THE AUSTRALIAN NATIONAL UNIVERSITY
Centre for Economic Policy Research

DISCUSSION PAPERS

BROADCASTING REGULATION AND THE NEW TECHNOLOGIES

Martin Cave

DISCUSSION PAPER NO. 105

August 1984

G.P.O. Box 4, Canberra 2601, Australia
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ISBN: 0 949293 06 7
ISSN: 0725 430X

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Summary

Most economic analysis of broadcasting regulation has been predicated on the assumption of scarce frequencies. Yet new technologies for delivering programmes to households (cable, direct broadcasting by satellite, etc.) are eliminating that restriction. The paper analyses the appropriate regulations in the new circumstances. Following the Spence-Owen model of broadcasting regulation, it argues that both pay-broadcasting and a competitive industry structure become more attractive as restrictions on frequencies diminish. Finally, the paper briefly compares regulatory policies towards television in Great Britain and the United States and Australia, noting that they have been most restrictive in Australia, where concern to maintain the viability of existing broadcasters has frequently been an obstacle in the use of new technologies.
Introduction

Except in the United States, broadcasting has received relatively little attention from economists. This is unfortunate in view of long periods which most populations spend watching television, and the high estimates which have been made of the value which consumers place on programmes. Nonetheless, discussions of broadcasting typically focus on ethical and social considerations which are usually ignored in discussing the supply of other services; economic considerations tend to get pushed into the background.

In Australia, as elsewhere, the regulatory framework for broadcasting was established in the 1920s in the context of over-the-air radio broadcasting which required the use of a ‘public asset’—scarce frequencies. The need to allocate that asset in a way which precluded interference from one signal to

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another was one of the major justifications for the regulatory system. Television broadcasting was inserted into the same framework in the 1950s. However technological developments in recent years have weakened the constraints imposed by scarce frequencies. Techniques have been found for increasing spectrum use both extensively (using higher frequencies, for example) and intensively (by squeezing more signals into a given waveband). Satellites are providing a new means of delivering programmes either directly to households, or to earth stations for subsequent retransmission to households by conventional means. Cable provides a method of delivering programmes to consumers which avoids use of airwaves altogether. Finally, video recorders provide both a new means for distributing programmes and opportunities to store broadcasts for later consumption. The period when broadcasting regulation had to take account of spectrum scarcity is coming to an end.

In this paper I shall attempt to give a normative analysis of broadcasting regulation, and I shall also discuss some aspects of the regulatory response to new broadcasting technologies in Australia, Britain and the United States. Naturally that

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regulatory response is the outcome of numerous factors, many of which can be explained more satisfactorily in terms of positive rather than normative theories of regulation. However, my emphasis will be on the latter: what kind of regulatory framework is likely to achieve the economic efficiency and other goals imposed on the broadcasting system?

1. The Welfare Economics of Broadcasting Regulation.

This section discusses three aspects of regulation—regulation of sources of finance, regulation of market structure, and content regulation. If we temporarily abstract from the final aspect, then the feature of broadcasting which distinguishes it from most other goods and services is its public good property: the marginal cost of supplying an existing programme to a consumer in the reception area who has the appropriate equipment is zero. Thus, for economic efficiency, broadcast signals should be available free of charge to consumers willing to pay the associated private costs.


6. This assumes that perfect interpersonal price discrimination is not feasible and that the marginal consumer places a zero valuation on consuming a broadcast.
Existing methods of payment for the provision of broadcasts include finance out of general taxation, the imposition of a licence fee on owners of reception equipment, advertiser finance, and charges imposed on households levied either for each programme consumed ('pay-per-view') or for each channel made available for a specified period.

In countries with almost universal television ownership (by more than 95% of households in Australia) a licence fee system is almost equivalent to a uniform lump-sum tax, with the latter's normal efficiency-preserving but distributionally regressive properties. Programmes are then available at zero marginal cost, as they are of course when broadcasting is wholly financed out of general taxation. Advertiser-supported broadcasting provides programmes at zero monetary cost, the cost of the programming presumably being passed on in the form of higher goods prices. It does however impose on consumers the cost of exposure to commercial messages - a cost, which, though difficult to measure,
may be considerable. Distributionally, advertiser support has been shown in some countries to benefit lower-income households who (a) view more programmes, and thus enjoy a disproportionately high share of the benefits and (b) buy fewer and less advertising-intensive goods (and thus pay a disproportionately low share of the costs). According to one study, the redistribution towards low-income households accomplished by advertiser-supported television was equal to 10% of aggregate television advertising expenditure in the U.S. in 1968, and about 11% in Britain.

If we abstract for the moment from differences between programmes and assume that individuals have demand curves relating numbers of hours of (homogenous) viewing to price per hour, then we can analyse the departures from optimality implied by private provision of broadcasts, financed either by charges or by advertising. Broadcasting can then be viewed as a price-excludable public good - i.e. a good which is non-rival in consumption but from which certain consumers can be excluded wholly or partially (for example, by broadcasting in an encoded

8. Consumers have demand curves for advertisements many of which can be supposed to have stretches below the horizontal axis. Since viewers must consume programmes and advertisements in roughly fixed proportions, advertiser-supported broadcasting can be viewed as a form of price discrimination.

form, and requiring consumers to hire decoders). The private production of goods of this kind has now been quite thoroughly examined.

The (predictable) conclusion of these analyses is that unless the supplier is presumed to have perfect knowledge of individual demand curves, the private market will undersupply broadcasts, whether it is organised monopolistically or competitively, and whether or not all units of the good are charged at a uniform price. (We assume that interpersonal price discrimination is not feasible.) When the choice lies between uniform pricing per unit (in the broadcasting context, pay-per-view at an invariant rate) and all-or-nothing pricing (charging a fee for access to a channel for a period of time or ‘bundling’ of channels), the former will normally generate a higher level of welfare.


11. An example of non-uniform pricing across units would arise if different prices were charged for programmes broadcast at different times of day or if the number of advertising messages varied from time period to time period.

However it is obviously unsatisfactory to assume that broadcasting is a homogeneous product. The choice of market structure and of the source of broadcasting finance has to take account of product differentiation. In particular, the selection of programme type is likely to be affected by whether available channels are programmed by different suppliers or by a single monopolistic supplier.

The argument for common control is a straightforward application of Hotelling's principle of minimum differentiation, that when a small number of firms compete in supplying a good or service which varies in one or more dimensions, there will be excessive clustering or duplication of the good's attributes. In the broadcasting case the implication is that a limited number of competitive channels will broadcast similar programmes designed to appeal to the same mass audience, and neglect minority tastes. Suppose, for example, that of a total audience of 10,000, 8,000 prefer programme type A and 2,000 programme type B. Suppose also i) that there are two channels, both advertiser supported; ii) all programmes cost the same to make; and iii) advertisers place the same value on all members of their

audience. In a monopoly system, one channel will be devoted to each programme type, and the whole potential audience will be satisfied. In a competitive system each channel will broadcast a type A programme, and only 8,000 potential customers will be satisfied. In fact, if the audience divides equally, five channels would have to be available to guarantee availability of a type B programme. This result was noted by Steiner in the early 1950s, and he later applied it specifically to British television broadcasting, arguing for one mass-audience channel financed by advertisements, and a public service system dedicated to minority tastes.

But note that Steiner’s result depends on some fairly restrictive assumptions. Firstly, entry must be restricted; otherwise all minority programmes with break-even audiences will be supplied, and the cost of competition is limited to unnecessary expenditure on duplicated programmes. Secondly, the audience is assumed heavily skewed; with a 6:4 audience split in the above example, both programme types could be supplied with

14. The last two assumptions can clearly be relaxed by making the obvious adjustments.

only two channels, organised competitively. Thirdly, it is assumed that programmes within each type are perfect substitutes, so that duplication yields no benefits. Yet not all consumers will be indifferent between any two programmes, so that ‘duplication’ yields some benefit, and competition within the same programme type generates pressure for a higher quality of output. Fourthly, it is assumed that consumers will switch off rather than watch a second choice of programme.

The importance of this last point is shown if we amend our numerical example above by supposing that there is a third programme type C, which all households will watch as a second choice (a ‘common denominator’) in preference to switching off. In this case a profit-maximizing monopolist will only broadcast a type C programme, leaving the other channel dark. Under competition, only type A programmes will be broadcast. The choice thus lies between giving four-fifths of the audience its first choice, or the whole population its second choice. Which should be preferred?

On our present assumption that household tastes are decisive, the correct answer is that it depends on the values which households place on the respective programmes. Measuring benefit

by audience size (as did much of the early discussion of broadcasting regulation) is crude and unsatisfactory. The relevant consideration is the area under the demand curve for each particular programme or channel, not a simple head count of viewers. This demand curve is, of course, affected by technological developments, for example, the ability to store programmes for later viewing.

The most complete attempt to analyse the problem in these terms has been made by Spence and Owen, as an application of the former's analysis of product selection under monopolistic competition. Rather than present a formal version of their model I shall simply give an intuitive account of it and discuss some of their results.

The analysis assumes that the choice lies between programme charges and advertiser finance as sources of broadcasting finance, and between monopoly and monopolistic competition as market structures. Regulation is thus conceived explicitly as a second-best problem. We first consider the biases in prices and programme selection generated by charges. Clearly the departure of price from marginal cost is one source of inefficiency

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generating sub-optimal consumption levels of given programmes. But there is a bias in programme selection as well. Programme suppliers are unable to capture as revenue the total surplus generated by their programmes, and hence will fail to supply some programmes which yield a positive net surplus but a negative net profit. These will typically be programmes with steep inverse demand functions; these are precisely programmes with small groups of high-value viewers after which the reservation price falls off dramatically. It can also be shown that there is a special bias against costly programmes. These biases apply whether broadcasting is monopolistic or monoplistically competitive, but are likely to be more severe in the monopolistic case; a monopolistic system will raise prices and reduce programme supply further than a competitive system, because the monopolist, when deciding whether to introduce a new programme, considers the effects of its introduction on the audiences of (and profits from) existing services.

When broadcasting finance is via advertiser support, the distortion introduced by a positive price is reduced or eliminated (assuming that the implicit price of watching commercial messages is less than the programme charge). However, the programme selection bias is magnified. Under advertiser-support, broadcasters attract an audience by offering

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10. Spence and Owen, op. cit., in note 17, p.112.
'free' programmes and then wholesale that audience to advertisers at rates which depend on audience size (and composition) but are generally independent of the satisfaction generated by the programmes which the advertisements surround. Thus the bias noted above against programmes with small but very appreciative audiences applies with even greater force. Again, the restriction on programme variety is more severe under monopoly than under monopolistic competition.

It is impossible to provide a general answer to the question of whether our assumptions charges or advertiser support produce a better outcome. However, Spence and Owen do reach some suggestive conclusions based on one particular case of their model: the special case where all potential programmes have the same demand curve and the same cost level, and where there is a uniform degree of substitution between any pair of programmes. These assumptions are sufficient to generate equal audiences for all programmes, and the outcome of any combination of assumptions about market structure and financial arrangements can then be summarised on the accompanying figure.

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19. This case is set out in more detail in the Appendix.
The first best optimum is 0. There every programme whose surplus exceeds its costs is produced and made available to consumers at zero price. In general, competitive pay-broadcasting (CP) is below and to the left of 0, with monopolistic pay-broadcasting (MP) below and to the left of CP. Competitive advertiser support generates point CA, while monopoly advertiser support generates point MA.

We do not know the shape of the iso-social welfare lines centred on 0, so we cannot directly compare CP and CA (or MP and MA). But it is possible to identify the effects on that comparison of a number of factors. Firstly, the closer substitutes the programmes are, the more point 0 moves downwards and to the right; hence 1) advertiser-support becomes relatively more attractive, as the harmful effects of its limitation of programmes diminish, and ii) monopoly becomes relatively more
attractive (Steiner's result). Secondly, if there is a limit on the number of channels available, because of spectrum shortage or for any other reason, then the balance of advantage moves in favour of advertiser support, as the compensating advantage of pay-broadcasting (greater variety) ceases to apply.

Before going on to draw out the policy implications of these results, we should review the assumption that consumer tastes in broadcasting are sovereign. Arguments against this proposition (and often in favour of some form of content regulation) generally reduce to one or more of the following: i) consumers lack the information to make a well-informed choice of programmes; ii) consumers have the appropriate information, but have the 'wrong' tastes; iii) consumers' tastes are endogenous, an artifact of suppliers' programme decisions; and iv) viewing or listening to broadcasts is an activity which spills over into behaviour which affects others; some kind of intervention in programme selection is thus required to correct the externality.

The first two arguments are often conflated, as gloriously illustrated by the observation in 1924 of J.C.H. Reith, then managing-director of the British Broadcasting Company: 'it is occasionally indicated to us that we are apparently setting out to give the public what we think they need - and not what they want; but few know what they want, and very few what they
need. Nonetheless, information remedies are the more natural way to solve the first problem. On the other hand, the second argument — that some programmes are ‘merit’ goods and other ‘demerit’ goods — does provide an (admittedly flexible) ground for content regulation of some kind.

The argument that tastes are endogenous raises problems for welfare economics identical with those encountered in analyses of the effects of advertising, which have not been satisfactorily solved. The argument can be made that if programme suppliers can manipulate tastes, then should not a regulatory body either prevent that manipulation or itself choose how tastes are going to be moulded? Again, this provides a very flexible ground for content regulation. The argument becomes conceptually much easier if patterns of viewing or listening spill over into behaviour which affects others. An enormous literature has grown up on the effects of viewing pornographic and violent materials


21. The ‘Australian content’ rules provide a possible illustration of how regulatory intervention can influence tastes. Minimum quotas for Australian programmes were introduced in 1973; many such programmes have now become highly popular, and most channels significantly exceed their quotas. Some writers have viewed the policy as purely symbolic (K. Harrison, The Points System for Australian Television Content: A Study in Symbolic Policy, RIPA, Brisbane, 1980). But it can be viewed as a successful regulation-promoted manipulation of consumer tastes; or alternatively as an illustration of the ‘infant-industry’ argument, if the increased output led to significant quality improvements.
in particular. The results are highly inconclusive, but nonetheless content regulation of this kind is widespread.

The results of this discussion can be summarised as follows. The case for regulation of broadcasting derives from market failures of various kinds, some of these market failures being the result of consumer misperceptions, others the more familiar departures from optimality associated with public goods and externalities. If we take consumer tastes as sovereign, then all forms of broadcasting organisation (apart from provision of programmes at a zero price by an omniscient authority) involve some departures from optimality. In particular, Spence and Oxen show that both pay-broadcasting and advertiser support introduce systematic distortions: i) against programmes with steep demand curves and ii) against expensive programmes; the bias being stronger under advertiser support. Moreover, pay broadcasting becomes relatively more attractive as the number of channels increases. These results imply potential role for a public broadcasting service to fill in the gaps left by commercial broadcasters, especially in providing for minority tastes. Public broadcasting might also be used to supply programming which is deemed desirable in terms of content but which would not

otherwise be supplied. However, if such programming is to reach a wide audience it may also have to be imposed on commercial broadcasters. If entry is unrestricted the price paid for imposing such a policy would be a decline in profitability, and a reduction in the number of channels available. If entry is restricted and positive profits are being earned, the last effect will be avoided.

II. Regulating New Technologies

In this section I review the regulatory options available for dealing with the new broadcasting techniques, and make some observations on the policies adopted in Australia, Britain and the United States.

The regulatory agency has little difficulty in implementing whatever decisions are made about broadcasting finance. Of course pay broadcasting involves higher transaction costs, as over-the-air broadcasts have to be encoded and then decoded by customers. Cable delivery systems also require special equipment to restrict the supply of certain signals to particular homes. (These costs may be quite high if 'pay-per-view' is adopted and metering is necessary.) Nonetheless, few serious economic problems arise relating to the implementation of whichever policy is adopted.
The specific nature of the delivery technology may however have an impact on the choice of market structure. This applies particularly to the case of cable. Cable provides a virtually unlimited number of channels and on that score seems to offer favourable opportunities for competitive broadcasting. Nonetheless, there are potential natural monopoly elements in cable delivery systems which seem to operate in favour of monopoly. These questions have been debated under the heading of the 'separations' issue: should the functions of supplying cable broadcasts be split between a (possibly competitive) system of programme supply, and a (possibly monopolistic) system for programme delivery?

Most authors are prepared to concede that the delivery system is a natural monopoly. In the US, only a tiny minority of municipalities have competing cable systems. There is also evidence from cost data. According to Owen and Greenhalgh, when a 56-channel cable system is divided into two 28-channel systems, each with the same number of subscribers, costs increase by 49%. But when a given number of subscribers is divided equally between two systems, each providing the same number of channels, costs

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23. In many cases, however, this is the outcome of a regulatory decision (exclusive franchising) rather than market forces.
rise by only 18%. Economies across products thus dominate economies across customers. Nonetheless, the latter may still be sufficient to prevent the emergence of competitive full-service systems.

However, the supply of programming is not a natural monopoly, and this has led some writers to propose a competitive arrangement in which the delivery system acts as a 'common carrier', leasing channels to programme suppliers, possibly on a non-discriminatory basis, and possibly subject to price regulation. The advantage of this arrangement is that it prevents a monopolistic cable operator from restricting the number of channels made available to customers and raising prices. The disadvantages are that transactions costs (billing, programme information etc.) may be higher if channels are programmed independently, and that a uniform fee per channel may reduce the range of programmes available. Thus some services might be discontinued if they can pay a delivery fee equal to the marginal cost of delivering the programming to the customers, but not a fee equal to the average cost per channel.


25. For an exhaustive analysis, see Besen and Johnson op. cit. in note 24.
One response is to allow cable operators to lease channels in return not for a uniform fee per channel, but for a uniform percentage of the programmer's gross revenues. However the policy which has generally been adopted avoids imposing mandatory separation, but acts to circumscribe the cable operator's monopoly power in other ways. These may involve requiring the operator to carry certain programmes free-of-charge, prohibiting the operator from acquiring exclusive rights to certain programming, or requiring that a proportion of channels be leased to competing suppliers. Alternatively, the monopoly licence or franchise may be allocated through a 'Chadwick auction', in which firms compete with one another in undertaking to make a given package of services available to households at the lowest possible price. The same set of arguments obviously applies not only to cable but to any delivery system which exhibits natural monopoly properties.

It is now time to review some regulatory responses to the new technologies in terms of the analysis set out in the first part of this paper. Their diffusion is most widespread in the United

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States, where in 1981 cable television had reached 23% of television homes. The relevant regulatory body, the Federal Communications Commission, has pursued inconsistent policies towards cable, first declining to regulate it at all, then imposing a complicated series of restrictions, and more recently adopting a general policy of deregulation of all kinds of broadcasting, including cable, direct broadcasting by satellite, and other new technologies. The new approach is characterised by the current chairman of the FCC as the abandonment of the 'public trusteeship' model of broadcasting regulation based on 'the amorphous "public interest" standard', in favour of a marketplace approach based on broadcasters' perceptions of public demand. The result is a proliferation of channels, some financed by charges, some by advertising, some by voluntary subscription, with diminishing content regulation.

The British government has also chosen to adopt the new technologies of cable and direct broadcasting by satellite (DBS) as a supplement to the existing four over-the-air television channels (two sets of complementary channels, one financed by licence fee, the other by advertising). A number of cable

franchises have already been allocated, and the government envisages that DBS will begin in 1987-8, as a monopolistically controlled service provided jointly by the BBC, existing commercial television companies, and independent producers. Three years after the start of operation, two further channels will be made available for competitive services. These decisions seem to have been adopted not so much on grounds of broadcasting policy as for industrial policy reasons - the desire to establish a strong domestic market for high technology equipment as a springboard to export sales. Nonetheless, their effect is to introduce both pay services and increased competition into broadcasting, although in a highly regulated way.

The approach in Australia has been considerably more cautious. In 1980 the Minister for Posts and Communications instructed the Australian Broadcasting Tribunal to hold an inquiry into cable and radiated subscription television services (RSTV). The report, published in 1982, favoured the development of both cable and RSTV as soon as practicable, but recommended a framework of

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regulation the chief elements of which were as follows:

i) cable and RSTV operators should be licenced by a regulatory body;

ii) only one licence of each kind should be issued for each service area;

iii) certain technical standards should be imposed;

iv) there should be various limitations on ownership;

v) a ‘must carry’ rule should apply to local services;

vi) there should be a prohibition on the importation of ‘distant signals’ from other television markets;

vii) there should be no regulation of charges, but advertising material should be prohibited on enhanced services;

viii) undertakings relating to Australian content should be a consideration in the allocation of franchises;

ix) the grant of a licence in any area may take into account the need to maintain the commercial viability of existing stations.

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In 1983, the Labor government announced a decision not to proceed at present with cable development. The Ministry of Communications has, however, solicited proposals for RSTV services for each of five areas. The preliminary guidelines envisage restrictions similar to those on existing broadcasters; these relate to licencing (a five-year initial licence, renewable for three years), ownership and control, and Australian content. The service would be financed wholly by subscription, and no advertising would be allowed. Licence holders would enjoy a monopoly for five years but entry might then be permitted.

Finally, the government has so far adopted a fairly restrictive approach towards the use of satellites for broadcasting. A decision has already been made to restrict direct broadcasting by satellite from the first two satellites (to be launched in 1985) to the Australian Broadcasting Corporation, chiefly to deliver programmes to remote areas. This leaves open the role of satellites in distributing programmes within Australia for retransmission by conventional means. The Australian Broadcasting Tribunal has recently completed a report on the regulation of satellite programme services.

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In this use satellite transmission simply replaces conventional terrestrial distribution. It does, however, have superior range and flexibility, and can also relay a signal to any number of receivers within the relevant reception area (or 'footprint'). It therefore makes networking - the simultaneous broadcast of the same programme by many stations - easier to accomplish.

By itself, the advent of the satellite as a means of distribution would not have a major impact on broadcasting in Australia. But its arrival coincides with plans to extend the number of commercial stations in non-metropolitan areas either by granting a competitive licence, or (where such a policy is not viable) by granting existing licencees one or possibly two supplementary licences, thereby creating multiple-channel local monopolies. The increased demand for programming thus created will further the development of networking at a time when the satellite makes it technically feasible. It is therefore reasonable to expect a system to develop in which networks with simultaneous programming and national sale of advertising time play an increasing role.

The outcome of the system depends importantly upon the number of outlets in each market and the degree of regulation of contract terms. With three channels in each market, it is likely

34. Ibid, Vol. 1, Ch. 2, PP.52-63, 80-81.
that each will develop a relationship with one of the three networks. Since those networks programme competitively in the metropolitan areas, the same practice will be transferred to regional stations even if they are controlled monopolistically. Restricting regional areas to two channels will increase the licencees' bargaining power vis-a-vis the networks, and enable those licencees to develop relationships with more than one network; it may thus encourage complementary programming. The same outcome could be achieved by regulating contractual terms between licencees and networks—for example by prohibiting agreements which require the licencee to broadcast programmes at network-determined times or which share advertising revenues in ways which discourage programming from other sources than the network. The Tribunal itself proposes, as one possible means of preventing dominance of television stations in Sydney and Melbourne, the establishment of three networking consortia, each jointly owned by metropolitan television stations (one from each mainland capital) which would provide programmes and national advertising to all stations.


III. Conclusions

This paper has only focused on a few of the many aspects of broadcasting regulation and has limited itself as far as possible to considerations of economic efficiency. The general implications of the analysis are that market solutions to the broadcasting problem involve departures from optimality which create a potential role for public intervention (including supply of programmes) and that in the absence of (or with imperfect) intervention, the nature of the best attainable outcome which can be generated by the market is sensitive to the number of channels available.

Of the three countries considered, Australia has so far shown itself least willing to alter the structure of broadcasting regulation in the face of the possibilities created by the new technologies. There are many possible reasons for this, but it is hard to avoid the conclusion that concern for the viability of

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37. Neglected aspects include the regulation of ownership and control, and procedures and criteria adopted in the licencing process.

38. For a more general discussion, see, for example, H. Mayer and K. Harrison, 'Broadcasting Regulation: Australia's Dilemmas', Studies of Broadcasting, No. 2, 1984, pp.57-90.
existing broadcasters is a major one. This concern will have to be diminished before any of the pro-competitive policies analysed here can be introduced.

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39. Such concern is a long-standing feature of broadcasting regulation (see Cole, op. cit., in note 5 above, esp. pp.78-9), and one embodied in the Australian Broadcasting Act (Armstrong, op. cit., in note 2, pp.155-6).
Appendix: The Spence-Owen Model in the Uniform Case

Notation

\( n \) = number of programmes broadcast
\( x \) = audience per programme
\( F \) = cost per programme
\( z \) = price per viewer paid by advertisers
\( p \) = price charged each consumer for viewing
   a programme (either a monetary charge or an implicit charge for viewing advertisements)
\( A \) = a measure of the degree of substitution between programmes

All the variables are assumed uniform for all viewers or programmes.

The benefit generated from viewing the \( i \)th programme is assumed to take the form:

\[
B(x_i) = f(x_i) - \frac{z}{A} (n-1),
\]

where \( f(x_i) \) is concave. This corresponds to the case of a uniform downward-sloping demand curve for each programme, which is shifted inwards towards the origin the greater the degree of substitution between programmes (the greater is \( A \)) and the larger the number of programmes available (the greater is \( n \)).
The net surplus generated by all programmes together is given by the sum of the benefits from viewing those programmes minus the costs of producing them plus advertising revenues they generate.

\[ T(x,n) = nf(x) - Ax(n - n) - nF + nzx. \]

When price \( p \) is charged for viewing a programme, the marginal viewer equates his or her benefit from consuming that programme to the price:

\[ p = f' - 2Ax(n-1). \]

Summing over viewers and programmes, we derive expressions for industry revenue and then for industry profits \( S \), which are maximised by a monopolist

\[ S(x,n) = nxf' - 2Ax(n - n) - nF + nzx. \]

It can be shown that the function implicitly maximised in monopolistic competition is

\[ R(x,n) = nxf' - Ax(n - n) - nF + nzx. \]

The points marked in figure 1 are then found by maximising $T(x,n)$, $S(x,n)$ and $R(x,n)$ with respect to $x$ and $n$, setting $z=0$ for pay broadcasting and $p=0$ (or equal to the implicit cost of viewing advertisements) for advertiser support.