E C O N O M I C S   B U L L E T I N

Television News Scheduling Revisited

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Abstract

Existence problems have been pervasive in the economics literature on horizontal product differentiation. Adding a directional constraint to a standard Hotelling location model leads to a general result of non-existence of a pure strategy Nash equilibrium. Here we present a slightly different model where allowing for preferences over broadcasters, independent of arrival time at home, recovers existence of pure strategy Nash equilibria (although a mixed strategy equilibrium also exists).

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1 Introduction

Since the seminal work of Hotelling (1929), the economics profession has been attracted by models of horizontal product differentiation. It turned out that equilibrium existence can be a serious problem, as shown by D'Aspremont, Gabszewicz and Thisse (1979).

A special class of horizontal product differentiation models, characterized by directional constraints, has seldom being analyzed.[1] In a recent paper, Cancian, Bills and Bergstrom (1995) showed that such type of constraints may have important implications for equilibrium existence. They proved that adding a directional constraint to a standard Hotelling location models leads to non-existence of a pure strategy Nash equilibrium.

Similar models were developed by Nilssen and Sorgard (1996a,b). Nilssen and Sorgard (1996a) add a second choice varible, the programme profile, as well as different timings for the game.[2] They also experience pure-strategy Nash equilibrium existence problems. Nilssen and Sorgard (1996b) generalize the transport cost assumption: moving in one direction has different transport costs than moving in the other direction. They also consider simultaneous and sequential location decisions. Finally, Nilssen (1996) extends the analysis to more than two firms, but introduces sequential location decisions.

Here, we present, keeping the example of news broadcast, a slightly different model where allowing for preferences over broadcasters, independent of arrival time at home, recovers existence of pure strategy Nash equilibria. Existence of preferences over broadcasters means that viewers may prefer to wait for the preferred station instead of watching the first broadcast available.

In the proposed model, equilibria involve asymmetric locations for each station and there are usually two pure strategy Nash equilibria (plus one mixed strategy equilibrium).

This surge of recent work on the implications of directional constraints justifies our interest in conditions recovering existence of pure-strategies Nash equilibria.

Section 2 presents the model and the basic result. Section 3 concludes the note.

2 The model

The main implications of directional constraints is that viewers can only watch news after they get home, not before. If viewers start watching the first news broadcast available, undercutting in schedules means that there is no pure strategy Nash equilibrium. In a less extreme version, Nilssen and Sorgard (1997) introduceda asymmetric transport costs.

Suppose now that viewers have preferences over two existing television stations. In order to watch the news service of the preferred station they may be willing to wait some time, provided that news service has not occurred yet (the directional constraint at work). The cost of waiting is determined by how apart are broadcasts schedules.

[1] A description of previous literature on location without price competition and without directional constraints can be found in Gabszewicz and Thisse (1992).

[2] The various possibilities were dictated by the particular example used: a firm sets both variables first; and firms set time schedules sequentially and then set programme profiles simultaneously.

The assumption of preferences over broadcasters which are independent of scheduling time seems a reasonable one. Individuals may prefer some anchor man over another from a competing station. Also, another typical example of directional constraints is airline departure scheduling. In this case, it is clear that people do prefer some companies over others and they may be willing to wait to fly with the preferred airline.

We assume the time at which viewers reach home to be continuously distributed on the interval [0,1]. On the preferences from watching the evening news, assume the following. A viewer that arrives at time z from work has utility

$$u - (x - z) \tag{1}$$

if he watches newscast from station x, where u is reservation utility and $(x - z)$ reflects the cost of waiting for the beginning of emission (in fact, it is modeled as just waiting time).

On the other hand, if he chooses to view station y, utility is given by

$$u - (y - z) + c \tag{2}$$

where c is a parameter reflecting preferences over television stations. Parameter c has a uniform distribution $[\underline{c}, \bar{c}], \underline{c} < 0 < \bar{c}, \mid \underline{c} \mid < 1, \mid \bar{c} \mid < 1$ and $\bar{c} - \underline{c} = 1$ (to simplify presentation). Each viewer only watches one news service.

Take the example given by $(\underline{c} = -1/2, \bar{c} = 1/2)$. This structure means that half of the viewers have a preference for channel x $(c < 0)$ and half for channel y $(c > 0)$. This symmetric example on preferences preserves the feature that for equal location choices, broadcasts share equally the audience.

An individual chooses to view station x if $c < y - x$. The viewer has preferences over two characteristics: the moment emission begins (the sooner the better) and the broadcaster. This condition states the existence of a trade-off between these two characteristics. Total viewers of each station are:

$$D_x = \int_0^x \int_{\underline{c}}^{(y-x)} 1dcdz = (y - x - \underline{c})x \tag{3}$$

$$D_y = y - D_x \tag{4}$$

Viewers can wait for a later broadcast if they arrive earlier than the start ob both news services. However, if they get home after the first station has started broadcasting, then they can only see the other station's newscast. Television stations have the objective of maximizing audience, as advertising revenues will be maximized as well.

Proposition 1 *There are two pure-strategies equilibria characterized by*

$$(a)\ (x = (1 - \underline{c})/2, y = 1)\ \textit{or}\ (b)\ (x = 1, y = (1 + \bar{c})/2) \tag{5}$$

Proof: Straightforward resolution of first-order conditions of each station's problem. Note that the boundary condition of emission time not higher than one is active in equilibrium for one of the stations. ■

The proposition establishes that pure strategies Nash equilibria can arise in a slightly more general model, in the sense that preferences over stations exist.[3]

Given the directional constraint, equilibria have asymmetric locations despite symmetry between broadcasters and in viewers preferences. Take again the symmetric case of $\bar{c} = -\underline{c} = 1/2$. The chosen locations are 0.75 and 1, clearly asymmetric.

Preferences over broadcasters are key to the result, as they decrease the incentive for a broadcaster to locate too close to the competitor.

The first broadcaster to go "on the air" looses some viewers (that arrive home late) to the other station. However, locating closer to the rival television channel would mean that some viewers would find worthwhile waiting for the second news service (those with a high preference for that station).

Therefore, the first broadcaster faces a tradeoff between loosing viewers with high preference for the other station and gaining some latecomers if the emission is rescheduled for a later time.

The second broadcaster has the same tradeoff but in a much weaker form due to the directional constraint. Viewers arriving after the first news emission cannot watch it. Hence, it pays to delay the broadcast as long as possible in order to capture a higher audience. The cost of delaying is to loose some viewers that would be willing to wait for this station emission. However, given preferences over stations by viewers and the impossibility to see emissions that started earlier than arrival time from work, it is never optimal to get viewers with a high preference (but also a long waiting time) for the late station at the expense of those who get late at home (which have no option but to see the second news service).

Even if preferences are not symmetric (say, station y is preferred by a majority of viewers: $\bar{c} > -\underline{c}$), two interior Nash equilibria arise. Under asymmetric preferences, the interior location of broadcast y (in equilibrium (b)) is closer to one than the interior location of station x (in equilibrium (a)). This is so because station y has relatively less viewers to loose than station x.

It is conjectured that with a higher density of viewers arriving early at home than those arriving late, circumstances may arise where both broadcasters choose interior locations.

3 Conclusion

Directional constraints are certainly important in some economic activities, like television news scheduling and airline departure times. Non-existence of pure strategies Nash equilibrium is troublesome. We have presented a simple variation of the model which yields pure strategies Nash equilibria in the presence of directional constraints. The departure from earlier work rests on the assumption that individuals have preferences over firms independent of their locations. Equilibrium locations are asymmetric due to the directional

[3]There is also an equilibrium in mixed strategies.

constraint, although firms are initially symmetric. The example shows that equilibrium existence can be recovered with mild changes in the model.

References

Cancian, M., A. Bills and T. Bergstrom. 1995. "Hotelling Location Problems with Directional Constraints: An Application to Television News Scheduling." *Journal of Industrial Economics*, **43**(1): 121–124.

d'Aspremont, C., J.J. Gabszewiz and J.F. Thisse. 1979. "On Hotelling's "Stability in Competition"." *Econometrica*, **47**: 1145–1150.

Gabszewiz, J.J. and J.F. Thisse. 1992. "Location". In R.J. Aumann and S. Hart, editors, *Handbook of Game Theory*, Vol.I, pp. 281–304.

Hotelling, H. 1929. "Stability in Competition." *Economic Journal*, **39**: 41–57.

Nilssen, T. 1996. "Sequential Location when Transportation Costs are Asymmetric." Memorandum 36/96, Department of Economics, University of Oslo, October.

Nilssen, T. and L. Sorgard, 1996a. "Time Schedule and Programme Profile: TV News in Norway and Denmark." Unpublished manuscrypt.

Nilssen, T. and L. Sorgard. 1996b. "Strategic Location with Asymmetric Transport Costs." Memorandum 35/96, Department of Economics, University of Oslo, October.