\Pi^{1B} - \Pi^{2B}\right) \equiv sign\left(\theta_v - \theta_1\right)$. Consequently, for parameter values in area I_a and located to the left of the line $\theta_v - \theta_1 = 0$, the firm maintains the 1-bundle offer but increases the number of documentary channels. To the right of the line, it switches to a two-bundle policy. For parameter values located in area II to the right of the line $\theta_v - \theta_1 = 0$, the firm maintains the 2-bundle offer while adding documentary channels policy; it switches to a 1-bundle policy for parameter values to the left of that line.

Case D: Starting area I_c, the firm has the choice between maintaining the 1-bundle offer just adding documentary channels, and switching to a 2-bundle offer. As shown for case C, for parameter values to the left (right) of the line $\theta_v - \theta_1 = 0$ is chooses the 1-bundle (2-bundle) option.

Case E: The unconstrained solution is is obtained for parameter values in area I_b (1-bundle offer based on the preferences of type 1) or in area III (2-bundle offer; the large bundle has extra documentary channels and is targeted at type 2). Since the line $\theta_v - \theta_1 = 0$ is the line that separates the two zones, the regulation does not affect the number of bundle being offered.

A2. The effects of Regulation 2: $\min\left\{d_1, d_2\right\} \geq d^r$

A2.1. case: $d^r < x/2$

We compare responses

a) $s_1 = s_2 = d_1 = d^r = s < d_2 = x - d^r$ (square basic bundle)

b) $s_1 = s_2 = s < d_1 = d^r < d_2 = x - s$ (rectangular basic bundle).

In both cases, optimality requires that all surplus be extracted from consumers with the lowest willingness to pay which here is class 1. Therefore $p_1 = V(\theta_1, s_1, d_1)$. The self-selection constraint (4) for class 2 therefore becomes

$$V(\theta_2, s_2, d_2) - p_2 \geq V(\theta_2, s_1, d_1) - V(\theta_1, s_1, d_1)$$

or $$p_2 \leq V(\theta_2, s_2, d_2) - V(\theta_2, s_1, d_1) + V(\theta_1, s_1, d_1).$$

Combining this inequality with the individual rationality constraint of type 2 $V(\theta_2, s_2, d_2) - p_2 \geq 0$ we can write

$$p_2 \leq \theta_2 u(s_2) + (1-\theta_2)u(d_2) + \min\left\{0, (\theta_1 - \theta_2)\left[(u(s_1) - u(d_1)\right]\right\}$$

Because profits increase in prices, the profit maximizing p_2 must be set equal to this upper bound. Hence, $\Pi = \alpha p_1 + (1-\alpha)p_2$ can be restated as

$$\begin{aligned}\Pi = {} & \alpha\left[\theta_1 u(s_1) + (1-\theta_1)u(d^r)\right] \\ & + (1-\alpha)\left[\theta_2 u(s_2) + (1-\theta_2)u(d_2) + \min\left\{0, (\theta_1 - \theta_2)\left[(u(s_1) - u(d^r)\right]\right\}\right]\end{aligned} \tag{A.1}$$

where we have set $d_1 = d^r$. Bundle composition must be chosen to maximize (A.1). In the two configurations under scrutiny, we have $s_1 = s_2 = s$ and $d_2 = d = x - s$. Therefore, the profit function can be rewritten

$$\begin{aligned}\Pi(s, d^r) = {} & \alpha\left[\theta_1 u(s) + (1-\theta_1)u(d^r)\right] \\ & + (1-\alpha)\left\{\left[\theta_2 u(s) + (1-\theta_2)u(x-s)\right] + \min\left[0, (\theta_1 - \theta_2)\left(u(s) - u(d^r)\right)\right]\right\}\end{aligned} \tag{A.2}$$

- If the monopoly offers a rectangular basic package $s < d^r$, (A2) becomes

$$\Pi(s, d^r) = \theta_1 u(s) + (1-\theta_v)u(x-s) - (\theta_1 - \theta_v)u(d^r) \tag{A.3}$$

This function reaches a maximum at $\tilde{s}$ such that

$$\theta_1 u'(\tilde{s}) - (1-\theta_v)u'(x-\tilde{s}) = 0 \tag{A.4}$$

Given part *i*) of Proposition 2 and the concavity of $u(s)$, it is easy to verify that $\tilde{s} > s^*$. Also, note that $\tilde{s} < d^r < x/2$ requires $\theta_1 < (1-\theta_v)$, specifically that parameters be in the left part of area III in Figure 2.

• If the monopoly offers the square basic package $s = d^r$, (A2) becomes

$$\Pi(d^r, d^r) = \theta_v u(d^r) + (1-\theta_v)u(x-d^r).$$

The difference between the two profits is

$$\Pi(d^r, d^r) - \Pi(\tilde{s}, d^r) = \theta_1\left\{u(d^r) - u(\tilde{s})\right\} + (1-\theta_v)\left\{u(x-d^r) - u(x-\tilde{s})\right\}$$

For d^r slightly above s^*, this difference is obviously positive since s^* is the unconstrained choice. When d^r increases, the effect on the difference of profits is $\theta_1 u'(d^r) - (1-\theta_v)u'(x-d^r)$. Because $d^r < x/2$ and u is concave, this derivative is obviously positive when $\theta_1 > (1-\theta_v)$, which means that $s = d^r$ remains the best response for this set of parameters. When $\theta_1 < (1-\theta_v)$ and d^r is high enough, in particular when d^r is close to .5, the derivative of the differences in profits is negative, which means that the "rectangular solution" may eventually be a better response than the "square solution". The threshold for the switch is $\bar{d}^r$ implicitly defined by $\Pi(\bar{d}^r, \bar{d}^r) - \Pi(\tilde{s}, \bar{d}^r) = 0$. But this equality can be true only if $\tilde{s} = \bar{d}^r$.

A2.2. case: $d_2^* > d^r > x/2$

Response a) defined above is not feasible. Therefore, when $\theta_1 > (1-\theta_v)$, the firm has no other choice than switching to the constrained 1-bundle offer with $s_1 = s_2 = x - d^r < d_1 = d_2 = d^r$. When $\theta_1 < (1-\theta_v)$, the best response is

either b): 2-bundle offer with $s_1 = s_2 = \tilde{s} < d_1 = d^r < d_2 = x - \tilde{s}$

or c): 1-bundle offer with $s_1 = s_2 = x - d^r < d_1 = d_2 = d^r$.

The profits are $\Pi(\tilde{s}, d^r) = \theta_1 u(\tilde{s}) + (1-\theta_v)u(x-\tilde{s}) - (\theta_1 - \theta_v)u(d^r)$ and $\Pi\left(x-d^r, d^r\right) = \theta_2 u\left(x-d^r\right) + \left(1-\theta_2\right)u\left(d^r\right)$ respectively. The difference is

$$\Pi(\tilde{s}, d^r) - \Pi\left(x-d^r, d^r\right) = \theta_1 u(\tilde{s}) + (1-\theta_v)u(x-\tilde{s}) - \left(\theta_1 - \theta_v + 1 - \theta_2\right)u(d^r) - \theta_2 u\left(x-d^r\right)$$

and we now demonstrate that it is always negative within the relevant range.

* Suppose first that θ_1 is close to $1-\theta_v$, which means by (A.4) that $\tilde{s}$ is close to $x/2$. We obtain

$$\Pi(x/2, d^r) - \Pi\left(x-d^r, d^r\right) = \left(\theta_1 + (1-\theta_v)\right)u(x/2) - (\theta_1 - \theta_v + 1 - \theta_2)u(d^r) - \theta_2 u\left(x-d^r\right)$$
$$= \theta_2\left(u(d^r) - u\left(x-d^r\right)\right) - 2\theta_1\left(u(d^r) - u(x/2)\right)$$

We clearly have $\theta_2 < 2\theta_1$ so that, when d^r is slightly above $x/2$, the difference in profits is negative. When d^r increases and eventually reaches *x*, the difference remains negative, meaning that the 1-bundle solution is better than the rectangular 2-bundle solution.

* When θ_1 is decreased below $1-\theta_v$, from (A.4) $\tilde{s}$ also decreases. We can calculate

$$\begin{aligned}\frac{d\left(\Pi(\tilde{s},d^r)-\Pi\left(x-d^r,d^r\right)\right)}{d\theta_1} &= u(\tilde{s})-u(d^r)+\left[\theta_1 u^{'}(\tilde{s})-(1-\theta_v)u^{'}(x-\tilde{s})\right]\frac{d\tilde{s}}{d\theta_1} \\ &= u(\tilde{s})-u(d^r)<0\end{aligned}$$

upon using (A.4). Therefore, the 1-bundle offer is a better response than the 2-bundle offer with a rectangular basic package.

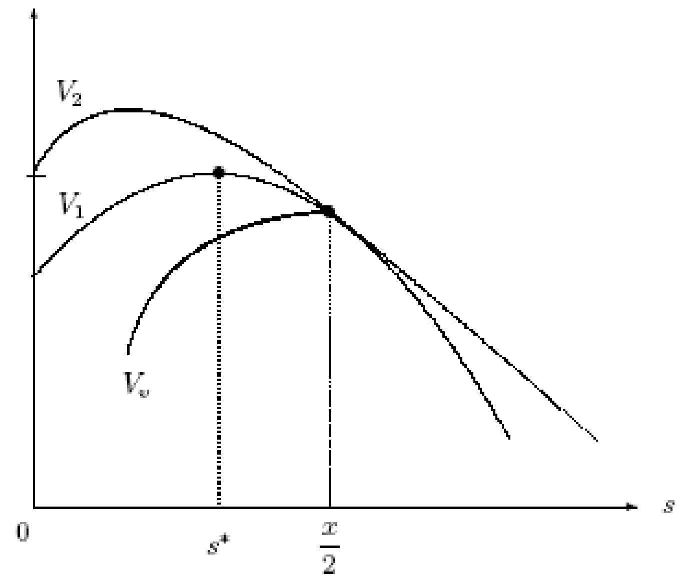

Figure 1a : $\theta_v > \theta_1$
one-bundle offer
$s^* = argmaxV_1$

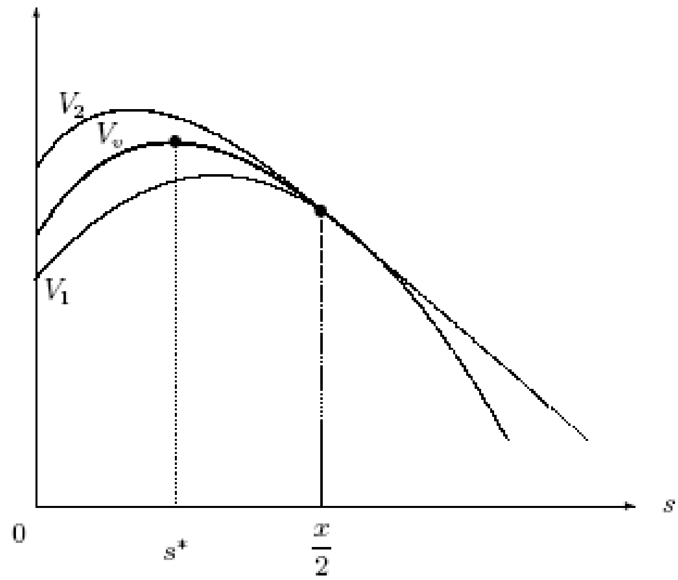

Figure 1b : $\theta_v < \theta_1$
two-bundle offer
$s^* = argmaxV_v$

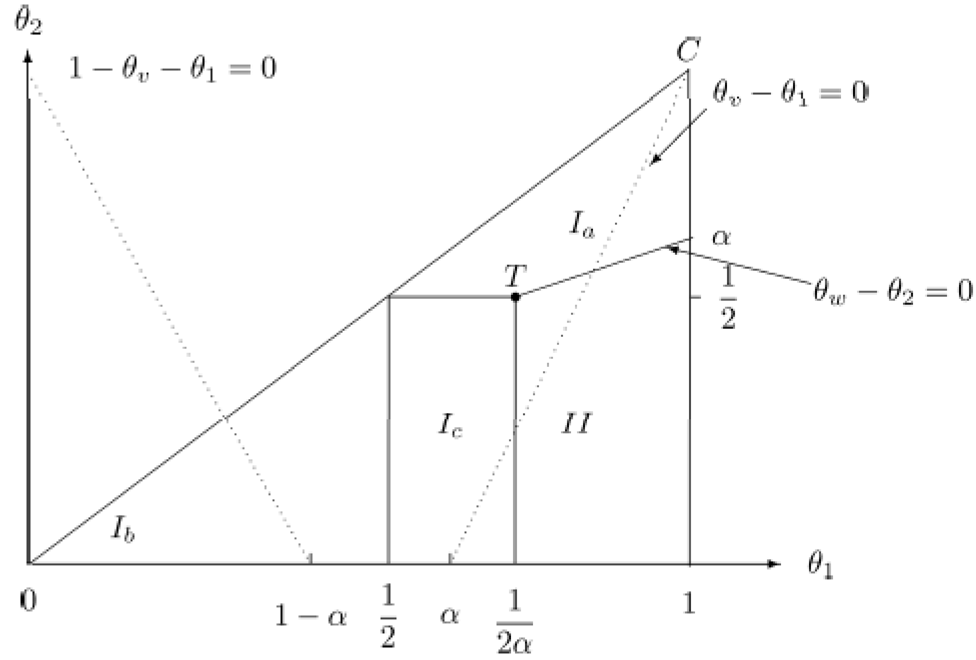

Figure 2a : $\alpha > 1/2$

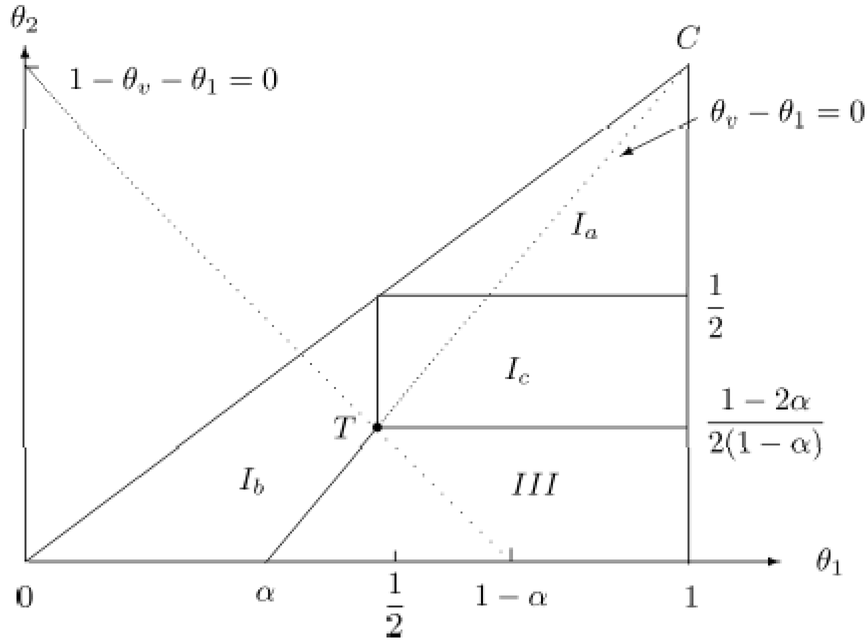

Figure 2b : $\alpha < 1/2$

I_a	:	$s_1 = s_2 = s > x/2 > d = d_1 = d_2$	and	$p_1 = p_2 = \theta_2 u(s) + (1-\theta_2)u(d)$
I_b	:	$s_1 = s_2 = s < x/2 < d = d_1 = d_2$	and	$p_1 = p_2 = \theta_1 u(s) + (1-\theta_1)u(d)$
I_c	:	$s_1 = s_2 = s = x/2 = d = d_1 = d_2$	and	$p_1 = p_2 = u(x/2)$
II	:	$s_1 = s > x/2 > d = d_1 = d_2 = s_2$	and	$p_1 = \theta_1 u(s) + (1-\theta_1)u(d)$ and $p_2 = u(d)$
III	:	$d_1 = s_1 = s_2 = s < x/2 < d = d_2$	and	$p_1 = u(s)$ and $p_2 = \theta_2 u(s) + (1-\theta_2)u(d)$

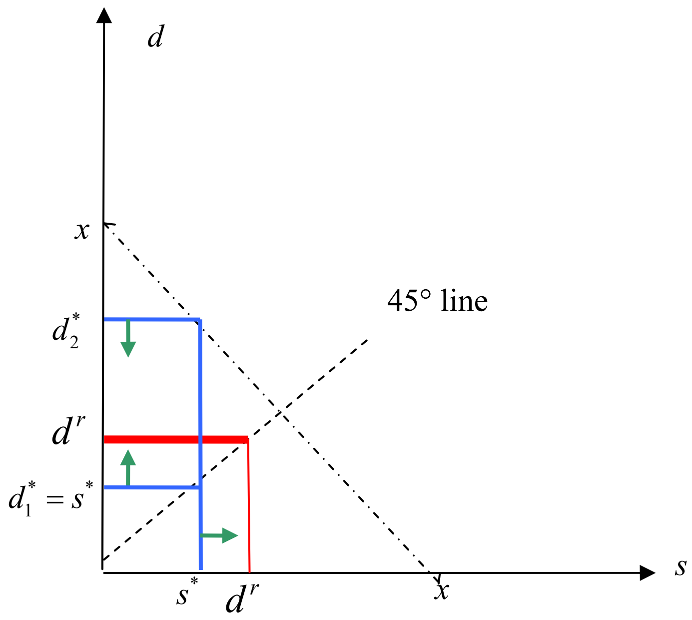

Figure 3: Response to the $\min\{d_1, d_2\} \geq d^r$ regulation