Faculty of Economics and Commerce

Australian National University

Working Paper in Economics and Econometrics Number 443

ISBN 86831 443 9

Cultural quotas in broadcasting II: policy*

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This version: July 2004

Abstract

This paper considers the application of 'cultural quotas' to radio broadcasting: a requirement that a minimum percentage of broadcast content be of local origin. Using a Hotelling location model derived in Richardson (2004) we show that, while the laissez-faire solution involves less than (socially optimal) maximal differentiation, a quota reduces the differentiation between the stations even further. While a cultural quota may raise consumer welfare, the reduced station diversity and advertising levels monotonically lower overall social welfare. We consider two other policies – a limit on advertising and a publicly provided non-commercial station – and show that both also reduce diversity, compared to the laissez-faire solution. An advertising cap is not as effective as the quota in achieving greater airplay for local content for least welfare cost but a public station can be, depending on the magnitude of its associated fixed costs.

Keywords: radio, public broadcasting, local content requirement, Hotelling
JEL classification numbers: L59, L82, Z10.

* I am very grateful to Paul Hansen for proposing the model used here and for subsequent discussions on this topic and to Peter Neary and Simon Anderson for helpful references. I also thank Willie Chetwin, seminar participants at the University of Toronto, two referees and the editor for valuable comments. This paper was commenced while I was visiting the University of Toronto and I am very grateful to the Department of Economics for their hospitality. Any errors are, of course, my own.

I. INTRODUCTION

Many countries have imposed local content requirements on their domestic broadcasters. In a companion paper (Richardson (2004)) we have modelled the choice of programming mix between local and international content as one of horizontal differentiation à la Hotelling. Consumers' preferences for the two types of content vary and commercial radio stations choose their broadcast mix in an effort to maximise advertising revenue. A cultural quota is then modelled as a locational constraint on radio stations. In this setting Richardson (2004) shows that less than maximal differentiation obtains between unconstrained stations and we demonstrate here that a quota further reduces that differentiation. While a cultural quota may raise consumer welfare and the profits of the constrained radio station, it monotonically lowers overall welfare – absent any positive externality attached to the broadcasting of local content – by decreasing diversity and thus advertising. We consider two other policies – a limit on advertising and a publicly provided non-commercial station – and show that neither may be as effective as a quota, even allowing for an externality, in achieving greater airplay for local content at least welfare cost. Interestingly, while an advertising cap reduces station diversity symmetrically, a public station also reduces the overall diversity of content played.

There is a substantial policy-oriented literature discussing cultural quotas and related issues at an informal level (see, for example, Acheson and Maule (1990) and Jacobsen (2000)) but we are aware of only two recent papers that construct formal models of cultural protection. Francois and van Ypersele (2000) present a model in which cultural goods are produced in different countries under increasing returns to scale and in which consumers have relatively homogeneous valuations for some of these goods ("Hollywood" movies produced in one country) but heterogeneous valuations for others ("auteur" cinema produced in both, potentially). In such a model, protection of a domestic market may raise welfare in both the domestic and foreign countries. Domestic production of auteur cinema is encouraged by restrictions on foreign exports of Hollywood movies, which can raise welfare at home by satisfying an otherwise unmet demand from high-valuation consumers. While considering the same broad area as the present paper, Francois and van Ypersele's model is very different and largely unrelated to our work. Our analysis focuses on 'spatial' differentiation between cultural goods and between the media that present it to consumers. Our policy instrument is a restriction on those media rather than on the underlying goods themselves.

Crampes and Hollander (1999) look at a number of regulatory schemes for broadcasting, including content requirements, but in a non-spatial model of subscriber-supported media (i.e. not free-to-air broadcasting.) So their model does not deal with advertising at all. Finally, Owen and Wildman (1992) provide a good survey of much of the literature on the economics of TV broadcasting but, again, without directly discussing the issues we address here.

In the next section we briefly summarise the model of Richardson (2004) before turning to an examination of three alternative policies for a cultural regulator concerned with the amount of local content played: a quota, an advertising ceiling and a public non-commercial station playing only local content. A final section concludes.

II. A MODEL

As in Richardson (2004), there are two radio stations each making a 'locational' choice in terms of the mix that it plays of two kinds of content: Local and that of the

Rest of the world. We denote a choice of only Local content as being at location $0 \in [0,1]$, *à la* Hotelling (1929), and a choice of only Rest of the world content as being at the other end of this interval at point 1. The two stations are described by their location along this interval, denoted by L and R, without loss of generality, $L \le R$.

Consumers are distributed uniformly along this unit interval in terms of their preferences for mixes of the two kinds of music and each consumer located between the stations can construct their own optimal mix of the two kinds of content by taking an appropriate convex combination of the two stations. Every consumer gets utility of $\underline{v}$ from listening only to their ideal mix of music and we suppose this is always sufficiently high that all consumers listen to the radio: the market is covered. A consumer's disutility from a less-than-ideal mix of content types is increasing and quadratic in the 'distance' from their ideal mix to the mix they consume but consumers also get disutility from advertising interrupting their programming. All up, a consumer at location s gets total utility of $u(s,\lambda,L,R,a_L,a_R)=\underline{v}-t[\lambda L+(1-\lambda)R-s]^2-[\lambda a_L+(1-\lambda)a_R]$ from listening to L a fraction λ of the time and R the rest of the time, where a_j denotes advertising at station $j=L,R$. Optimising over λ, a consumer's mix of radio stations depends on her location and we derive the total audience, x_j, listening to each station $j=L,R$, given the locations and the amounts of advertising at each:

$$
\begin{aligned}
x_L(L,R,a_L,a_R) &= \frac{1}{2}\left[\frac{(a_R-a_L)}{t(R-L)}+(R+L)\right] = s_L + \frac{1}{2}(R-L) \\
x_R(L,R,a_L,a_R) &= \frac{1}{2}\left[2-(R+L)-\frac{(a_R-a_L)}{t(R-L)}\right] = 1-s_R + \frac{1}{2}(R-L)
\end{aligned}
\qquad (1)
$$

We suppose that each radio station faces a competitive demand for advertising time from advertisers who seek to maximise some monotonic increasing function of total advertising exposure: the number of consumer-minutes advertised. This affects advertisers' sales of output, and we can then derive demands for advertising at each station as functions of locations and the prices charged to advertisers by the stations.

$$a_L(L,R,p_L,p_R) = \frac{1}{3}t(R-L)[2+(R+L)-2(2p_L+p_R)]$$
$$a_R(L,R,p_L,p_R) = \frac{1}{3}t(R-L)[4-(R+L)-2(2p_R+p_L)] \qquad (2)$$

Total welfare, *W*, is total consumer welfare, *U*, plus radio stations' profits, plus total surplus accruing to advertisers at each station, S_L and S_R respectively. Under a particular restriction on advertisers' "production function" from advertising:

$$W = \underline{v} - 2F - \frac{t}{3}\left[L^3 + (1-R)^3\right] - \frac{4t}{81}(R-L)(1-(R+L))^2 \qquad (3)$$

Richardson (2004) establishes the following results:

Proposition One*: Absent any externality attached to local music, first best locations involve maximal differentiation:* L=0 *and* R=1*, whether or not advertising levels can also be chosen: the level of advertising is irrelevant to welfare in the first best. Half of all music heard in equilibrium is of local origin.*

Proposition Two*: The laissez-faire non-cooperative solution involves less than maximal differentiation:* L=0.05*,* R=0.95*. Compared to the outcome under maximal differentiation but with endogenous advertising – also the outcome if firms were to collude on location choices – the laissez-faire solution yields lower advertising, higher consumer surplus and lower profits to both radio stations and advertisers. Again, half of all music heard is local.*

III. A CULTURAL REGULATOR

Now suppose we have a cultural regulator. As we wish to allow that there may be something to the arguments made by proponents of local content requirements that hearing local music generates some 'cultural' external benefit, we propose simply that the regulator's objective function considers not just social welfare but the amount of local content heard: they seek to maximise $v^R = W + \rho M_L$ where ρ measures the value of this external benefit that is linear in the amount of local content heard. This is a very terse means of capturing the elaborate and emotional arguments that are often made in defence of cultural protection but, in the context of a simple model, it seems the most accurate way in which to give some power to these arguments. Thus,

$$v^R = \underline{v} + \rho M_L - 2F - \frac{t}{3}\left[L^3 + (1-R)^3\right] - \frac{4t}{81}(R-L)(1-(R+L))^2 \tag{4}$$

But total local content heard is:

$$M_L = x_L(1-L) + x_R(1-R) \tag{5}$$

so, from (1),

$$M_L = \frac{1}{2}\left[\frac{1}{t}(a_R - a_L) + (R-L)(R+L) + 2(1-R)\right] \tag{6}$$

Before considering a number of policy instruments that might be available to a cultural regulator we consider the first-best choices of locations and advertising such a regulator would make. The contrast with Richardson (2004) is that here *ρ>0*. Nevertheless, the optimal choice of *L* is still zero: if local music heard has value in itself then the regulator would not wish to move station *L* from playing only local music. Furthermore, it would choose zero advertising at that station to increase its audience. The optimal location of *R* is now a complicated function of ρ and *t* with the property that an interior solution is decreasing in ρ: the more valuable is local music the more the planner would choose the second station to play, trading that off against the desirability of spanning the distribution of consumers. Welfare is everywhere increasing in the level of advertising at station *R* (as it increases the audience of *L*) and is effectively constrained by the demand curve from advertisers. Thus:

***Proposition Three**: If there is an externality attached to local music, first best locations still involve the left-hand station playing only local content (*L=0*) but the right-hand station also plays some local content (*R≤1*), the amount increasing* (R *decreasing) in the value of the externality. Advertising at the local music station is zero with advertising at the other station maximised.*

We now turn to a number of policy instruments that are available to a cultural regulator: a quota, a cap on advertising and the provision of a public radio station.

III.1. A cultural quota

Consider now the imposition of a local content requirement – a cultural quota – on both radio stations requiring that they play a minimum percentage – at least $c\%$ – local content. In light of the laissez-faire solution, the interesting case here is where $c \in (0.05, 0.95)$ so that it binds *R* but not *L* (although, as we shall see, this will be the case for any $c \in (0, 0.95)$). Station *R* has no incentive to more than satisfy the constraint so it will bind exactly on the station. As this quota is effectively a locational constraint it turns out to be notationally simpler to deal with $\gamma \equiv 1-c$: the maximum permitted fraction of non-local content that *R* can play. A greater local content requirement – a tighter quota – then corresponds to a lower γ.

Before looking at the optimal quota we first derive the comparative static effects of changes in the quota level. Inspection of *L*'s best response function reveals that there are two qualitatively different quota levels here: if $\gamma \leq 0.8$ – which we shall call a *restrictive* quota – then *L*'s best response is to locate at the end of the segment i.e. $L=0$, whereas for $\gamma \in (0.8, 0.95)$ – a *mild* quota – L will be less than completely specialised in local content.

III.1.a. Effects on local content audience

Consider first the case of a restrictive quota in which $\gamma \leq 0.8$. Consequently $R=\gamma$ and, L's best response is $L=0$. We can then recalculate the values of all variables of interest. Our first result[1] is that the profits of both stations are increasing in γ so tightening a restrictive content requirement (a *lower* γ) makes both stations worse off.[2] As the quota is tightened, the price of advertising at L decreases and that at R increases but, nevertheless, advertising at both stations falls: L's market share is falling while R's is rising. What effect does the quota have on the amount of local content played and heard? With this restrictive quota clearly more local content is being *played* – L is now playing only local content and R is playing more than before. Total local content aired is now $\frac{1}{2}(2-\gamma)$. But we may have fewer people listening only to station L and we certainly have a greater fraction listening only to R. For the rest, we need to integrate over the consumers listening to both stations. Interestingly, there are now some consumers who prefer less local content than is provided by R (i.e. located to the right of R) who will still listen to some L. The reason is that there is less advertising on L than on the otherwise preferred R. Still, we can show that tightening the quota always leads to more local content being heard overall.

If we consider instead the case of a mild quota (in which $\gamma \in (0.8, 0.95)$) then, as with a restrictive quota, both the price and level of advertising at L decrease as the

[1] The derivations of all results are in a Technical Appendix available from the author on request.
[2] As in Richardson (2004), there is a non-negative profit constraint on the regulator, which we ignore, implicitly assuming any losses are covered by the regulator.

quota is tightened, as its market share falls, while *R*'s price rises with its market share and advertising at *R* also increases. While station *L*'s profits increase in γ, *R*'s profits are decreasing so *R* gains from a tighter quota while *L* is harmed by it. This observation – that the constrained firm gains while the unconstrained one loses from the constraint – is a familiar one from the literature; see e.g. Ronnen (1991) or Crampes and Hollander (1995) on minimum quality standards.

What effect does a mild quota have on the amount of local content played and heard? Once more, total local content heard exceeds 50% and tightening the quota always leads to more local content being heard.

Putting these two quota regimes together, we can plot the amount of local content played and heard as in Figure 1 (not to scale).

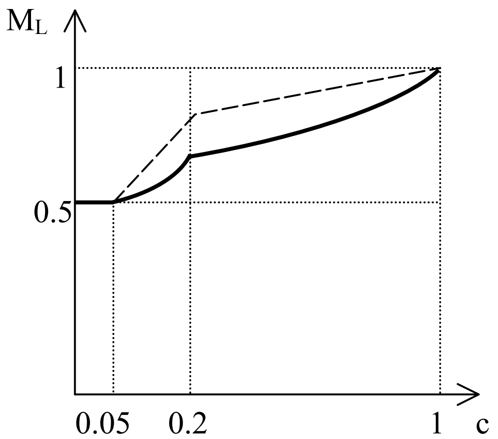

Figure 1

In this Figure the dotted line shows local content *played* as a percentage of all airtime while the heavy line illustrates local content *heard* as a percentage of all airtime. What explains the shape of this Figure? Tightening the quota always increases the amount of local content played, initially quite sharply as both stations play more until *L* is playing only local content (after *c=80%.*) But the quota has two effects on the amount of local content being listened to – it changes the mix played by each station (an effect that always works to increase the amount of local content) but it also changes the audience each station faces. As the quota is tightened, both stations *R* and *L* move down the spectrum. While *R*'s market increases, the audience shifting effect – more people listening to the less local content intensive station – never outweighs the mix effect.

We summarise these comparative statics results below.

Comparative statics of a cultural quota*: Tightening a local-music quota*

(i) *monotonically reduces both* R *and* L*, the latter reaching zero at a quota of 20%, increasing* R*'s market share at* L*'s expense;*

(ii) *reduces the profits of* L *and initially increases then decreases the profits of* R*;*

(iii) *reduces both the price and level of advertising at* L *but increases both the price and level of advertising at* R*;*

(iv) *increases the amount of local music heard, but by less than the increase in the amount played.*

If we consider, by way of a benchmark, a model with no advertising in which consumers subscribe directly to their preferred station(s), it is straightforward to show – and intuitive in light of the above analysis – that a content requirement acts just like a restrictive quota above. The reason is that, because the laissez-faire solution in the subscription case is maximal differentiation, a quota on *R* elicits no locational response from *L*. So, as the quota is tightened, local music heard increases, both firms' profits decline and both utility and welfare decline.

III.1.b. Welfare

Again, consider first a restrictive quota. Some consumers listen only to *L* and their disutility is $a_{L\gamma}+ ts^2$ where a gamma subscript indicates values taken under a restrictive quota. For such a consumer, welfare rises as the quota is tightened because the only effect on them, at the margin, is the decrease in $a_{L\gamma}$ as γ falls. Some consumers listen only to R and their disutility is $a_{R\gamma}+ t(s-\gamma)^2$. Such a consumer gains from the decreased advertising at R as γ falls but loses from their increased disutility as R moves down the spectrum and becomes less appealing. (Indeed, we can find a critical location $\underline{s}_R(\gamma)=(35\gamma+14)/45$ such that a consumer with $s>\underline{s}_R$ is worse off overall as the quota is tightened and a consumer with $s<\underline{s}_R$ is better off.) Finally, for other consumers listening to both stations disutility is $t(\Gamma_s-s)^2+a_{R\gamma}-\lambda_s(a_{R\gamma}-a_{L\gamma})$. (We can show that as the quota is tightened, consumers who listen to both stations but are not 'too close' to L will listen to less of L and more of R, even though the advertising at L is decreasing more rapidly as the quota is tightened than that at R.) So, all up:

$$v_{\gamma}^{R} = \underline{v} - 2F + \frac{\rho}{18}\left(5\gamma^2 - 14\gamma + 18\right) - \frac{t}{81}\left\{27 - 77\gamma + 73\gamma^2 - 23\gamma^3\right\} \tag{7}$$

Hence if there is no externality ($\rho=0$) welfare is increasing in γ for all relevant γ so the quota is always harmful. Diagrammatically we can portray the effects of this quota on consumers' welfare as in Figure 2.

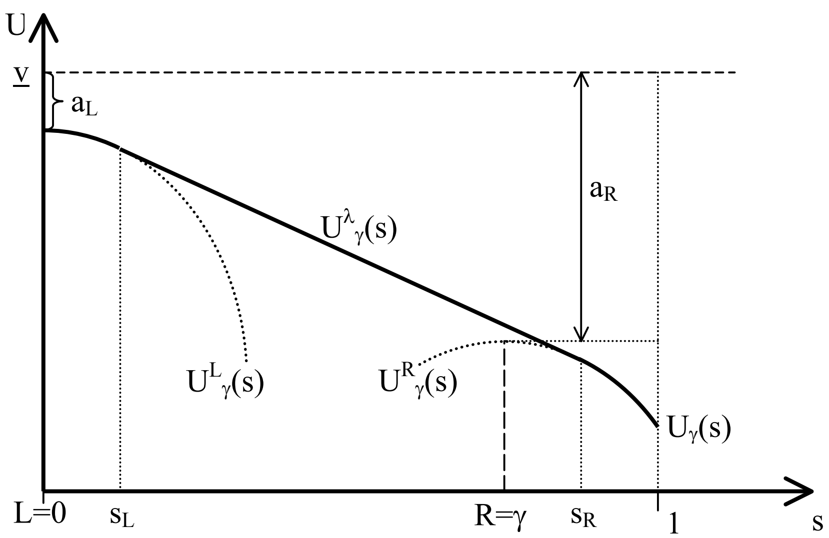

Figure 2

Welfare is highest for a consumer at 0 who listens only to *L*, her ideal station, which also happens to have the lowest advertising. Other consumers with $s \leq s_L$ also consume only *L* because of the low advertising but they incur increasing (quadratic) disutility costs the less local content they prefer. Consumers between s_L and s_R mix both stations but get lower utility as their preferred mix of *R* rises as it advertises more than its rival. Finally, consumers listening only to *R* are the worst off, as shown. Note that a consumer located exactly at *R* would get utility of $\underline{v}-a_R$ if they consumed only *R* but can do better by listening to some lower-advertising *L* as well.Turning to the case of a mild quota and proceeding as before demonstrates that, in the absence of any externality, welfare is increasing in γ over the entire range of $\gamma \in [0.8, 0.95]$. So welfare again falls as the quota is tightened.

Looking at welfare (with $\rho=0$) over the entire range of the quota yields Figure 3 (not to scale) in which welfare losses are steeper initially until *L* is driven to play only local content when the quota hits 20%. If we look at the various components of welfare, however, it is interesting to note that consumers actually gain from a small quota, as illustrated. Consumers' welfare initially rises as the local content requirement is increased from the no-quota level of 5% and then increases more rapidly as it rises beyond c=20%. It is maximised at around $c_2 \cong 62\%$ and then falls.[3]

[3] Suppose this 'optimal' local content requirement of around 62% were to be imposed. Then station *L* plays only local content and gets a little under 33% of the market, station *R* plays around 62% local content and gets a little over 67% of the market and local content is a little under 74% of total broadcasting heard. Consumer welfare is approximately $\underline{v}-0.2567t$, compared to the no-intervention level of approximately $\underline{v}-0.3601t$. Now station *R* charges more for advertising and places fewer advertisements and makes lower profits than in the absence of a quota, while station *L* charges less but still places fewer advertisements and so also makes lower profits.

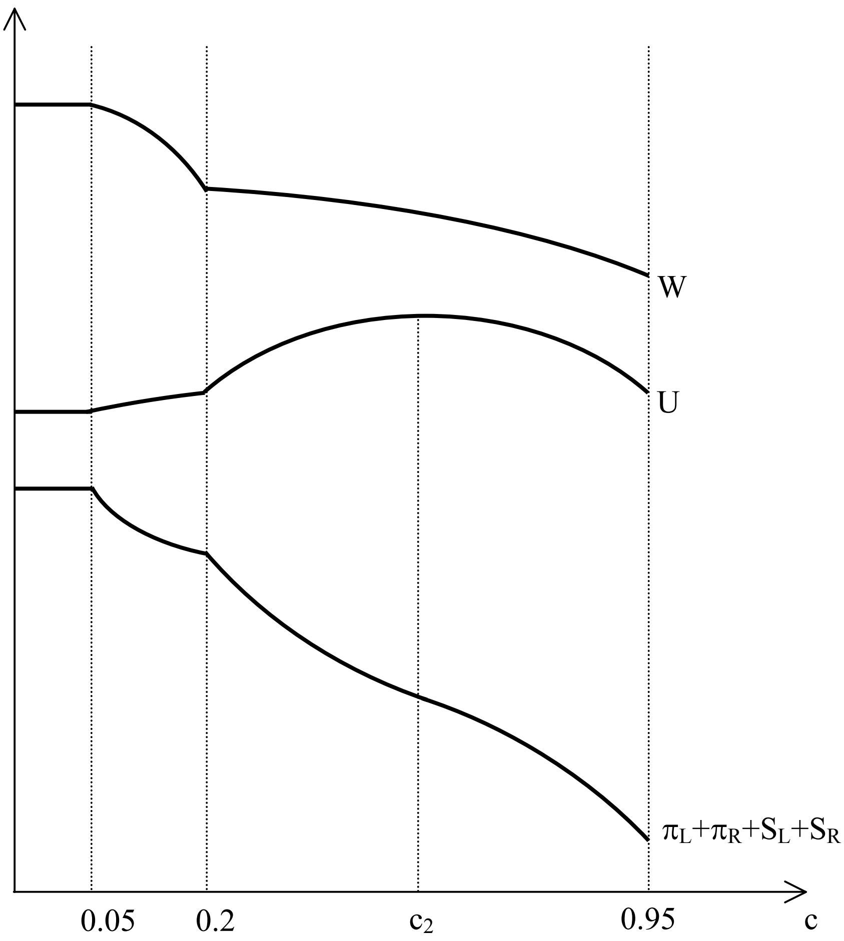

Figure 3

What is driving this is that as the quota is tightened, the stations become less differentiated and total advertising heard falls as the quota is tightened. This initially raises the welfare of consumers who dislike advertising until the quota is so restrictive that the welfare gains from reduced advertising are more than offset by the disutility losses of less ideal station content mixes.

Looking at the other components of welfare, $(\pi_L+\pi_R)$ and (S_L+S_R) are isomorphic and Figure 3 also illustrates their sum. While profits and surplus are monotonically decreasing in the local content requirement, once it exceeds 20% and station L plays only local content, profits and surplus decline more steeply in c although at an initially decreasing rate, as shown. Finally, plotting the value of the externality would simply give us a relationship (unshown) isomorphic to the heavy line in Figure 1 illustrating M_L.

So far we have said little of the externality. Its effects, however, are quite straightforward. We have seen that in the absence of any external benefit associated with listening to local content a cultural quota is welfare-reducing. The more significant the externality becomes, the more attractive is a quota. Figure 4 presents a numerical simulation of the model that illustrates this point.

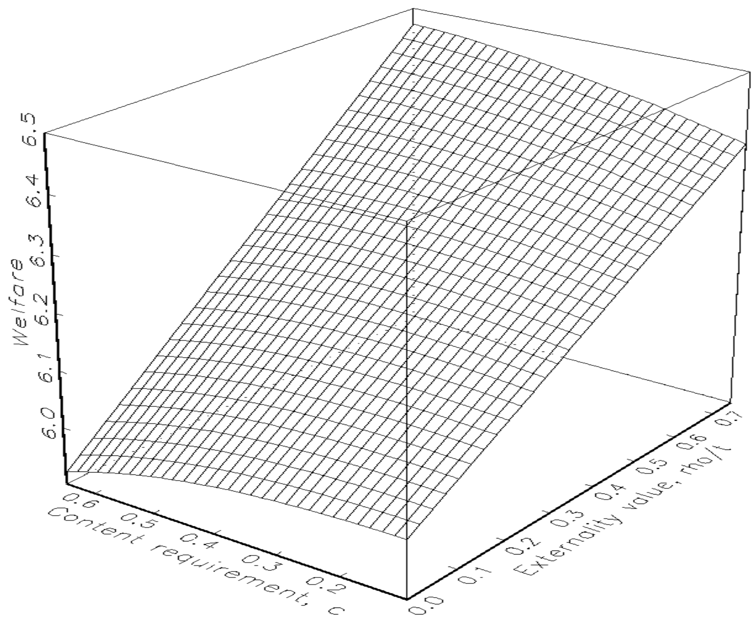

Figure 4

With no externality (ρ equals zero) welfare is declining monotonically in the content requirement. When the externality is more significant ($\rho=0.7t$) welfare is increasing monotonically in the content requirement. At intermediate values of ρ we find an optimal level of the content requirement that, not surprisingly, is increasing in ρ.

We summarize the discussion of this section as follows:

Proposition Four: *Tightening a cultural quota*

(i) *monotonically reduces social welfare;*

(ii) *initially increases consumers' welfare but eventually reduces it;*

(iii) *monotonically reduces stations' and advertisers' total surplus;*

(iv) *increases a regulator's welfare if the value,* ρ*, placed on local music is sufficiently high – the regulator's optimal quota is then increasing in* ρ.

III.2 Advertising limits

The gains in welfare from imposing a cultural quota come in this model from the decreased advertising such a quota induces by making the radio stations more similar in programming. This suggests that a better policy would be simply to cap the amount of advertising stations can offer. In this section we consider such a policy, which has been proposed for television regulation (see the discussion in Gabszewicz *et al* (1999)).

Suppose the amount of advertising each station can place is limited to $\underline{a}$. Suppose, initially, that this ceiling is 'very low' in a sense made clear below. Then it will constrain both stations[4] and each will simply choose its price such that demand from advertisers is exactly $\underline{a}$. Inverting (2) and solving the reaction functions:

$$p_L(L,R,\underline{a}) = \frac{1}{2}\left[(R+L) - \frac{\underline{a}}{t(R-L)}\right]$$
$$p_R(L,R,\underline{a}) = 1 - \frac{1}{2}\left[(R+L) + \frac{\underline{a}}{t(R-L)}\right] \tag{8}$$

In the first stage of the game, then, radio station $j{=}L,R$ chooses its location to maximise $\pi_j{=}p_j\underline{a}$. From (8) and assuming a symmetric solution we can solve for equilibrium locations and hence prices and profits as functions of the limit, $\underline{a}$:

[4] We focus only on symmetric equilibria. But see Gabszewicz *et al* (1999) for a detailed derivation in their model of the constraint binding both stations as an equilibrium property.

$$L = \frac{1}{2} - \sqrt{\frac{\underline{a}}{4t}} \qquad R = \frac{1}{2} + \sqrt{\frac{\underline{a}}{4t}}$$
$$p_L = p_R = \frac{1}{2}\left(1 - \sqrt{\frac{\underline{a}}{t}}\right) \qquad \pi_L = \pi_R = \frac{\underline{a}}{2}\left(1 - \sqrt{\frac{\underline{a}}{t}}\right) - F$$
$$x_L = \frac{1}{2} \qquad x_R = \frac{1}{2} \tag{9}$$

As noted earlier, the equilibrium we describe above applies only when the advertising limit is severe. To see this we can note that, in the absence of any constraint, any symmetric solution has $a_L=a_R\equiv a=2(1-2L)t/5$ compared to $\underline{a}=4t(½-L)^2$ here, from (9). So, given locations, the constraint only binds if $\underline{a}\leq a$ which can be rewritten as $L\in[0.3,0.5]$ which, in turn, requires $\underline{a}\in[0,0.16t]$ from (9). Thus our analysis above only holds if the advertising ceiling is less than $4t/25$. If, instead, $\underline{a}\in[0.16t,0.36t]$ where the upper limit is the laissez-faire level of advertising, Appendix A shows that the equilibrium locations will then be those that yield $\underline{a}$ as an optimal choice in the absence of any advertising limit.

Turning to welfare, we again have $v^R = \pi_L + \pi_R + U + S_L + S_R + \rho M_L$. We can show that welfare is *everywhere* decreasing as advertising is restricted over the range $\underline{a}\in[0,0.36t]$. Consumer welfare alone, however, is maximised at $\underline{a}\cong 0.01$ at which point (subject to our earlier caveat concerning zero-profit constraints) we get $U\cong\underline{v}-0.707t$ which compares favourably to the laissez-faire level of consumer welfare, ($\underline{v}-0.3601t$).

So while an advertising ceiling is always welfare-reducing, it does benefit consumers. As in Gabszewicz *et al* (1999), it leads to both stations locating progressively much nearer to the centre of the spectrum and thus leads to much lower differentiation between them – not surprisingly, as the only rationale for differentiation here is to foster advertising – and exactly half of all music heard being local. But while consumers find that the disutility costs associated with an undesirable product mix are increased, this is more than offset by gains from reduced advertising. Nevertheless, an advertising cap is less successful in achieving the goals of a cultural quota than the quota itself as it reduces welfare by more as well as having no effect on the amount of local music heard.

An interesting implication of this is that the optimal advertising policy is to impose an advertising floor of $\underline{a}=0.4t$ which gives maximal differentiation – $L=0$ and $R=1$ – and consumer utility of $\underline{v}-\underline{a}$. So, while consumer welfare is lower, total welfare is higher at $\underline{v}+(\rho/2)$.

We summarize the discussion of this section in Proposition Five.

Proposition Five*: An advertising ceiling, compared to the laissez-faire solution,*

(i) *decreases diversity by leading* L *and* R *to locate closer together;*

(ii) *monotonically reduces the joint surplus of advertisers and radio stations;*

(iii) *initially increases consumer welfare before decreasing it;*

(iv) *monotonically reduces social welfare;*

(v) *has no impact on the amount of local music heard..*

III.3. A public station

Suppose the government were to provide a publicly-funded radio station – denote it P – that broadcasts no advertising and plays only local content and so is located at 0 on our spectrum.[5] A consequence of such a policy is that L will move up the spectrum and we shall look for an equilibrium in which $P<L<R$. There are a number of possible listening patterns that might arise for consumers. Some might listen to only

[5] Note that we avoid the usual non-existence problem with three firms in the Hotelling model (see Economides (1993)) because of non-linear transport costs and because our public station's location – and price – is fixed by assumption.

P, only L or only R, others might listen to both P and L or to both L and R, as before, but it is also possible that some might listen to both P and R: the lack of advertising at P makes it attractive.

But any equilibrium must involve $a_L<a_R$. If not then no consumers would listen to L at all: a consumer between R and P can create their own ideal content mix by combining those two stations with lower advertising than if they listened to any L. Indeed, for any locations $0=P<L<R$ it must be the case that a_L is such that no consumer mixes P and R. The reason is that if any consumer finds it optimal to combine P and R then all consumers between P and R must do so too, thus leaving no market for L. This is most easily seen in Figure 5. Suppose locations and advertising are such that consumers' surplus from station P, L and R, as a function of location s, is as shown by $U_P(s)$, $U_L(s)$ and $U_R(s)$ respectively. As shown, any consumer in the interval $P+R$ does better by combining P and R rather than consuming any L at all.

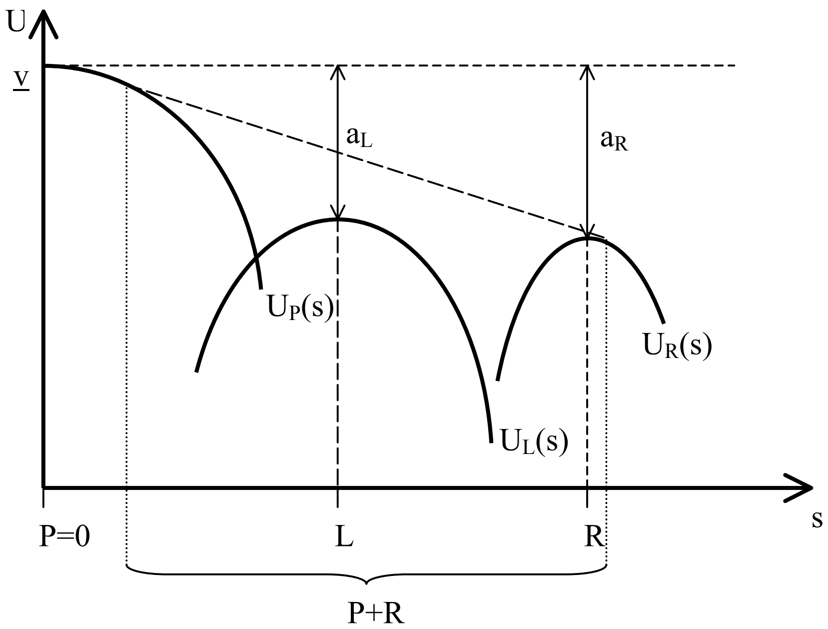

Figure 5

So there are only two possible configurations of advertising and audience mixes here, given locations. One is that a_L is sufficiently low that we have a situation where consumers listen to only *P*, only *L*, only *R*, both *P* and *L* or to both *L* and *R*. It can be shown that such an outcome cannot be an equilibrium; instead, station *L* will increase its advertising to the point at which consumers are just indifferent between consuming *P* and *L* and consuming *L* and *R*. Thus $a_L R = a_R L$. This reduces its total market share but increases its advertising and is illustrated in Figure 6.[6]

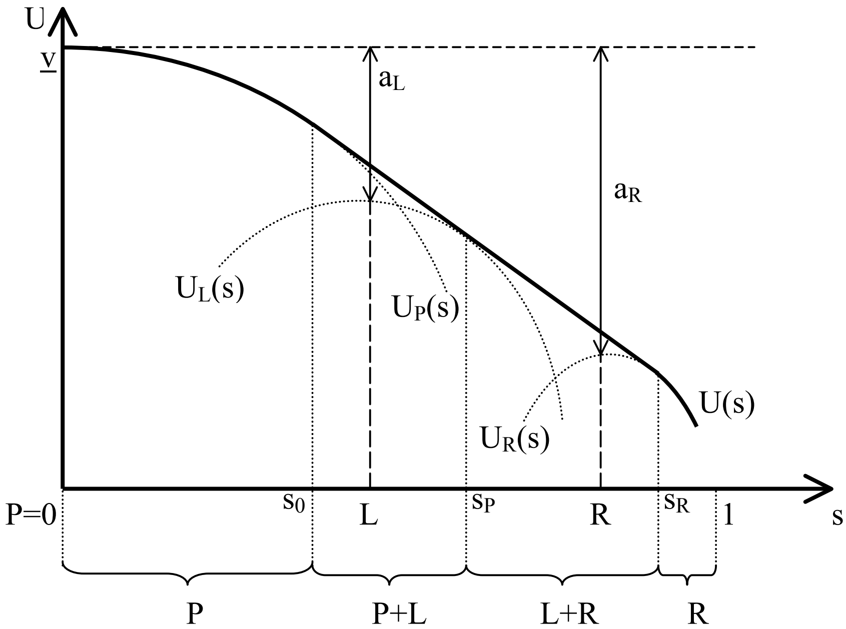

Figure 6

Proceeding as before, we first need to identify the critical locations at the boundaries of each market segment. We can then derive the market shares of the stations as before but with a third station, *P*. From these expressions we can calculate total advertising exposure at the two commercial stations, $a_i x_i$ for $i=L,R$, and maximise advertisers' surplus over the choice of a_i given prices and locations. We can then solve for the equilibrium prices and advertising levels at the two commercial stations,

6 See Appendix B, which discusses a potential non-existence problem here.

which in turn yield profits as functions of locations. Differentiating each of these and manipulating yields two messy expressions that solve for L and R:

$$L = \frac{2\sqrt{489} - 10}{87} \cong 0.3934 \quad R = \frac{318 + 6\sqrt{489}}{522} \cong 0.8634 \tag{10}$$

From this we can calculate all the variables of interest:

$$\begin{array}{ll} p_L^* \cong 0.3534 & p_R^* \cong 0.2741 \\ a_L^* \cong 0.0671t & a_R^* \cong 0.1472t \geq a_L^* \\ \pi_L^* \cong 0.0237t - F & \pi_R^* \cong 0.0404t - F \\ x_L^* \cong 43\% & x_R^* \cong 29\% \\ x_P^* \cong 28\% & \pi_P^* = -F \end{array} \tag{11}$$

The first thing to note here is that while the existence of the public station drives station L to play less local content, it leads station R to play *more* – it shifts down the spectrum from 0.95 to around 0.86. So, rather surprisingly, instead of driving both commercial stations *up* the spectrum, the provision of P rather induces *less* diversity. This occurs because of the reaction of L to the new entrant: L is displaced by a non-commercial station and this must lead to a drastic reduction in its advertising if it is to attract listeners. This puts pressure on R's market share so R then moves closer to increase its market share and appeal to advertisers. While both stations have substantially lower profits than in the absence of P, if R were to move further up the spectrum it would be followed by L. How much local content is played and heard? Local content *played* is a little over 58.1% of total airtime and local content *heard* is a little under 58.3% of total broadcasting listened to.

Turning to welfare, we find that a non-commercial public radio station playing only local content yields surplus to the regulator of v_P^R:

$$\begin{aligned} v_p^R &= U + \pi_P + \pi_L + \pi_R + S_L + S_R + \rho M_L \\ &\cong \underline{v} + 0.5830\rho - 0.0071t - 3F \end{aligned} \tag{12}$$

How effective is a publicly-provided station? If the regulator's objective is to increase the amount of local content heard, we have seen that this policy raises it from 50% to around 58%. If we chose the local content requirement that yielded the same amount of local content it can be shown that we would need a requirement of around 28% which would yield welfare of $\underline{v}+0.5830\rho-0.0098t-2F$. This may be greater than that associated with the public station depending on the costs of establishing the latter: if greater than $0.0027t$ then a publicly provided station is not an attractive option.

Fixed costs aside, however, the public station is preferred to the local content-equivalent quota (but not necessarily to the regulator's optimal quota) for a couple of reasons. As total advertising washes out of the welfare calculus, the only sources of welfare differences can be disutility costs from less than ideal mixes for consumers. But market 'coverage' is greater with the public station (where $P=0$ and R is around 0.86) than under the local content-equivalent quota (in which $L=0$ and R is around 0.72). Furthermore, the differences in advertising levels across the stations distort the listening choices of inframarginal consumers away from their ideals less dramatically with the public station than the equivalent quota: with the public station, the difference in advertising levels between the commercial stations is only $0.0801t$ whereas under the equivalent quota it is $0.0896t$.

We summarize this discussion in Proposition Six.[7]

***Proposition Six**: A publicly-provided non-commercial radio station (no advertising) playing only local music, compared to the laissez-faire solution,*

[7] We have also looked at the impact of a public firm competing with a single commercial broadcaster à la 'mixed oligopoly' models. In such a case we assume the public firm, with no advertising, chooses its location to maximise welfare. Its equilibrium location turns out to be at around L=0.112 which induces the commercial station to locate at around R=0.704. Advertising at R is around 0.175 at a price of 0.296, local music heard is around 62.5% of total listening time and welfare, for $\rho=0$, becomes $W\cong\underline{v}-2F-0.0101t$. This compares favourably to welfare under the local content-equivalent quota (of $\gamma\cong0.173$) of $W\cong\underline{v}-2F-0.1943t$. I am grateful to a referee for suggesting this exercise.

(i) *induces* L *to play less local music but* R *to play more;*

(ii) *reduces profits at both commercial stations;*

(iii) *increases local music heard above the level played;*

(iv) *increases consumers' welfare;*

(v) *can increase the regulator's welfare and by more than the local music-equivalent quota if the fixed cost of establishing the public station is sufficiently low.*

IV. CONCLUSION

In the context of a model developed in Richardson (2004), this paper has considered three policy options for a regulator that wishes to increase the exposure of local content in broadcasting. A local content requirement – a cultural quota – will increase the amount of local content heard and can even lead to greater utility for consumers. However, it harms advertisers and the radio stations[8] by reducing the differentiation between the latter and overall is welfare reducing in the absence of any externality associated with an increased local content audience. Comparing this policy to both a cap on advertising and a publicly-funded non-commercial station that plays only local content, the quota can be welfare-dominant, with or without an externality.

An advertising cap also decreases diversity by leading the stations to locate closer together in the centre of the spectrum. While consumers gain from the lower advertising, more are harmed by the decreased diversity of the stations available. The problem with the publicly provided station is that it competes most directly with the more local content oriented station, *L*. So the latter must cut its advertising drastically

[8] Eventually – a mild quota, we have seen, benefits the constrained station, *R*.

which induces the other commercial station to move in closer rather than to move further away.[9] So, again, diversity is reduced. An interesting consequence of this is that the optimal policy is to impose an advertising *floor* – a requirement that stations advertise more. This arises because the laissez-faire solution has too little diversity, which is as critics often suggest. However, it occurs because stations compete for advertising and are driven closer by this competition. If required to sell *more* advertising each would move away from the other as close locations imply fierce price competition in order to satisfy the advertising requirement. Aware of this, the stations become more diverse and, in so doing, decrease consumer disutility from less-than-ideal locations (although consumers are worse off overall as the losses from greater advertising more than offset the gains from greater diversity.)

At a sufficient level of abstraction, our results seem fairly general. In particular, we highlight the fact that a cultural quota decreases the diversity of radio stations and stress the ramifications of this for advertising. As our comparative statics follow from the model's Hotelling roots they seem quite robust, in contrast to our welfare conclusions, which rely on a restriction on the advertising side of the model resulting in the gains from advertising to advertisers exactly offsetting the losses to consumers. If, instead, it were assumed that advertising has a net positive (negative) effect then one might expect a quota to be less (more) attractive than in our model because, in reducing diversity, it also decreases the amount of advertising heard.

In terms of future work that might be pursued here, we have assumed in our analysis that the market is always covered – all consumers listen to radio stations. If

[9] Note that when advertising is endogenous, closer locations lead to greater aggression in the form of lower advertising, which is why laissez faire locations are well apart as the firms, in anticipation of that competition, locate away from each other. When advertising is limited exogenously, as here, a firm is drawn closer to its rival: the incentive to move in is the higher market share and the incentive to move out – to lessen advertising competition – has been stifled by the regulation.

we allow that consumers will not listen if the combined disutility of the content mix and advertising level is ‘too high’ then an extra welfare-reducing effect of a cultural quota will arise: some consumers with a strong preference for international content will drop out of the market in the face of the quota. Further, our model has the testable empirical implications that a local content scheme will increase the local content of all radio stations, whether the scheme is directly binding on them or not and that it will reduce advertising, *ceteris paribus*.

Appendix A

We claim in the paper that the equilibrium locations under a 'slight' advertising constraint will be those locations that yield $\underline{a}$ as an optimal choice in the absence of any advertising limit. From the expressions for equilibrium advertising in (16), and assuming a symmetric solution, we can solve for:

$$L = \frac{1}{2}\left(1 - \frac{5}{2}\frac{\underline{a}}{t}\right) \equiv L' \text{ and } R = \frac{1}{2}\left(1 + \frac{5}{2}\frac{\underline{a}}{t}\right) \equiv R'$$

Now, suppose these locations *are* chosen. Would either station then wish to move, given the advertising limit? Note first that

$$\frac{\partial a_L}{\partial L} = \frac{t}{45}\left[10(R-L) - 8 - 10(R+L)\right] = -\frac{4t}{45}\left[2 + 5L\right] < 0$$

$$\frac{\partial a_R}{\partial L} = \frac{t}{45}\left[-(28 - 10(R+L)) - 10(R-L)\right] = -\frac{4t}{45}\left[7 - 5L\right] < 0$$

So L could be *increased* without violating the constraint, but not decreased. Anyway,

$$\frac{d\pi_L}{dL} = \frac{t}{(15)(45)}\left\{10\left[4 + 5(R+L)\right](R-L) - \left[4 + 5(R+L)\right]^2\right\} = \frac{t\left[4 + 5(R+L)\right]}{(15)(45)}\left\{5R - 15L - 4\right\}$$

Evaluating this at the locations calculated above for L and R, yields:

$$\left.\frac{d\pi_L}{dL}\right|_{\substack{L=L' \\ R=R'}} = \frac{t\left[4 + 5(R+L)\right]}{(15)(45)}\left\{\frac{5}{2} + \frac{25}{4}\frac{\underline{a}}{t} - \frac{15}{2} + \frac{25}{4}\frac{\underline{a}}{t} - 4\right\} = \frac{t\left[4 + 5(R+L)\right]}{(15)(45)}\left\{\frac{25}{2}\frac{\underline{a}}{t} - 9\right\} < 0$$

where the negative sign follows from the fact that $\underline{a} \leq 0.36t$. So, ignoring the constraint, L would like to move down the spectrum, away from R at these locations. Doing so, however, will run into the advertising constraint. If L is reduced, given R, then p_L must be increased so that $a_L = \underline{a}$ still. From (22) we have the price that must be set and solving L's problem then gives,

$$\frac{d\pi_L}{dL} = \frac{\underline{a}}{2t(R-L)^2}\left\{t(R-L)^2 - \underline{a}\right\}$$

$$\left.\frac{d\pi_L}{dL}\right|_{\substack{L=L' \\ R=R'}} = \frac{\underline{a}}{2t(R-L)^2}\left\{\frac{25t}{4}\frac{\underline{a}^2}{t^2}-\underline{a}\right\} = \frac{\underline{a}}{2t(R-L)^2}\left\{\frac{\underline{a}}{4t}(25\underline{a}-4t)\right\} = \frac{\underline{a}^2(25\underline{a}-4t)}{8t^2(R-L)^2} > 0$$

where the sign follows because $\underline{a} \geq 0.16t$. So, given the constraint, L does not wish to move down the spectrum either. Thus $L=L'$ is a best response to $R=R'$ and a similar exercise shows the same for R'.

Appendix B

Returning to the issue regarding the possibility, with a public station, that $x_L=0$, we note that there is a possible nonexistence problem here.[10] Looking at Figure 6, we have $a_L(p_L,x_L)R=a_R(p_R,x_R)L$. Let $x_R'=x_R+x_L$. Now suppose that, given R and L, station R instead sets $p_R'>>p_R$ to yield $a_R'(p_R',x_R')=a_R-\varepsilon<a_R$ such that no consumers listen to L at all (see Figure 5.) Then R's market share will be approximately x_R' and because $a_R'=a_R(p_R',x_R')\cong a_R(p_R,x_R)$ its profits would seem to be discretely higher than with price p_R, suggesting that the latter cannot be part of a Nash equilibrium. Edgeworth paradox-like, this reasoning would suggest no pure equilibrium exists in prices for any locations as R's profit function is discontinuous in its price. However, this argument ignores the fact that demand for advertising at L also depends on p_R. If firm R were to choose its price to 'undercut' L's advertising levels, the fall in L's market share would also decrease demand for advertising at L, given p_L. Thus a small rise in p_R does not lead to a discrete increase in π_R but rather changes π_R by trading off a higher price against lower advertising, a trade-off that has approximately zero effect on profits when p_R is chosen optimally.

[10] This is rather different to the non-existence problems (for pure strategies) that can plague standard Hotelling-type models. See Osborne and Pitchik (1987) for a discussion.

References

Acheson, K. and C. Maule, 1990, Canadian content rules: a time for reconsideration. Canadian Public Policy 16#3, 284-297.

Crampes, C., and A. Hollander, 1995, Duopoly and quality standards. European Economic Review 39#1, 71-82.

Crampes, C., and A. Hollander, 1999, The regulation of audiovisual content: quotas and conflicting objectives. Mimeo, Centre de Recherche sur les Transports, University of Montreal.

Economides, N., 1993, Hotelling's "Main Street" with more than two competitors. Journal of Regional Science 33#3, 303-319.

Francois, P. and T. van Ypersele, 2000, On the protection of cultural goods. Mimeo, Tilburg University, July 2000.

Gabszewicz, J., D. Laussel and N. Sonnac, 1999, TV-Broadcasting competition and advertising. Mimeo, C.O.R.E., October 1999.

Gal-Or, E., and A. Dukes, 2002, Minimum differentiation in commercial media markets. Mimeo, University of Pittsburgh.

Hotelling, H., 1929, Stability in competition. Economic Journal 39#153, 41-57.

Jacobsen, V., 2000, *Local content regulation of New Zealand television*. Arthur Andersen: Wellington, NZ.

Osborne, M. and C. Pitchik, 1987, Equilibrium in Hotelling's model of spatial competition. Econometrica 55#4, 911-922.

Owen, B. and S. Wildman, 1992, *Video Economics*. Harvard University Press: Cambridge, MA.

Richardson, M., 2004, Cultural quotas in broadcasting I: a model. Working Paper in Economics and Econometrics Number 442, Faculty of Economics and Commerce, Australian National University: Canberra: Australia.

Ronnen, U., 1991, Minimum quality standards, fixed costs and competition. RAND Journal 22#4, 490-504.