Faddists, enthusiasts and Canadian divas: a model of the recorded music market

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Faddists, enthusiasts and Canadian divas: a model of the recorded music market*

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Abstract

This paper constructs a model of the provision of commercial music in which some consumers (enthusiasts) enjoy diversity and others (faddists) prefer to follow what is popular. Record companies sign up bands, only some of whom will 'succeed' – a process modelled in a number of alternate ways – and radio stations broadcast recordings. Consumers hear music on the radio and purchase recordings, where the likelihood of purchase depends, in part, on the extent of radio airplay for a particular recording. We show that consumers' taste for diversity leads to under-entry in general and we illustrate the working of the model by considering the impact of a local content quota in broadcasting. It is shown that a quota that restricts the airtime devoted to foreign music induces a shift in the pattern of band entry into 'international' genres. But a mild quota is welfare-improving in this model: even though the diversity of local music is reduced, the quota increases the number of new entrants, drawn in by the increased profitability of success. We also discuss the consequences of a quota that requires increased broadcasting of 'new' music and show that, while the addition of the 'new' band component decreases the total amount of time devoted to listening to the radio by consumers (yielding a welfare loss), it does nothing to a record company's incentives to sign up new bands.

Keywords: *recorded music, local content, radio broadcasting, cultural quotas*
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1. Introduction

This paper constructs a model of the market for recorded music, modelling consumers (as both radio listeners and purchasers of recordings), radio stations, record companies and content providers ('bands'). Consumers are divided across genres of music and, while all enjoy diversity in radio airplay in their preferred genre, some are faddists, who purchase only the latest hits from established bands, be they foreign or domestic, while others are enthusiasts who might also purchase from new (domestic) bands. In any genre there is a set of new domestic bands that could potentially be contracted by a record company and some (endogenous) subset is, in fact, so contracted. After one period, some bands 'succeed' and survive as established bands; the rest disappear. Record companies extract any record sales revenues and rents from other activities (concerts and the like) from contracted bands for up to two periods, after which surviving bands are off-contract and retain any such income themselves. Genre-specific radio stations choose the airplay mix between new and established bands to maximise the listening time of their audience (in order to sell advertising time[1]) and consumers only purchase the recordings of bands aired on the radio.

We illustrate the workings of this model by considering the imposition of a 'simple' local content quota in broadcasting in this setting – one that just specifies an upper limit on the share of airtime devoted to international bands – and deriving its steady state effects on entry decisions and, importantly, welfare. We show that it induces a shift in the pattern of band entry into 'international' genres. Nevertheless, we show that a mild quota[2] will be welfare-improving in this model, for (*inter alia*) a novel reason: it raises the profitability of successful domestic bands and thus

[1] Mangani (2003) considers a model of broadcasting in which programs differ along both a vertical and a horizontal dimension and in which profit maximisation and audience maximisation are different things. This is not the case here.

[2] We use 'mild' to describe a quota that is just binding in a genre, rather than 'small', as a small quota is actually one that is extremely binding (i.e. it allows only a small share of foreign music.)

encourages entry by new domestic entrants, the increased diversity of which appeals to some consumers. In practice, some countries have refined their quota instruments to remedy what is perceived to be a possible problem with the simple quota: the latter can be met (and is met, in our model) by increasing the airplay of only established domestic bands and thus appears to do little for new but untested domestic talent. France, for example, requires that a specified fraction of the local content quota must be met by the playing of 'recent' recordings.[3] We also discuss the consequences of such a quota in our model and show that, while the addition of the 'new' band component decreases the total amount of time devoted to listening to the radio by consumers (yielding a welfare loss), it actually does nothing to a record company's incentives to sign up new bands.

Many countries prevent domestic broadcasters from freely choosing the proportions of international and 'domestic' content that they broadcast. Why? There are two broad arguments put forward for 'cultural protectionism' in general. Mas-Colell (1999) draws a useful distinction between "protection of national cultural production" and "protection of the production of national culture." The former of these is protection designed to maintain the existence of a particular industry, be it sound recording or movie-making and, as Mas-Collel suggests, it is difficult to see why the case for such protection is much different to the case for preserving shoe-making, car assembly or any other sector of the economy.[4] The second term, however, refers to policies designed to, "promote the availability and consumption of

[3] "French music radio stations must broadcast a minimum of 40% French music (50% of which must be dedicated to "new" French artists)." American University ICT Database (2001). For more on the prevalence of local content requirements in broadcasting see the Appendix to this paper.

[4] It has been suggested that preserving cultural production industries might be necessary to enable achievement of the second goal. As Productivity Commission (2000) reports, "[m]aintaining a particular level of activity for Australian film and television production industry is not a stated objective of the current legislation. However, it is often argued that of production activity falls below a certain (unspecified) level, the cultural and social objectives could not be achieved)" (p.380).

[cultural goods] transmitting "Spanish", "French" or "Catalan" content: language, historical episodes, costumes, traditions, and the like." While the former is certainly cited by proponents of cultural protection[5], the principal arguments made for cultural protection are of the latter sort: that cultural industries[6] should be protected to save unique aspects of the local culture and identity and to foster global cultural 'diversity'.[7]

There are two ways in which broadcasting quotas could conceivably be used to achieve these goals. Requiring radio stations to broadcast more domestic music, for example, directly increases the demand for local recordings by the radio stations themselves. Of much more likely significance is that being exposed to domestic music on the radio leads consumers to purchase more such recordings themselves. To the extent that domestic content is different to international content, it is argued that this mechanism would sustain a larger market share for domestic content.

But a binding local content requirement in broadcasting presumably constrains broadcasters from choosing the airplay mix they prefer and that, in turn, presumably is designed to maximise some perception of the welfare of their listeners (in order to maximise the 'ears' that can be sold to advertisers.) So a content requirement would

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[5] See Gordon and Meunier (2001) who cite former French Culture Minister Jack Lang as stating, "that "the traditional market system cannot always assure the necessary financing" to keep French cinema in business, and other analysts [who] point to American control of distribution channels, massive marketing budgets, and unwillingness to show subtitled films as among the reasons for the American domination [of French markets]." (p.29.)

[6] The scope of industries that might be considered 'cultural' is vast, including food industries, protected under geographical indications legislation as well as more directly. Gordon and Meunier (2001) (p.30) cite the following position of one French commentator: "McDonald's … commercial hegemony threatens our agriculture and its cultural hegemony insidiously ruins alimentary behaviour – both sacred reflections of the French identity."

[7] This is by no means an uncontroversial proposition. It finds an extravagant expression in the words of ex-French President Mitterand, cited at p.1147 of Acheson and Maule (2006): "Creations of the spirit are not just commodities…What is at stake is the cultural identity of all our nations… A society which abandons to others the way of showing itself, that is to say the way of presenting itself to itself, is a society enslaved." By contrast, Revel (2003) perceives the French position as being essentially one of anti-Americanism and writes, "[t]he idea that a culture can preserve its originality by barricading itself against foreign influences is an old illusion that has always produced the opposite of the desired result. Isolation breeds sterility."

be expected to impact on welfare through distorting this mix. Furthermore, a content requirement may not bind on all genres of airplay. It will be particularly relevant where there is a greater preference for international content and one might anticipate that it will induce a shift in airplay away from international providers of those genres towards domestic artists in the same genre. Finally, if there is a positive link between airtime and recording sales then a binding quota will presumably induce entry by content providers into these constrained genres. As a consequence, it might be thought that a local content quota will lead to the increased 'internationalisation' of domestic music: Celine Dion, Shania Twain, Avril Lavigne and other Canadian singers become essentially indistinguishable from American singers.[8] This, of course, is an effect that runs directly contrary to the stated intentions of the protection in the first place.

There is an extensive literature on the economic analysis of broadcasting but few authors address the issues focussed upon here. In particular, we are not aware of any literature that formally models the artist/record company/radio station/consumer interaction. A number of economists have looked at radio broadcasting, informally discussing general issues (Coase (1966)) or formally modelling theoretical and econometric analyses of specific aspects of the market (Berry and Waldfogel (1999a, Berry and Waldfogel (1999b), Anderson and Coate (2005) and Rogers and Woodbury (1996)). There is a long literature addressing the question of optimal program diversity and its relationship to market structure (see, for example, Doyle (1998) and Richardson (2006)) but in the context of models in which a broadcaster chooses its

[8] Hence our titular reference. Our first encounter with the term 'Canadian divas' was in an online opinion piece of Paul Krugman's suggesting that, "Boston residents who indulge their taste for Canadian divas do undermine the prospects of local singer-songwriters and might be collectively better off if local radio stations had some kind of cultural content rule" Krugman (1999). He goes on to note that, "there is a very fine line between such arguments for collective action and supercilious paternalism, especially when cultural matters are concerned".

programming mix from some spectrum. There is a substantial policy-oriented literature discussing cultural quotas and related issues at an informal level (see, by way of example, Acheson and Maule (1990) and Jacobsen (2000)) but we are aware of only a few recent papers that construct formal models of cultural protection.

Francois and van Ypersele (2002) present a model in which cultural goods are produced in different countries under increasing returns to scale (with a fixed cost) 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 the production of cultural content, the market structure of the industry that generates it and the media that present that content to consumers. Our policy instrument is a restriction on those media rather than on the underlying goods themselves and the fixed cost of domestic content production is not a critical determinant of the effect of local protection.

In a similar vein to Francois and van Ypersele, Bala and Long (2005) construct a dynamic 2-good model in which consumers have preference for one good or the other and in which preferences can evolve over time. In particular, consumers with a preference for one particular type of good replicate in the population over time according to the inverse of the relative price of that good. They show that an autarky economy can sustain an equilibrium with both goods being produced and

heterogeneity of preferences existing in steady state. Trade with a larger economy can then eradicate one of the preferences in the population, what they describe as "the demise of cultural diversity." Again, this is a model with a very different agenda to that of the present paper, in that, like Francois and van Ypersele, it presents a model in which autarky may be preferred to free trade for 'cultural' reasons. Our paper focuses more specifically on a particular sector and a particular policy instrument.

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

Richardson (2006) does model a cultural quota explicitly in a setting of radio broadcasting. However, his focus is on the effects of such quotas on commercial radio broadcasters and advertisers and he does not consider the domestic supply response (and therefore the incentives of record companies) at all.

Finally, Perona (2010) is a recent paper that articulates explicitly the suggestion made above that a simple quota can be met just by putting established domestic artists on higher rotation. In his model there is a domestic and a foreign title in each of a continuum of genres and each consumer prefers a particular genre. Each consumer considers the two titles to be complementary in the sense that a consumer has a taste for diversity and a balance of the two titles and, importantly, each consumer's utility is increasing in the amount of airtime devoted to her preferred genre. Radio stations then choose the range of genres they will broadcast, aware that consumers have an outside option of not listening to the radio at all so that they must

hear a sufficient quantum of their preferred music to keep the radio switched on. Perona considers both the monopoly radio case and that of two competitive stations and shows that the imposition of a local content quota leads stations to broadcast a smaller interval of genres. The reason is that the enforced change in domestic/foreign mix in the genres it broadcasts makes listeners worse off, *ceteris paribus*, and, in order to ensure that they still value the listening experience sufficiently to keep the radio on, more airtime must be devoted to the genres still being broadcast. But this comes at the expense of marginal genres and the consequence is that a smaller range of genres is broadcast in the presence of the quota than in its absence: a decrease in diversity. While Perona's model addresses local cultural content requirements explicitly, it focuses on the decisions of radio stations and leads to changes in diversity along the dimension of genres broadcast. Our scope is rather more broad, looking at the decisions of suppliers of content – bands and recording companies – as well as the broadcasting choices of radio stations. We emulate his "loss of diversity" result but for rather a different reason: rather than dropping some genres entirely, we find that, for a certain type of quota, the numbers of radio stations in some genres fall and this is primarily in genres that are "intensive" in foreign music. Furthermore, a quota in our model induces an increase in the number of domestic new entrant bands seeking contracts and, in this relative sense, decreases the diversity of domestic music across genres: a greater proportion of domestic new bands are concentrated in quota-constrained ('international') genres.

The remainder of the paper is organised as follows. Section 2 lays out our model, section 3 explains the timing of actions by the various players and section 4 exposits the laissez-faire, no-quota equilibrium of the model. Section 5 analyses the impacts of local content quotas, a further two sections consider the robustness of the

analysis, including its robustness to issues of technological changes (such as internet downloading and internet radio), and a final section summarises and concludes.

2. *The Model*

We consider a model in which there are four sets of actors: bands (B), record companies (R), Radio Stations (S) and Consumers (C). The model is effectively an overlapping three-period model. In any period there is a set of new entrant bands as well as old bands that have 'succeeded' and are either still under contract to record companies or have gone off-contract. All new entrants are domestic: some of these will go on to 'succeed' in the next period whilst others will fail. We consider each set of actors in turn.

i. Bands

We make a 'small country' assumption: all foreign bands are, by definition, 'successful' and may be either on- or off-contract with record companies – foreign bands are signed by foreign companies and any rents accrue offshore.[9] There is a large number of potential new domestic bands indexed by j =1,2,… that might enter into genre g and an endogenous subset M_g actually do so.

New bands entering a genre $g \in G=\{1,2,...,G\}$ incur some fixed cost F_B to do so and are approached by record companies and contracted (or not). In the first period bands make record sales that depend (positively, as discussed further below) on their airtime a (and, in a case discussed below where bands have different qualities, on that quality too) but earn nothing from this, as they are under contract to a record company. In any genre, some new entrants will fail and disappear while others will

[9] Under this specification there is no interest group that represents the interests of international music (and so would oppose any quota directly.)

succeed and survive into the next period. We discuss the determination of this success in some detail below. A successful band is identified as such by all record companies but is pre-contracted to its original company, as explained next. We assume that successful bands not only sell records but generate a rent in each period – this might depend on concert revenues, T-shirt sales and so forth. In the first period of success this, too, accrues to the record company. There is a common exogenous probability 1-h of exit for a successful band after one period of success (under contract) so with probability h a successful band in its second period of life goes on to become a successful band in the third (and final, for the band) period wherein any rents accrue to the band, as it is off contract. In any genre, then, there will be, at a point in time, a set of n_g* successful foreign bands, n_{g2} successful domestic bands on contract, n_{g3} successful domestic bands off contract and n_{g1} new domestic entrants, for a total of $N_g \equiv N_{gs}+n_{g1} \equiv (n_g^*+n_{g2}+n_{g3})+n_{g1}$ bands in genre g.

ii. Record Companies

Each of an exogenous number of record companies incurs a fixed cost in period one, F_1, for managing a new band (which covers recording and promotion expenditures) and a fixed cost in period two, F_2, for managing a successful band that is still on contract. Each record company is associated with specialisation in a particular genre (so our record companies can alternatively be thought of as independent units within record companies): there is a one-to-one mapping between the set of record companies and the set of genres. In the case, discussed later, in which bands vary in

some quality dimension, we suppose that record companies cannot observe the quality of a new band *ex ante*.[10]

A record company will consider the set of new entrant bands in its genre (M_g), choose a number of them to sign up (n_{g1}) and offer them a contract that involves a payment to the band in return for the record company being entitled to all revenues from the band for its first two periods: record sales less the negative revenue of F_1 in the band's first period and the band's second period record sales and rents (if successful) less F_2. Because bands commit to a genre before a contract is signed and because each genre has a single record company in it, so all surplus from the relationship can be extracted by the record company. We assume bands have an outside option valued at zero; hence the equilibrium contract offer to a band is zero.[11] Nevertheless, every new band costs the record company F_1 to record and promote and it will seek to make money particularly on those bands that subsequently succeed.

A record company then records its new artists and presents and promotes these bands to radio stations.

iii. Radio Stations

As our focus in this analysis is on the responsiveness of producers – bands and record companies – to cultural quotas, we do not model the decision-making of radio stations completely. Each of K_g (endogenous) radio stations incurs an entry cost F_s and specialises in genre g. Each station's effective objective is to maximise the time its

[10] So all new releases will optimally be priced the same as the record companies do not suspect which are more likely to succeed. We assume, however, that the recordings of established bands are also sold at the same price: see footnote 14.

[11] One might consider that a band could be offered less than this, too: it could self-fund some of F_t either directly or through borrowing. But the unobservability of a band's quality makes the latter infeasible (in the case where bands differ in quality) and if we assume that bands have zero assets, the former is also infeasible. Furthermore, we take the 2-period contract as exogenous to capture an observed feature of reality.

listeners devote to listening to it (which enables it to sell more (unmodelled) advertising) and this entails maximising the welfare of its audience, insofar as it can. The station has a fixed endowment of airtime to allocate to bands, normalised to one, and we assume it faces a two-stage problem in this decision: first it chooses the allocation of this airtime across the successful, established bands and the new entrants and then it decides how much of each of these divisions to allocate to each band in that category. We assume that each station receives α in advertising revenue per unit of listener time it attracts to its programming.[12]

iv. Consumers

Two types of consumer derive utility from a particular genre[13] of music from two sources: listening to it on the radio and buying a recording. The L consumers are divided across the genres exogenously such that a fraction λ_g listen to genre g (so $\sum_g \lambda_g = 1$) and we assume consumers are loyal to their genre (in the sense of obtaining higher utility, generically, from music in that genre than from music in other genres; we normalise the value they place on other genres to zero.) All consumers consider new music and established music to be differentiated generically. Within genre g some consumers – an exogenous fraction μ_g – are 'enthusiasts' or 'purists': they value diversity within their preferred genre and derive utility both from hearing music on the radio and from purchasing the recordings of their favourite new artist. The remaining fraction $1-\mu_g$ of a genre's consumers, however, are 'faddists': they derive utility from being part of the latest fad and buying the recordings only of successful

[12] So a radio station broadcasts throughout the day – one unit of time – and splits that between new and established bands. A consumer listens to the radio for, say, t_i units of time – less than one – and it is assumed implicitly that that is randomised across the day so that a consumer will hear new and established bands in the same ratio in which they are played by the radio station.

[13] Berry and Waldfogel (1999b) note that there is a positive and significant relationship between the number of different formats offered in radio broadcasting – our genres – and the share of the population that actually listens to the radio, suggesting that consumers do, indeed, have genre preferences.

artists, domestic and foreign. Both kinds of consumers' problems, as we shall see, boil down to which recording to buy and how much time to devote to radio listening.

For tractability we assume that all consumers in any genre are equally split across the (identical) radio stations in the genre and have identical Cobb-Douglas preferences with respect to radio listening – as opposed to recording purchases, where faddists and enthusiasts differ – defined over the mix of airtime devoted to new entrant bands in the genre and to established, successful artists. In particular, the utility derived by a consumer in genre g from listening to the radio depends on A_g (the airtime devoted in genre g to new bands), A_{gs} (the airtime devoted to successful, established bands, whether domestic or foreign), t_g (the consumer's choice of time to devote to radio listening) and w (the consumer's opportunity cost of time spent listening to the radio), all in the fashion expressed in (3) below.

But the consumer also chooses to purchase the recordings of their favourite new or established band and derives additional utility from that. We model this as a discrete choice in the following way: a consumer places a value v_{gj} on purchasing the recording of band j in genre g and this value depends on the band's share of radio airtime, a_{gj}, the (common) price of the recording p[14], and a random idiosyncratic component ε_{gj}. Thus $v_{gj} = a_{gj} + \varepsilon_{gj} - p$ and we assume the idiosyncratic values are independently and identically distributed according to the double-exponential distribution function:

$$F(\varepsilon) = exp\{-e^{-\varepsilon}\} \tag{1}$$

We can then calculate the probability, denoted x_{gj}, that a particular new band j yields the maximum utility across all new bands in the genre for an enthusiast consumer:

[14] We do not model the setting of uniform prices in this sector, but take it as a long-standing feature of the industry (if puzzling to economists: see Shiller and Waldfogel (2011))

$$x_{gj} = \frac{exp\{a_{gj}\}}{\sum_{k=1}^{n_{g1}} exp\{a_{gk}\}} \tag{2}$$

Note from this that, if all bands had the same airtime, each would be equally likely to be a consumer's favourite band (with probability $1/n_{g1}$.)

The expression for x_{gj} indicates a consumer's likelihood of purchasing the recording of band j in genre g. Their utility from so doing is then $v_{gj} = a_{gj}+\varepsilon_{gj}-p$. But consumers also derive utility from hearing music on the radio, as discussed, so the problem facing the enthusiast consumer who buys the recording of artist j is to choose t_g to maximise their total consumer utility given by:

$$U_g = ln(t_g)\left(A_g^{\beta} A_{gs}^{1-\beta}\right) + (1 - t_g)w + v_{gj} \tag{3}$$

Radio stations, in this model, recognise that consumer welfare is increasing in n_{g1} (through v_{gj}), but the numbers of bands are exogenous to the radio stations. Their only choice variable is the time devoted to each band and we assume that they choose to give each new (established) band an equal share of the total airtime the station itself chooses to devote to new (established) bands. In essence, then, the radio station's choice – *sans* quota – is simply how much of its airtime to devote to new music and how much to devote to established music; within each of these allotments it simply divides up the time available equally across all relevant bands.[15]

For a faddist consumer in genre g buying the recordings of artist j, for whom only established artists have value, welfare is, in obvious notation:

$$U_{gf} = ln(t_{gf})\left(A_g^{\beta} A_{gs}^{1-\beta}\right) + (1 - t_{gf})w + v_{gsj} \tag{4}$$

[15] If consumers have some preference for diversity within the A and A_s allocations (so would prefer to hear 20 songs rather than hear the same song 20 times), as in Perona (2010), then it would be optimal for the radio stations to behave as supposed here. We do not explicitly model this, however.

3. Timing

We assume that before each period t the government imposes any domestic music quota; all potential new bands then choose their genre; they present to the genre-specific record company and are either contracted or not; contracted bands are recorded and presented by the record companies, along with established, successful bands, both domestic and international, to radio stations; radio stations choose how to allocate airtime to these recordings; consumers devote time to listening to a radio station, given these allocations, and purchase recordings of either new or established artists. Then some bands 'succeed' and become established, earning rents for periods $t+1$ and (with survival probability h) $t+2$ before disappearing, while unsuccessful new bands from t fail and disappear before $t+1$.

4. No quota

i. Agents' choices

Consider first the airtime allocation of radio stations. A genre-specific station g knows that a fraction μ_g of its $\lambda_g L/K_g$ consumers choose t_g to maximise (3) and a fraction $(1-\mu_g)$ choose t_{gF} to maximise (4) and, so choose these listening times so that:

$$A_g^{\beta} A_{gs}^{1-\beta} = t_g w$$
$$A_g^{\beta} A_{gs}^{1-\beta} = t_{gF} w \qquad (5)$$

To maximise t_g and t_{gF}, the times consumers devote to listening to the radio, the station should thus choose its mix to maximise the LHS of each equation in (5), subject to the constraint that the overall airtime shares sum to one.

The profitability of a radio station will depend directly (through unmodelled advertising earning α per listener, recall) on its audience size. Radio stations accordingly will choose their genre such that, given the distribution of other stations,

no alternative genre is more profitable. Supposing that genre g attracts K_g stations, we use the notation $\pi_{sg}(\lambda_g/K_g)$ to denote the profitability of one of the K_g stations in genre g. In genre g there are $\mu_g\lambda_g L$ enthusiast consumers each devoting time t_g to listening to the radio and $(1-\mu_g)\lambda_g L$ faddists devoting time t_{gF} to radio listening so that the total listening time of fans in genre g is $\{\mu_g t_g+(1-\mu_g)t_{gF}\}\lambda_g L$. Thus:

$$\pi_{sg}\left(\frac{\lambda_g}{K_g}\right) = \frac{\alpha\lambda_g L}{K_g}\{\mu_g t_g + (1-\mu_g)t_{gF}\} - F_s \ = \alpha L\frac{\lambda_g t_g}{K_g} - F_s \tag{6}$$

where the second equality follows in equilibrium, wherein $t_g=t_{gf}$.

Rolling back to the decisions of the record companies, they incur a cost of F_1 for every new band in period one and F_2 for every successful band retained on contract into period two, and reap revenues from the record sales of new bands in period one, as well as one period of rents and record sales from successful bands. In a given genre, expected record sales from a new band depend on its radio airtime a_j and the number of enthusiast consumers in that genre ($\mu_g\lambda_g L$). However, by virtue of its success, we assume that an established band earns a rent beyond record sales which we denote R_g, indicating that it can vary by genre. Record companies take the number of radio stations in their genre as parametric.

All recordings sell for a price p and the record company retains all such earnings, by virtue of its contract with each band. Expected recording sales revenue from a typical new band in genre g is:

$$S_{gj} = px_{gj}\mu_g\lambda_g L \tag{7}$$

where x_{gj} is given in (2).

Given the 3-period lifecycle of successful bands, the number of successful domestic bands in a genre at any point in time is split between successful bands from the previous period that are still on contract and those surviving from the period

before who are off-contract. In steady-state equilibrium these numbers will be equal in expectation, adjusted by the exogenous survival probability h. On top of new band record sales revenues, record companies also receive record sales and a genre-specific rent of φR_g from a successful band in genre g for one period, where φ, discussed below, is less than one – and this is discounted by the common discount factor δ.

Given the number of successful bands n_{g2} (which is related to the number of new bands through the probability of success as discussed below), the rent to a record company in genre g is then $n_{g2}\varphi R_g$. In sum, total expected profits for a record company in a given period t are, in obvious notation and noting that successful bands still on contract were entrants in the previous period:

$$\pi_{gt} = p\lambda_g L\left[\mu_g \sum_{k=1}^{n_{g1t}} x_{g1kt} + (1-\mu_g)\sum_{k=1}^{n_{g2t-1}} x_{g2kt-1}\right] + n_{g2t-1}\varphi R_g - n_{g1t}F_1 - n_{g2t-1}F_2 \tag{8}$$

In steady state, new entrant band numbers are constant and so are successful band numbers (in expectation) so the record company's maximand becomes:

$$\pi_g = p\lambda_g L\left[\mu_g \sum_{k=1}^{n_{g1}} x_{gk} + (1-\mu_g)\sum_{k=1}^{n_{g2}} x_{gsk}\right] + n_{g2}\varphi R_g - n_{g1}F_1 - n_{g2}F_2 \tag{9}$$

Finally, we turn to the entry decisions of bands. The essential choice for them is whether or not to enter their genre (i.e. to form a band that seeks a record contract.) In genre g we will have M_g bands vying for recording contracts, which are granted only to $n_{gl} \leq M_g$ of the bands. All bands are *ex ante* identical to the record company so a band's probability of a contract is simply n_{gl}/M_g. Suppose there is some given distribution of all other bands and we are considering the entry decision of a single band. If it enters, it incurs a fixed entry cost of F_B initially and if it turns out to be unsuccessful then it will receive zero (its losses being borne by the record company)

so its decision is driven solely by its payoff in the case of success. We assume that each band *perceives* its probability of success as being 1.[16] If it enters then it anticipates that it will, if it survives from period 2 to period 3 (with known probability h), receive φR_g plus record sales revenues (of $(p\lambda_g(1-\mu_g))Lx_{g2j}$) in that period. In equilibrium, then, a band will be indifferent about entry only if its *subjective* expected return – which depends only on third-period rents, given the structure of its record company's contract – is zero. Thus our equilibrium condition, denoting by G^* the set of genres profitable for radio stations, is:

$$\frac{n_{g1}}{M_g}\left(p\lambda_g\left(1-\mu_g\right)LE\left(x_{g3}\right)+\varphi R_g\right)\delta^2 h = F_B \;\; \forall g \in G^* \tag{10}$$

We now say a little more about the per-band rent, R_g. We assume that the per-band rent to be earned in any particular genre is an increasing function of the faddist consumer demand for that genre, $\lambda_g(1-\mu_g)L$, and a decreasing function of the number of successful bands in that genre, $N_{gs}=n_{g2}+n_{g3}+n_g^*$. To be specific, we suppose that the aggregate rent to be had in a sector is simply a linear function of consumer numbers, $c_g\lambda_g(1-\mu_g)L$ for some constant c_g, and that the per-band rent is then simply their record-sales weighted share of this. That is, we assume, using x_{gs} to denote the record sales of a successful domestic band, that

$$R_g = x_{gs}\lambda_g\left(1-\mu_g\right)c_g L \;\; \forall g \in G^* \tag{11}$$

However, this rent represents a transfer from faddist consumers buying T-shirts, for example, or attending concerts, and represents the aggregate value placed by such consumers on these services. We allow that it might cost the bands real resources to provide these services and suppose simply that this cost is some fraction of the consumer valuation. Consequently, if consumers pay R_g for services they value at that

[16] There is considerable empirical evidence, as well as some modelling of the phenomenon, that artists, "derive substantial non-pecuniary benefits" from artistic activity (see Papandrea and Albon (2004) and references therein), which is consistent with the view that artists over-estimate their chances of success.

price, only a fraction $\varphi \in [0,1]$ accrues to bands as rent, the rest being dissipated in costs. Then the equilibrium condition (10) becomes:

$$\frac{n_{g1}\lambda_g(1-\mu_g)LE(x_{g3})}{M_g}(p+\varphi c_g)\delta^2 h = F_B \;\; \forall g \in G^* \tag{12}$$

ii. Welfare

Free entry by bands and radio stations ensures zero expected profits at those levels,[17] leaving record company profit and consumer surplus (and rent payments) as the components of our welfare measure. For record companies we have profit as described in (9) in any period.

Anderson and de Palma (1992) consider a discrete choice framework with N consumers and n goods in which a consumer gets utility from good i of $U_i=\alpha_i-p_i+\mu\varepsilon_i$, where α_i is a variety-specific constant and ε is identically, independently Gumbel distributed: $F(x;\mu,\beta)=exp[-exp(-(x-\beta)/\mu)]$. They show that aggregate consumer surplus in that model can be represented (up to a constant) as follows:

$$CS = N\mu \ln\left(\sum_{j=1}^{n} exp\left[\frac{\alpha_j - p_j}{\mu}\right]\right) \tag{13}$$

In our model we have the same distribution except with μ=1 and β=0 and the analogous expressions for consumer surplus in genre g are:

$$CS_{ge} = \mu_g\lambda_g L \ln\left(\sum_{j=i}^{n_{g1}} exp(a_j + T - p)\right) = \mu_g\lambda_g L(T-p)\ln\left(\sum_{j=1}^{n_{g1}} exp(a_j)\right) \tag{14}$$

for enthusiast consumers and, for faddists for all successful bands[18]:

[17] As noted previously, we do not model the advertising side of the radio stations' problem explicitly. But, in terms of welfare, we assume that the advertising market is competitive and that advertisers extract no surplus from advertising.

[18] Note that the rent transfer does not enter into consumer welfare as it represents the valuation consumers place on the non-recording services received from successful bands and so washes out.

$$CS_{gf} = (1-\mu_g)\lambda_g L(T^f - p)\ln\left(\sum_{j=1}^{N_{gs}} exp(a_j)\right) \tag{15}$$

with $T \equiv \left[\ln t_g \left(A_g^{\beta} A_{gs}^{1-\beta}\right) + (1-t_g)w\right]$ and T^f defined isomorphically. So aggregate consumer surplus in genre g can thus be written as:

$$CS_g = CS_{ge} + CS_{gf} =$$

$$\lambda_g L\left[\mu_g(T-p)\ln\left(\sum_{j=i}^{n_{g1}} exp(a_j)\right) + (1-\mu_g)(T^f - p)\ln\left(\sum_{j=i}^{N_{gs}} exp(a_j)\right)\right] \tag{16}$$

In sum, in any period in steady state we have welfare generated by genre g, W_g, as:

$$W_g = \lambda_g L\left[p\mu_g \sum_{k=1}^{n_{g1}} x_{gk} + (1-\mu_g)(p+\varphi c_g)\sum_{k=1}^{n_{g2}} x_{gsk}\right] - n_{g1}F_1 - n_{g2}F_2 +$$

$$\lambda_g L\left[\mu_g(T-p)\ln\left(\sum_{j=1}^{n_{g1}} exp(a_j)\right) + (1-\mu_g)(T^f - p)\ln\left(\sum_{j=i}^{N_{gs}} exp(a_j)\right)\right] \tag{17}$$

Note that if each successful band gets the same airtime, a, then CS_{gf} simplifies down to $(1-\mu_g)\lambda_g L\ (T^f-p)[\ln(N_{gs})+a]$.

iii. The nature of band 'success'

We have assumed that, at the end of period one, only some fraction of new entrants in genre g will survive. But there are a number of alternative ways in which this success might be modelled.

First, we might assume that the number of successful bands is a known, deterministic function of the number of new entrants:

$$n_{g2} = f(n_{g1}), \qquad f(0) = 0, f' \in (0,1), f'' \leq 0 \tag{18}$$

As only a fraction h of period 2 successful bands go on to be successful bands off-contract in period 3, we have $n_{g3}=hn_{g2}=hf(n_{g1})$ so that the total number of successful bands in genre g in any period is given in steady state by $N_{gs}=(1+h)f(n_{g1})+n_g^*$. This approach is one in which the probability of success is entirely exogenous.

But, while there is doubtless some uncertainty in the future prospects of a band, the essence of 'success' in this market is that the record company decides to retain a particular band on contract. In that respect, 'success' is endogenous and is essentially a decision made by the record company. One extreme modelling version of this would be to suppose that there is no uncertainty in the decision at all (beyond the uncertainty inherent in record sales through the logit demands.) We discuss this approach in section 6 of the paper (and show that it is effectively equivalent to the case of exogenous success.) A more interesting case is that where bands have some innate 'quality' (say θ) unobservable to record companies but which affects their record sales; a record company then observes the first period sales of its new bands, draws an inference from these sales about each band's underlying θ and uses this inference to determine which bands to retain and which to drop. We also discuss a special case of this in section 6 of the paper.

For the remainder of this section of the paper we continue with the case in which success is entirely exogenous. In period one the record company in genre g signs up n_{g1} bands. But note that, because all new bands in a genre sign with the same record company, all revenues from new band sales accrue to the same company. As record sales are expressed in terms of market shares, so the record company's share of new band sales is always one. Of course, some of these bands then succeed and go onto period two, a number we denote $n_{g2}=f(n_{g1})$ and this is where the choice of n_{g1} impacts potential record company profits. With n_{g2} deterministic, so too is per-band airtime and the record company's profit is:

$$\pi_g = k_1 + k_2 E\left(n_{g2} x_{g2}\right) - n_{g1} F_1 - n_{g2} F_2 \tag{19}$$

where $k_1 = pL\mu_g\lambda_g$ and $k_2 = (1-\mu_g)\left(p+\varphi c_g\right)\lambda_g L$ are positive constants. That is, denoting by a_{gs} the airtime devoted to a successful band in genre g,

$$\pi_g(n_{g1}) = k_1 + k_2 f(n_{g1}) \frac{exp(a_{gs})}{(1+h)f(n_{g1})exp(a_{gs}) + n_g^* exp(a_g^*)} - n_{g1}F_1 - f(n_{g1})F_2 \tag{20}$$

To sum up, in equilibrium a number of bands M_g enters genre g seeking a record company contract. These bands, expecting to be successful with probability 1, distribute themselves across genres such that condition (12) holds. This expectation is generally false, given bands' overestimate of their own abilities, and the probability of success depends on the number of bands signed. A genre-specific record company signs up bands and offers contracts to them that extract the entire surplus from the relationship for the first two periods after which, by industry convention, the bands go off contract; a record company in genre g chooses the number of new domestic bands to sign up to contracts in order to maximise (20). Radio stations also distribute themselves across the genres such that condition (6) holds and no station can gain, given the distribution of other stations, by switching genres. They choose the allocation of airtime to be split between new and successful bands to maximise t_g and t_{gf} from (5) and then, if unconstrained, divide those allocations equally amongst the relevant artists in their genre. Overall welfare is then given by (17).

iv. Equilibrium

Consider first the airtime allocation of radio stations. Solving a station's problem yields:

$$A_{gs} = 1 - \beta, \qquad A_g = \beta \tag{21}$$

That is, it plays new and established music in the proportions given by their weights in the consumer's preferences. Deviations from this ratio will reduce consumer welfare and therefore reduce their listening time devoted to the radio.

Note, too, that t_g=t_{gF} in equilibrium. Expressions (5) and (21) then imply that t_g=t_{gF}=$\beta^{\beta}(1\text{-}\beta)^{1\text{-}\beta}/w$ so total listening time is $\beta^{\beta}(1\text{-}\beta)^{1\text{-}\beta}\lambda_g L/w$, earning the station total advertising revenues of $\alpha\beta^{\beta}(1\text{-}\beta)^{1\text{-}\beta}\lambda_g L/w$. Thus (6) becomes:

$$\pi_{sg}\left(\frac{\lambda_g}{K_g}\right) = \alpha L\frac{\lambda_g}{K_g}t_g - F_s = \frac{\alpha L}{w}\frac{\lambda_g}{K_g}\left(\beta^{\beta}(1-\beta)^{1-\beta}\right) - F_s \tag{22}$$

In equilibrium it must be the case that $\pi(\lambda_g/K_g)\geq\pi(\lambda_{g'}/(K_{g'}+1))\ \forall g,g'\in G$. As a numbering convention, we label genres 1,…G such that $\pi(\lambda_1/K_1)\geq \pi(\lambda_2/K_2)\geq\ldots\geq \pi(\lambda_G/K_G)$. Of the entire set of possible genres, only a subset may be profitable and we denote by $g^*\leq G$ the marginally profitable station s.t. $\pi(\lambda_{g^*}/K_{g^*})\geq 0\geq\pi(\lambda_{g^*+1}/1)\geq\ldots\geq\pi(\lambda_G/1)$ and by G^* the set of weakly profitable genres: $G^*=\{1,\ldots,g^*\}\subseteq G$. Henceforth, for analytical convenience, we ignore the integer constraint on radio station numbers and treat it as a continuous variable. Consequently entry will ensure that these profit inequalities hold as equalities and our free entry condition for radio stations becomes,

$$\alpha L\frac{\lambda_g}{K_g}t_g = F_s \Rightarrow K_g = \alpha L\frac{\lambda_g}{F_s}t_g = \frac{\alpha L}{w}\frac{\lambda_g}{F_s}\left(\beta^{\beta}(1-\beta)^{1-\beta}\right)\ \forall g\in G^* \tag{23}$$

From this, note that the more popular the genre, *ceteris paribus*, the larger will be the number of radio stations operating in that genre: K_g is increasing in λ_g.

The problem facing a record company in genre g is to maximise the expected value of π_g as expressed in (20). But, as noted, $E(x_{g1})$ for the uninformed record company is simply $1/n_{g1}$ – absent a quota so that all airtimes are equal – hence the term $\sum_{k=1}^{n_{g1}} E(x_{gk})$ just becomes one. The reason for this, as noted previously, is that enthusiast consumers are genre-specific and so is the record company, hence any sales by one band are simply cannibalised from sales by another band in the same genre – also run by the same record company. Considering successful bands, since all

successful bands (foreign or domestic) are *ex post* identical, each has an equal market share (of $x=1/N_{gs}$, so the record company's share of total successful record sales and rents is just $n_{g2}/N_{gs}=f(n_{g1})/((1+h)f(n_{g1})+n_g^*)$.) As a consequence, record companies sign up bands only in the expectation of profits from successful bands: if new band revenues were the only interest of the record company in a genre, it would only sign up a single band. So the firm's steady-state problem in (20) becomes,

$$\max_{\{n_{g1}\}} \pi_g(n_{g1}) = k_1 + k_2 \frac{f(n_{g1})}{\{(1+h)f(n_{g1}) + n_g^*\}} - n_{g1}F_1 - f(n_{g1})F_2 \tag{24}$$

This yields a FOC and SOC as follows:

$$\frac{dE(\pi_g)}{dn_{g1}} = k_2 \frac{f'(n_{g1})\left(\{.\} - f(n_{g1})(1+h)\right)}{\{(1+h)f(n_{g1}) + n_g^*\}^2} - \left(F_1 + f'(n_{g1})F_2\right)$$

$$= k_2 \frac{f'(n_{g1})n_g^*}{\{.\}^2} - \left(F_1 + f'(n_{g1})F_2\right) = 0 \tag{25}$$

$$\frac{d^2E(\pi_g)}{(dn_{g1})^2} = k_2 n_g^* \frac{f''(n_{g1})\{.\} - 2\left(f'(n_g)\right)^2(1+h)}{\{.\}^3} - f''(n_{g1})F_2 \leq 0$$

By the SOC for n_{g1}, the sign of dn_{g1}/dx is the same as that of $d^2\mathrm{E}(\pi_g)/\mathrm{d}n_{g1}\mathrm{d}x$ for any parameter x. The LHS of the FOC is increasing in k_2 and is decreasing in F_1, F_2 and h, so the optimal number of new bands in a genre is decreasing in F_1, F_2 and h and increasing in all elements of k_2 (i.e. increasing in p, L, φc_g, λ_g and $(1-\mu_g)$). The derivative of the FOC wrt n_g^* has the same sign as $(N_{gs}-2n_g^*)$. That is, the optimal number of domestic new bands in a genre is increasing in the number of foreign successful bands in the genre if and only if foreign bands constitute less than half of the total of successful bands in the genre in steady state. Alternatively, the optimal n_{g1} is increasing in n_g^* if and only if the number of foreign bands is less than the number of successful domestic bands, both on and off contract.

Accordingly, the solution to the record company's problem yields an optimal choice of n_{g1} where the signs of partial derivatives are as shown:

$$n_{g1} = n_{g1}\left(\underbrace{p}_{(+)}, \underbrace{\lambda_g}_{(+)}, \underbrace{L}_{(+)}, \underbrace{\mu_g}_{(-)}, \underbrace{h}_{(-)}, \underbrace{n_g^*}_{(+/-)}, \underbrace{\varphi c_g}_{(+)}, \underbrace{F_1}_{(-)}, \underbrace{F_2}_{(-)}\right) \tag{26}$$

The only signs that need some discussion, perhaps, are those on μ_g and n_g^*. An increase in the fraction of consumers in genre g who are enthusiasts (i.e. fans of new bands) leads to a decrease in the optimal number of new bands for a record company to sign up. While this seems counterintuitive, it stems from the fact that all enthusiast consumers in a genre buy from the same record company: an increase in such numbers has no net effect on record sales (due to cannibalisation) but the fall in faddist consumers reduces second-period sales of recordings by successful domestic artists, thus reducing the incentive to sign up new domestic bands.

The non-monotonicity of n_{g1} with respect to n_g^* can be understood by noting that, if there are no foreign bands at all, then the record company has no incentive to sign up more than a single band. The reason is again that all new band record sales are cannibalised from itself, as it is a genre monopolist, so the only reason to encourage entry, given the fixed costs of new bands, is to generate a larger share of the rent and of successful band record sales. But these domestic shares are simply proportional to the number of total successful bands in the genre so, if there are no foreign bands at all, this is all captured by the local record company (other than the unavoidable fraction that goes to successful domestic bands off contract.) But as n_g^* rises above zero the incentive to increase the number of domestic bands also increases: for any value of $n_g^* \geq 1$ domestic rents plus successful record sales accruing to the record company are strictly increasing in n_{g1}. But the marginal gain from another domestic entrant is smaller the larger is n_g^* while the fixed cost of entry is

unchanged, so the incentive to increase n_{g1} in response to a rise in n_g^* exists only when the latter is small.

Turning to bands, when there is no quota then E(x_{gs})=1/N_{gs} so (12) solves for M_g as follows:

$$\frac{n_{g1}\lambda_g(1-\mu_g)L}{F_B N_{gs}}(p+\varphi c_g)\delta^2 h = M_g$$

$$\Longrightarrow\ M_g = M_g\left(\underbrace{n_{g1}}_{(+)}, \underbrace{\lambda_g}_{(+)}, \underbrace{\mu_g}_{(-)}, \underbrace{\varphi c_g}_{(+)}, \underbrace{L}_{(+)}, \underbrace{\delta}_{(+)}, \underbrace{h}_{(+)}, \underbrace{p}_{(+)}, \underbrace{F_B}_{(-)}, \underbrace{n_g^*}_{(-)}\right) \tag{27}$$

In many models of entry behind a fixed cost we observe that the laissez-faire solution leads to over-entry from a social perspective. This occurs because of the business-stealing effect. A marginal entrant compares her profits with the fixed cost of entry and comes in if the former weakly exceeds the latter. But she ignores the fact that some of her profit is due to business simply stolen from other firms, profit that would not be represented as an addition to social welfare but is simply a transfer. Consequently, the marginal private entrant generates less social surplus than her entry cost and we have over-entry. In this model, however, the entry decision for new bands (in terms of being contracted, recorded and then aired on the radio) is made by a record company for *all* the potential entrants. Any business stealing by a new band is business stolen from the same company and so it will be taken into account when entry is determined. For this reason, there is no presumption in this model that there will be over-entry.

On the contrary, we can see that the laissez-faire solution in this model involves too few new domestic (and, consequently, subsequently successful domestic) bands. The record company chooses n_{g1} to maximise its own profits but welfare is the

sum of profits and the consumer surplus of both faddist and enthusiast consumers.

From (14) and (15) we get:

$$CS_{ge} = \mu_g \lambda_g L(T-p)\left(ln(n_{g1}) + \frac{A_g}{n_{g1}}\right)$$

$$\Rightarrow \frac{dCS_{ge}}{dn_{g1}} = \frac{\mu_g \lambda_g L(T-p)}{n_{g1}}\left(1 - \frac{A_g}{n_{g1}}\right) > 0$$

$$CS_{gf} = (1-\mu_g)\lambda_g L(T^f - p)\left(ln[n_g^* + (1+h)f(n_{g1})] + \frac{A_{gs}}{\{.\}}\right) \tag{28}$$

$$\Rightarrow \frac{dCS_{gf}}{dn_{g1}} = \frac{(1-\mu_g)\lambda_g L(T^f - p)(1+h)f'(n_{g1})}{\{n_g^* + (1+h)f(n_{g1})\}}\left(1 - \frac{A_{gs}}{\{.\}}\right) > 0$$

So, unsurprisingly, consumer surplus for all consumers is increasing in n_{g1} and the implication is that the laissez-faire solution involves too few bands from a social welfare perspective, as the record company ignores the impact on CS of its contracting decisions. An optimal intervention to correct this would be one that directly targets n_{g1}; that is, a subsidy to F_1, the fixed cost of contracting new bands.

We summarise these results in the following proposition:

Proposition 1: In the version of this model where success probabilities are deterministic, the laissez-faire equilibrium involves

i. *The radio broadcasting of new and established music in the proportion β/(1-β) in every genre;*
ii. *Entry of radio stations into a genre in direct proportion to λ_g, the popularity of the genre in the listening public;*
iii. *The choice by a record company in a genre of the number of new bands to sign to contracts, where this number is increasing in the price of recordings, the popularity of the genre in the population, the size of the population and the rents that accrue to bands in the genre; is decreasing in the proportion of the genre's consumers that are enthusiasts, the survival rate of successful bands (from being on-contract to going off-contract) and the record company's fixed cost of contracting bands and is non-monotonic in the number of foreign bands in the genre;*
iv. *The entry into the genre of a number of bands seeking contracts where that number is increasing in the price of recordings, the popularity of the genre in the population, the size of the population, the rents that accrue to bands in the genre, the number of new bands signed up the record company, the band's discount factor and the survival rate of successful bands; and is decreasing in the*

proportion of the genre's consumers that are enthusiasts, the number of foreign bands in the genre and the fixed cost of entry by bands;

v. *Too few contracted bands from an aggregate welfare perspective.*

5. A local content quota

In any genre g there is a number of foreign, successful bands (n_g*) that is exogenous and a number of recorded domestic bands, both new and successful, given by $n_{g1}+(1+h)f(n_{g1})$. The radio station chooses the mix of successful and new music to play and, absent a quota, will choose $A_g/A_{gs} = \beta/(1-\beta)$, as established above. A simple[19] local content requirement imposed on a genre g will require stations in that genre to play domestic music in a certain proportion – equivalently, airtime devoted to foreign music must be less than some proportion of total airtime. Thus the quota is a constraint that $\sum_{m=1}^{n_g^*} a_{gm}^* \leq Q$ for some airtime level Q.

As is shown more formally in the Appendix, a just-binding simple quota on foreign bands' airtime will, in the short run[20], lead to an increase in the airtime devoted to successful domestic bands, with no consequences for the aggregate airtime split between new and established bands. As a consequence, nothing disturbs the free-entry condition governing radio stations in each genre. However, the increased airtime for successful domestic bands means higher expected record sales for such bands and thus higher expected profits for new bands in the affected genre. This induces immediate entry by new bands into that genre (but with no immediate consequences for $n_{g2}+n_{g3}$, the number of successful domestic bands in the genre, as that is a function of the number of new entrants in the previous periods.) In the medium run – i.e. the next period – this entry of new bands will lead to an increased

[19] By which we mean a quota that draws no distinction between new and established domestic artists.
[20] Immediately the policy is imposed and before 'successful' band numbers can respond. That is, in the first period following the policy's imposition.

number of successful domestic bands in the genre who are on contract to record companies and, in the long run one period later still, this will flow through to the number of successful domestic bands off contract.

Now suppose that the economy as a whole is characterised by a variety of genres in which foreign bands are more or less important. If we consider an economy-wide quota set at some level independent of genre, then it will bind in genres where foreign bands are relatively prominent but not in others.[21] Its impact, then, will be to increase domestic band entry in genres where international music predominates; overall, we get an 'internationalisation' of domestic music and domestic bands sound, on average, more like international bands.

Turning to welfare, there is clearly a profit-increasing effect of a tighter quota. This occurs for standard profit-shifting reasons: given the fixed recording price, the quota shifts airtime to successful domestic bands and so increases domestic record sales and profits therefrom. Note that there is no distortion of the optimal airtime mix from the quota but that both n_{g1} and N_{gs} are increased by the quota.

Our expression for consumer surplus is now, noting that $T=T^f$ in equilibrium and that each new band gets the same airtime $1/n_g$,

$$CS_g = \lambda_g L(T-p)\left[\mu_g\left(ln(n_{g1}) + \frac{1}{n_{g1}}\right) + (1-\mu_g)\ln\left(n_g^* exp\left(\frac{Q}{n_g^*}\right) + \right.\right.$$

$$1+hfng1expAgs-Q1+hfng1 \tag{29}$$

Consequently there are conflicting effects on consumers of a tightening of the quota. First, enthusiast consumers are strictly better off because the quota induces entry of

[21] In practice, many countries have genre-specific quotas, with higher local content requirements typically in more popular genres. In Australia, for example, there are five categories of music and local content requirements range from 25% in the contemporary popular music format (and at least 25% of the local content must be "new": released in the previous 12 months) to 5% in niche formats, such as jazz, with no "new" constraint.

new bands and enthusiasts' welfare is increasing in the number of bands, n_{g1} (an effect that more than offsets their losses from lower airtime per band.) These bands are signed up because the profitability of successful bands has increased – as already noted, all of the profits accruing to new bands are simply cannibalised from other new bands and so do not represent a profit gain to the record company. In many contexts, this kind of entry – induced at an earlier stage by the prospect of subsequent profits – will simply dissipate any subsequent rents and so is welfare-neutral, at best. But in this model enthusiast consumers benefit from an increased diversity of new bands, whether they subsequently succeed or not. For some faddist consumers, however, there is a welfare loss from the reduced airtime for foreign bands: consumers who purchase the recordings of foreign bands now get lower gains from such purchases. But that reduced airtime is now devoted to successful domestic bands, the number of which has increased and this benefits faddist consumers of such bands.

The Appendix demonstrates that any simple quota that induces entry of new bands must raise the consumer surplus of faddist consumers; this is certainly the case for a mild (i.e. just-binding) quota. The entry-inducing effect of a tighter quota must be welfare-improving for such consumers, for reasons similar to those for enthusiast consumers, when a tightening of the quota induces domestic entry (as a just-binding quota must.) The direct effect on CS_{gf} is, in principle, ambiguous, depending on the relative airtime given to each foreign band versus that given to each successful domestic band. While at the no-quota point these two are equal and cancel out, we show in the Appendix that, more generally, each domestic band must get (weakly) more airtime than each foreign band in equilibrium under a quota, even when the induced entry is taken into account.

Turning to other players, note that a simple quota has no effects on radio stations' entry decisions at all. With no change in listeners' radio time, condition (6) is unaffected by the quota. For bands, however, a quota in genre g gives an incentive for entry into that genre. Consider first a quota imposed in a single genre, g. From the bands' genre choice equilibrium condition (12), we have an increase in expected third-period record sales ($E(x_{g3})$) due to the quota – the proceeds of which accrue to the band in question – as well as an increase in the number of bands signed by record companies to the genre, n_{g1}. Thus we will observe an increase in the number of bands in the genre seeking contracts, M_g.

Suppose instead that a common simple quota is imposed across all genres. The relative impact on one genre versus another will depend ultimately on the relative impact of the quota on expected record sales for successful bands across genres – while it is the third-period manifestation of this that is of interests to bands in their entry decisions, it is the second-period occurrence that induces record companies to sign up more new entrant bands. A given quota will be more profitable in terms of raising domestic record sales the more binding it is on foreign acts i.e. the greater is the proportion of airtime devoted to foreign bands in the absence of a quota. *Ceteris paribus*, the higher is the ratio $N_{gs}/n_{g2}(1+h)=[n_g^* + n_{g2}(1+h)]/n_{g2}(1+h)$ in a genre the greater is the impact on successful domestic bands' record sales of a given change in a quota. To be clear, we know from (12) that we will have a greater concentration of domestic bands seeking contracts in genres where, *ceteris paribus*, more domestic bands are signed to contracts (n_{g1}), non-record sales rents (c_g) are higher, there are more listening consumers (λ_g) and a lower fraction of listeners are enthusiasts (μ_g). But, given the pattern of entry *sans* quota, the argument here is that the subsequent entry induced by a quota will be relatively greater in genres where foreign bands are

more abundant. Hence we see our "Canadian divas" effect: a sector-wide common quota induces greater entry of domestic bands seeking contracts in genres where foreign music is more concentrated.

We summarise these results in the following proposition:

Proposition 2: In the version of this model where success probabilities are deterministic, a simple local content quota in steady state

i. *Will leave the radio airplay mix between new and established bands unaffected but will increase the share of airplay devoted to successful domestic bands;*
ii. *Will leave entry decisions by radio stations unaffected;*
iii. *Will increase both entry and contracting of domestic bands and thus the number of both new and successful domestic bands;*
iv. *Will lead to greater 'internationalisation' of domestic music: a greater share of domestic music (both by entrants and contracted bands and as heard on the radio) is produced by bands in genres where international music is most prevalent;*
v. *Is welfare-improving if mild.*

i. A modification

Note that in this model there is no minimum restriction on the amount of radio airplay that can be devoted to a band. The lack of indivisibilities in airtime means that the benefit to consumers of being exposed to n_g^* bands is the same whether each is heard for an hour a day or a second. Suppose instead that there is some minimum quantum of airtime for which a band must be played if it is to be played at all, say H. Suppose that, in genre g, the number of domestic new bands is sufficiently small that $n_{g1}H<1-\beta$; that is, when the radio station allocates its optimal, unconstrained airtime to new bands, each band receives strictly more than the minimum quantum. Suppose further that the set of foreign bands that can be played in the genre is sufficiently large that some non-empty subset n_g^* is chosen at which, given the number of successful domestic bands, $n_{g2}(1+h)+n_g^*=\beta/H$.[22]

[22] The radio station seeks to maximise the number of bands being aired so this assumption simply requires that $n_{g2}(1+h)<\beta/H$ and that there are enough foreign bands to enable the minimal allocation of

A simple quota in this context is exactly equivalent to a restriction on n_g^*, the number of foreign bands aired, as the quota cannot now be met by reducing the airtime per foreign band. A just-binding quota in this setting will then induce an increase in airtime for each successful domestic band, exactly as previously, without changing the mix between successful and new bands in radio airplay, but it will now have a negative impact on faddist consumer welfare by decreasing the overall number of successful bands – domestic and foreign – being aired, in the short run. As before, this will, in the medium and long runs, induce an increase in the number of new domestic entrants in the affected genre, but the overall consequences for successful band variety will depend on the responsiveness of $f(n_{gI})(1+h)$ to the fall in n_g^*.

ii. A more complex quota

As noted in the Introduction, a number of countries have introduced rather more complicated quotas that require not only that domestic music receive a greater share of radio airtime but that some proportion of this be allocated to 'new' domestic music. Such a quota has two components: a 'simple' quota as analysed above combined with a requirement that more new music be played.[23] In this section we focus on the second of these two effects and, as all new entrant music in our model is generated by domestic bands, we consider a policy that requires an increase in A_g/A_{gs}.

We saw previously that, absent a quota, a radio station will allocate airtime across new and successful bands to maximise listener welfare and this results in a split of $A_{gs}=1-\beta$ and $A_g=\beta$ which, in turn, yields a listening time allocation by all consumers of $t_g=\beta^{\beta}(1-\beta)^{1-\beta}/w$. If a policy is imposed that requires an increase in A_g at the expense

time to all aired successful bands; i.e. that there is 'room' for some foreign bands to be played when the station optimally allocates time to successful bands in the genre.

[23] In fact, the requirement can be met by playing new releases from established bands. Our model does not permit this possibility: implicitly bands here issue a single recording at the start of their lives and sell it for, potentially, three periods.

of A_{gs} then this will reduce the overall time devoted to listening to the radio, by (5). Ignoring this change in t_g for the moment, for given band numbers, the increase in A_g has no effect on record company profits: the increase in airtime each band receives has no impact on their record sales as it is common to all bands in the genre and overall record sales are unchanged (at $\mu_g\lambda_g L$.) The decrease in A_{gs} will optimally be shared across all successful bands, foreign and domestic, by a radio station and so every successful band will get reduced airtime. But the overall domestic share of record sales and rents will be unaffected by this common change and, again, total record sales are unaffected (at $(1-\mu_g)\lambda_g L$) so the domestic record company is not impacted by this policy at all. Hence it signs no new bands and there are no entry/exit consequences of the policy at all.

But welfare *is* impacted through the distortion induced in the radio airtime mix and the consequent reduction in airtime devoted to radio listening by consumers[24]. This distortion reduces the overall time devoted to listening to the radio so the previously maximised term $A_g^{\beta}A_{gs}^{1-\beta}$ falls and thus consumer surplus for both faddist and enthusiast consumers falls. For a just-binding quota this effect is zero, of course, as $A_g^{\beta}A_{gs}^{1-\beta}$ is maximised at that point so that a small change in the ratio has only a second-order effect. But the reduction in listening time is reflected in exit by radio stations. If the quota affects some genres more than others then we will observe in this case an *increase* in the relative amount of music broadcast that is of domestic origin: all stations broadcast more domestic content *and* exiting stations are those in

[24] In a richer model of advertising, this reduction in t_g would also impact on the advertising market. In this model we will see a decrease in the number of radio stations in genre g following the quota, as t_g falls in (22). This is a feature of our model: consumers have no preferences across radio stations in a particular genre, as they are all identical, so when less time is devoted to listening to a genre it is reflected not in the listening time per station but in the total number of stations. This exit of stations has no welfare consequences of its own, due to the zero profit condition for station equilibrium.

genres where the quota binds most tightly i.e. those with a greater concentration of foreign artists.

Now, a complex quota, as we have termed it, involves the packaging of the policy just described with a simple quota, analysed previously. Consequently, a just-binding complex quota will be welfare-improving under the same circumstances and for the same reasons that a just-binding simple quota is welfare-improving. However, a non-marginal complex quota will yield lower overall welfare than the equivalent simple quota.

We summarise these results in the following proposition:

Proposition 3: In the version of this model where success probabilities are deterministic, a complex local content quota in steady state will, beyond the effects of the simple quota,

i. *Alter the radio airplay mix in favour of new (domestic) bands;*
ii. *Lead to lower airtime for every successful band, domestic or foreign, and increased airtime per new domestic band, both for each remaining radio station and in aggregate;*
iii. *Have no consequences for record sales;*
iv. *Lead to the exit of some radio stations;*
v. *Have no consequences for either entry or the contracting of new domestic bands and thus for the number of both new and successful domestic bands;*
vi. *Lead to greater 'internationalisation' of domestic music to the extent that it drives out radio stations in the most heavily affected genres: those that are most 'international';*
vii. *Reduce welfare at a greater rate than a simple quota when it becomes increasingly binding.*

6. Modelling choices

i. Alternative specifications of the probability of 'success'.

In the model exposited so far, the probability of 'success' for a new domestic band is a known, deterministic function of the number of contracted bands. Here we briefly discuss two alternative specifications.

As noted above, while there is doubtless some uncertainty in the future prospects of a band, the essence of 'success' is that a record company decides to

retain a particular band on contract. Consequently, 'success' is endogenous and is essentially a decision made by the record company. So suppose that the record company can choose n_{g1}, as we have assumed so far, but can then also choose n_{g2}, almost independently. With everything as before, this means that the record company's problem becomes:

$$\max_{\{n_{g1},n_{g2}\}} \pi_g = k_1 + k_2 \frac{n_{g2}}{\{(1+h)n_{g2} + n_g^*\}} - n_{g1}F_1 - n_{g2}F_2 \;\; s.t. n_{g2} \leq n_{g1} \tag{30}$$

It is clear from this that, as noted earlier, the record company would never choose any n_{g1} in excess of one if it were looking only to its profits from new bands. The only thing that motivates a higher value is that it relaxes the constraint on n_{g2}. It can be easily seen from this problem that the record company would never choose a value of n_{g1} strictly in excess of its desired value of n_{g2} – i.e. the constraint will always bind – so, letting $n_{g1}= n_{g1}\equiv n$ for notational simplicity, its steady-state problem is simply:

$$\max_{\{n\}} \pi_g = k_1 + k_2 \frac{n}{\{(1+h)n + n_g^*\}} - n(F_1 + F_2) \tag{31}$$

This yields a FOC of :

$$\frac{\{.\} - (1+h)n}{\{(1+h)n + n_g^*\}^2} = \frac{n_g^*}{\{(1+h)n + n_g^*\}^2} - \frac{(F_1 + F_2)}{k_2} = 0 \tag{32}$$

This is very similar to (25) and, indeed, the LHS of the FOC in (32) is, as was (25), increasing in k_2 and decreasing in F_1, F_2 and h. Similarly, the derivative of (32) wrt n_g^* again has the same sign as (N_{gs}-2n_g^*). So all the results derived in the deterministic case already analysed apply in the same fashion to this equally deterministic case.

A more interesting and realistic case is that where record companies might draw some inference on a band's innate 'quality' by observing their first period record sales and might then base its re-signing decision on this. So suppose that bands have

some innate 'quality' (say θ, drawn from some distribution on support [0,1]) unobservable to record companies but which affects their record sales. In particular, suppose that a consumer again places a value v_{gj} on purchasing the recording of a band j in genre g but that this value now depends not only on the band's share of radio airtime, a_{gj}, the price of the recording p, and the random idiosyncratic component ε_{gj}, but also on the band's θ in the following manner: $v_{gj} = \theta_{gj}a_{gj} + \varepsilon_{gj} - p$. A band of quality θ now has an expected market share of:

$$x_{gj} = \frac{exp\{\theta_{gj}a_{gj}\}}{\sum_{k=1}^{n} exp\{\theta_{gk}a_{gk}\}} \tag{33}$$

where the denominator is summed to $n=n_{g1}$ in the case of new bands and $n=N_{gs}$ in the case of successful bands. So now it is not the case that equal airtimes will lead to equal market shares. But, while record companies, *ex hypothesi*, cannot observe each θ_j directly, they can observe a contracted band's actual record sales in its first period and so draw an inference as to its θ. The problem facing the record company is essentially that laid out in (30) except with this exponential ratio determining record sales:

$$\max_{\{n_{g1},n_{g2}\}} \pi_g = k_1 + k_2 E\left(\frac{exp\{\theta_{gj}a_{gj}\}}{\sum_{k=1}^{N_{gs}} exp\{\theta_{gk}a_{gk}\}}\right) - n_{g1}F_1 - n_{g2}F_2 \;\; s.t. n_{g2} \leq n_{g1} \tag{34}$$

Now, even in the case where θ is distributed uniformly on [0,1], this problem is largely intractable due to the Poisson binomial distribution of the term in expectations. So consider a more degenerate distribution: suppose that θ takes one of two values, θ_H or θ_L for $\theta_H > \theta_L$, where the probability of $\theta_H \equiv \rho$ and this is common knowledge. The interesting case here is where θ_L is sufficiently low that the record company would not wish to retain a band known to be of that type: if this were not true then the realisation of θ is of no interest to the record company and it would wish to retain all initially

signed bands: the problem collapses to that just analysed in which $n_{g2}=n_{g1}$. Similarly, the problem is uninteresting if θ_H is so low that *all* successful bands fail to cover the record company's fixed costs. So we suppose that the distribution is such that a record company would wish to retain any band it knew to be of type θ_H and not re-sign any band it knew to be of type θ_L. To be specific, we let θ_L=0 and θ_H=1.

Considering the program in (34), we see again that the only consideration that would lead a record company to sign up more than one new band is its effect in relaxing the constraint on the number of successful bands and that, again, the record company would never wish to choose n_{g1} greater than its anticipated choice of n_{g2}. So, in steady state, its problem comes down to choosing n_{g1} when the expected number of bands that will be retained after period 1 is just $n_{g2}=\rho n_{g1}$ and given that all retained bands will have θ=1. Thus, if all airtimes are equal then each successful band has the same market share and the record company's problem becomes:

$$\max_{\{n_{g1}\}} \pi_g = k_1 + k_2\left(\frac{\rho n_{g1}}{\{(1+h)\rho n_{g1} + n_g^*\}}\right) - n_{g1}(F_1 + \rho F_2) \qquad (35)$$

This is directly isomorphic to the program in (31) and yields the same qualitative results.

In sum, we argue that the specification of 'success' in our earlier analysis can be altered quite significantly without changing the essential tenor of the results.

ii. Multiple record companies in each genre.

An assumption made throughout the analysis in this paper has been that each genre is characterised by a single record company. This assumption buys us a great deal in terms of the tractability of the analysis, as we have noted, by reducing the choice of the number of new entrants to sign for a record company (n_{g1}) down to a decision that depends only on later period profits and not those in the first period. With

competition amongst record companies in a genre the optimal choice of n_{g1} will also consider the impact of an increase in n_{g1} on business-stealing from other competing record companies. This is likely to lead to greater numbers of bands throughout the market and so to lessen, or even completely offset, the under-entry problem already discussed. Consequently, the welfare consequences of local content requirements are likely to be more negative than in our analysis. This, however, is conjecture at this stage and remains a topic for further research.

iii. Faddists and enthusiasts.

One further aspect of the model that warrants further discussion in terms of robustness: the faddist/enthusiast distinction that we maintain between types of consumers in each genre, where the former buy recordings of only successful bands (foreign or domestic) and the latter buy recordings of only new (domestic) bands. An alternative would be simply to posit a single type of consumer who draws their favourite band from the entire set of alternatives. Under the discrete choice model of record buying used here, the probability of a consumer buying the recording of band j in genre g would then become:

$$x_{gj} = \frac{exp\{a_{gj}\}}{\sum_{k=1}^{n_{g1}} exp\{a_{gk}\} + \sum_{i=1}^{N_{gs}} exp\{a_{gi}\}} \tag{36}$$

Such a change would make little or no difference to the qualitative results of our analysis, but would complicate the algebra significantly. Under our current separation, if all bands of one type receive the same airplay (e.g. absent any quota) then each has an equal market share. With this more general specification that is still the case, but the denominator of these market share expressions for each type of band depends on the airtimes of *all* the bands in the genre, domestic or foreign, new or

successful. So an increase in the airtime devoted to successful domestic bands (the novel component of the complex quota discussed above) will, in this specification, directly impact the record sales of new domestic bands, independent of any effect on entry.

7. Robustness: a discussion

Our model is motivated by an industry structure that has prevailed for some decades in the commercial music business. With high fixed costs of recording and promoting artists, record companies fill an essential role of funding start-ups (new entrants), radio plays an essential role in broadcasting recordings so that consumers become aware of them and then successful bands and record companies share, in some fashion, in both the proceeds from record sales and any other rents that might be generated by successful bands. In recent years, many things have changed in the way that music is commercialised and in this section we reflect on how these changes might impact our analysis. Our broad conclusion is that the model is very robust to these changes wrought, particularly, by the internet.

In recent years we have seen at least four significant – and not unrelated – developments in the music industry. First is a significant reduction, due to technological changes, in the costs of recording and, to a lesser extent, in disseminating music. Second is the explosion of music downloading on the internet, both legal and otherwise. Third is the dramatic decrease in the importance of revenues from recording sales for bands, compared to concert and related revenues. Fourth is the rise of internet radio and the role of services such as Pandora and Spotify in the dissemination of new music.

Until quite recently, the business model of record companies has been rationalised by the high fixed costs of both recording an artist and marketing and disseminating their recordings. But the existence of cheap computing software and hardware has meant that it is much cheaper for artists to run home studios and the use of social media on the internet, in particular, is often perceived as reducing the costs of disseminating music. It should first be noted that the empirical incidence of artists bypassing the record company model successfully is vanishingly small: the vast majority of commercially successful artists still transact with record companies along the lines modelled in this paper.[25] In our model we assume a fixed cost of recording and promotion that an artist cannot meet themselves and this rationalises the existence of record companies who act, effectively, as underwriters for new bands. Simply reducing the fixed cost, while leaving artists unable to sidestep the record companies completely, has straightforward consequences in our model, through the comparative statics of a change in F, and does nothing to affect the qualitative analysis of a quota. Permitting bands to bypass record companies and radio stations completely, however, clearly would undermine much of the power of this model.

The simple existence of new distribution structures, such as online downloading, also has little impact on our qualitative analysis of the effects of local content requirements (other than, as discussed below, rendering the feasibility of local content schemes highly questionable.) We do not actually model the distribution of recordings and it does not matter to our analysis if this is through buying physical

[25] See Table 1 at p.671 of Connolly and Krueger (2006), which identifies the top earning 35 artists who toured the U.S. in 2002. All of these are affiliated with recording companies and most with the then major labels (Sony, Warner, BMG, EMI and Universal, or subsidiaries thereof.) More recently, Businesswire.com (2012) reports that in Nielsen Soundscan's 2011 Music Industry Report the four large record companies – Sony and BMG merged in 2004 – had a combined market share of 90% of sales of physical album sales in 2011, 86% of sales of digital albums and 87% of sales of digital tracks. The residual shares are likely to be dominated by smaller record companies.

CDs at a shop (either online or not) or downloading an MP3.[26] The explosion of illegal downloading could be significant to the extent that it undermines the record company business model, but the structure of record companies has not changed dramatically in the internet era and our analysis seems to apply equally to the current situation as to the past.[27]

Connolly and Krueger (2006) provide a thorough description of the economics of popular music and one of their main observations is that, for most modern artists, non-recording related income is much more significant than income derived from the sales of recorded music.[28] This has little impact on our analysis; it is an observation on the relative size of recording revenues and what we model as rents, a ratio that does not affect our results, so long as they are complementary[29] in the sense that record sales are a necessary prerequisite to success as a touring artist.

In all of these developments, our analysis is still relevant so long as artists use record companies and radio airplay is significant in determining the success of artists and thus their revenues, both from recordings and other sources. The fourth development we discuss here is the rise of internet radio. In the abstract this means little for our analysis: whether a recording is heard on an AM/FM radio, a digital radio or streamed over the internet, so long as it feeds into the likely success of an artist

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[26] Cowen (2008) notes that, in 2008, the most significant retailer of music in the U.S. was still Walmart, although Apple's iTunes was second.

[27] Record companies have experienced declining revenues from the increase in downloading in recent years and we have seen a concomitant increase in so-called "360 degree" contracts, in which record companies take shares of profit from non-record sale related activities of their artists. This is essentially built in to our analysis already, as we assume that all revenues generated by a band on contract, whether from record sales or not, accrue to its record company at first.

[28] They note that in 2003 recording sales in the US earned $11.8 billion versus $2.1 billion for concert ticket sales. They quote one band manager as saying that the top 10 percent of artists make money selling records, but the rest go on tour (p.673.)

[29] See Connolly and Krueger (2006) p.687. Note, too, that the U.S. Billboard pop charts that document the "top" recordings of the week are constructed to reflect explicitly both the highest selling albums of the week and which tracks from those albums are aired most regularly on radio broadcasting.

then our analysis still applies.[30] Much more significantly, though, is that the existence of internet radio threatens the very feasibility of the policy instrument we have analysed here: the local content requirement. The technology of radio broadcasts means that a radio station has a geographically limited watershed so, for most national regulators, controlling the broadcasts of all stations within one's sovereign territory means controlling the lion's share of radio broadcasts heard by denizens of that country.[31] But the ability of an Australian regulator to control the content of a Californian internet radio station is effectively zero, unless the station is simply blocked completely. The rise of alternative media for the circulation of music is, in our judgment, the most serious threat to the use of local content requirements in broadcasting, from a regulator's perspective.

Finally, our analysis supposes that consumers are exposed to new music only through their radio listening (which is why radio airtime is critical for bands' success) and we have cited survey data that supports the importance of radio listening in this fashion (see fn. 30.) The development of internet radio services such as Pandora (www.pandora.com) changes this nexus, as they provide playlists to a consumer based on the latter's listening patterns. Nevertheless, so long as consumers continue to have preferences over music listening as we have modelled here, with a preferred mix between new and established bands, a commercial provider such as Pandora still has the same incentive as radio stations in our model to provide playlists in that same

[30] There is some evidence that radio airplay was, relatively recently, still a significant factor in the music purchasing decisions of consumers. French Music Bureau (2003) at p.67 notes that the two most significant factors influencing the decision to buy a new album in the U.K. in 2002 were "hearing tracks from it on the radio" and "already know hit from hit single".

[31] This clearly varies from country to country. It is far easier for Australia, for instance, to regulate what its citizens hear on the radio than for France, although language barriers reduce the temptation of French consumers to listen to, for example, German radio broadcasts. But outside of land-based radio broadcasts, it is unclear what a regulator can do. In Australia, Vizard (1999) expresses this very pithily: "Do we have jurisdiction over off-shore suppliers who beam in by Internet, phone and satellite? How do we force the Los Angeles news Internet provider to include content relevant to us? How do we mandate that the BBC international news service include Australian weather reports? Or that the Discovery Channel include a pack of Tasmanian Devils savaging a sparrow?"

ratio. We can interpret the service, then, as equivalent to a radio station in our analysis – the consumer again chooses how much time to devote to listening to it and the exposure to any particular song within that service affects the probability of record purchase and so forth. However, a service such as this differs significantly from a radio station in our analysis in that it is not confined to a single genre.[32]

8. Conclusion

This paper has presented a model of the recorded music industry, integrating the demand and supply sides through the modelling of consumers, radio stations, record companies and artists. The model has then been used to analyse the supply-side consequences of local music quotas imposed on broadcasters.

Consumers are modelled as deriving utility both from time devoted to listening to music on the radio and from purchasing recordings, the latter modelled in a discrete choice framework. Radio stations choose their genres according to profitability, which stems primarily from the popularity of each genre amongst consumers. Genre-specific record companies sign and record new artists from the set of artists that present in a genre and do so primarily with a view to the profits and rents they will earn from the subset of bands that prove to be 'successful'. Finally, bands enter into the market hoping to be signed by a record company in order to become successful and consequently earn profits and rents when they go off-contract. In this setting the numbers of bands and radio stations in each genre are endogenous, as is the number of bands signed by a record company.

We discuss the properties of a steady-state equilibrium in this context and then use the model to analyse the imposition of local content requirements on broadcasters.

[32] The main way in which services such as Pandora change the music market is in simultaneously catering to preference heterogeneity across individual consumers. Our model does not include such heterogeneity *within* a genre.

Assuming that all foreign bands are successful, we show that a mild (just binding) quota will be welfare-improving in this model, as it induces a domestic record company to sign up more new bands and this is welfare-improving for consumers who gain from diversity. Nevertheless, the quota will induce an 'internationalisation' of domestic music – what we dub the 'Canadian divas effect' – by inducing entry primarily into genres most dominated by international artists. If the quota also requires that some increased proportion of new domestic music be played, we identify a welfare loss associated with this and due to the distorted programming choices it induces from affected radio stations. The paper concludes with some discussions of the model's robustness to recent technological developments and to changes in some of its underlying assumptions.

We consider the central contributions of the paper to be, first, its development of an integrated model of this sector and, second, its more thorough analysis of the supply-side effects of (i.e. the responses of artists and record companies to) local content quotas in broadcasting than has been undertaken previously. We identify a new channel by which such a quota might raise welfare but also illustrate its possibly perverse effects on the diversity of domestic music.

APPENDIX

i. Radio broadcasting quotas in practice[33]

In many countries, local content requirements in radio broadcasting are nearly as old as radio broadcasting itself. For example, the first Canadian radio station to broadcast regular programming – XWA/Montreal – went to air in 1919; in 1932 the Canadian Radio Broadcasting Commission (CRBC) was established to regulate and control all broadcasting in Canada and provide a national broadcasting service, determining the number, location and power of radio stations as well as the time that should be devoted to national and local programming.

The extent of local content requirement varies considerably – from 20% in New Zealand (since 2002), for example, through 35% in Canada to 80% in Nigeria[34] – and the definition of local content also varies. The Canadian MAPL system[35] is perhaps the most explicit and generally requires that Canadian content satisfy two of the following requirements: M (music) – the music is composed entirely by a Canadian; A (artist) – the music is, or the lyrics are, performed principally by a Canadian; P (production) – the musical selection consists of a live performance that is (i) recorded wholly in Canada, or (ii) performed wholly in Canada and broadcast live in Canada; L (lyrics) – the lyrics are written entirely by a Canadian. (By this reasoning, much of the music of Krugman's "Canadian divas" (cf. fn.8) does not qualify as Canadian content.)

In Australia, by contrast, the requirement is simply that broadcasting, "consists of music performed by Australians" and, "where more than one performer is involved in a

[33] For a more comprehensive discussion of broadcasting content protection around the world in 2000, see Appendix F of Productivity Commission (2000).
[34] See Letts (2003) at p.3.
[35] See Canadian Radio-television and Telecommunications Commission (2009).

musical performance, the musical items concerned shall be regarded as being performed by an Australian if the performance is predominantly by one or more Australians" where this appears to refer to Australian residents (Commercial Radio Australia (2011) §4.)[36]

A prominent set of local cultural content requirements is that of France. Originally implemented in 1996[37] and reformed in 2000, it now requires radio stations (subject to some variations across formats) to broadcast a minimum of 40% music performed in French (or a regional language spoken in France) at least half of which must be devoted to new French artists.

ii. The analytics of a simple quota

Suppose that the airtime devoted to foreign bands is restricted in genre g by a binding quota such that $\sum_{m=1}^{n_g^*} a_{gm}^* = Q$ where Q is less than the laissez-faire choice by the radio station *sans* quota. We term this a 'simple' quota as it imposes no restrictions on the mix between new and successful domestic bands' airtime. The problem facing a radio station in this genre is unchanged and it will still choose A_g and A_{gs} exactly as before, as given in (21). But, given n_g^*, it must reduce the airtime per foreign band to meet the quota, to $a_g^{*Q} = \frac{Q}{n_g^*}$, and this, for given n_{gs} and n_{gsc}, implies an increase in airtime per successful domestic band to $a_{gs}^Q = (A_{gs} - Q)/(n_{gs} + n_{gsc})$.

From the analogue for successful bands of equation (2) we have, in the presence of a simple quota

[36] Following a High Court of Australia decision (High Court of Australia (1998)) with respect to content rules in TV broadcasting, it is likely that NZ artists can also be included in the Australian radio content quota under the auspices of the CER free trade agreement between the two countries.

[37] This is not inconsistent with the European single-market philosophy, which also specifies European-wide content. In 1989 the European Union implemented the ironically-named Television Without Frontiers directive protecting audio-visual content within Europe and noting that, "all broadcasts emanating from and intended for reception within the Community … should respect the law of the originating Member State applicable to broadcasts intended for reception by the public in that Member State." See The Council of the European Communities (1989).

$$x_{gsj} = \frac{exp\left\{\frac{A_{gs} - Q}{n_{g2}(1+h)}\right\}}{\left[n_{g2}(1+h)exp\left\{\frac{A_{gs} - Q}{n_{g2}(1+h)}\right\} + n_g^* exp\left(\frac{Q}{n_g^*}\right)\right]} \tag{37}$$

For given n_{g1} (and therefore n_{g2}) differentiating (37) yields:

$$\left.\frac{dx_{gsj}}{dQ}\right|_{n_{g1}} = \frac{-\frac{[.]}{n_{g2}(1+h)}exp\{.\} - exp\{.\}\left(exp\left(\frac{Q}{n_g^*}\right) - exp\{.\}\right)}{\left[n_{g2}(1+h)exp\left\{\frac{A_{gs} - Q}{n_{g2}(1+h)}\right\} + n_g^* exp\left(\frac{Q}{n_g^*}\right)\right]^2}$$

$$= -\frac{exp\{.\}}{[.]^2}\left(\frac{[.]}{n_{g2}(1+h)} + exp\left(\frac{Q}{n_g^*}\right) - exp\{.\}\right)$$

$$= -\frac{x_{gsj}}{[.]}\left(exp\{.\} + \frac{n_g^*}{n_{g2}(1+h)}exp\left(\frac{Q}{n_g^*}\right) + exp\left(\frac{Q}{n_g^*}\right) - exp\{.\}\right) \tag{38}$$

$$= -\frac{x_{gsj}}{[.]}exp\left(\frac{Q}{n_g^*}\right)\left(\frac{N_{gs}}{n_{g2}(1+h)}\right)$$

$$= -x_{gsj}x_g^*\left(\frac{n_g^* + n_{g2}(1+h)}{n_{g2}(1+h)}\right) < 0$$

Thus a fall in Q (a tightening of the quota), leading to greater airtime for all successful domestic bands, leads to greater record sales.

The record company's steady state problem is, from (24) and (37):

$$\max_{\{n_{g1}\}} E(\pi_g) = k_1 + k_2 f(n_{g1})x_{gs} - n_{g1}F_1 - n_{g2}F_2$$

$$= k_1 + k_2\frac{f(n_{g1})exp\left\{\frac{A_{gs} - Q}{(1+h)f(n_{g1})}\right\}}{\left[(1+h)f(n_{g1})exp\{.\} + n_g^* exp\left(\frac{Q}{n_g^*}\right)\right]} - n_{g1}F_1 \tag{39}$$

$$- f(n_{g1})F_2$$

The FOC for this problem is, dropping the argument of f for clarity:

$$k_2\left(f\frac{d}{dn_{g1}}(x_{gs}) + f'x_{gs}\right) - F_1 - f'F_2 = 0 \tag{40}$$

where $F \equiv F_1 + f'F_2 > 0$. But:

$$\frac{d}{dn_{g1}}(x_{gs}) = \frac{1}{[.]^2}\big(-exp\{.\}\{.\}f^{-1}f'[.]$$

$$- exp\{.\}(1+h)(f'exp\{.\} - exp\{.\}\{.\}f')\big)$$

$$= \frac{exp\{.\}f'}{[.]^2}\big(-\{.\}f^{-1}[.] - (1+h)exp\{.\}(1-\{.\})\big) \tag{41}$$

$$= -x_{gs}\Big(\{.\}f'f^{-1} + (1+h)x_{gs}(1-\{.\})\Big)$$

where [.] and (.) represent the bracketed terms in (37) and where we have also used the definition of x_{gs} from that expression in simplifying. Accordingly, the FOC for n_{g1} can be written as:

$$\Gamma \equiv -x_{gs}\{.\}f' - (1+h)\big(x_{gs}\big)^2 f(1-\{.\}) + f'x_{gs} - \frac{F}{k_2}$$

$$= x_{gs}\left(1 - \left\{\frac{A_{gs} - Q}{(1+h)f}\right\}\right)\big(f' - (1+h)fx_{gs}\big) - \frac{F}{k_2} = 0 \tag{42}$$

Note that the expression in the curly bracket is a fraction less than one, so one minus that expression is positive. Thus the term $(f'-(1+h)fx_{gs})$ must also be positive. Denoting the LHS of this equation by Γ, from the firm's SOCs we know that the sign of dn_{g1}/dQ is the same as that of $d\Gamma/dQ$. From (37) we have

$$\frac{dx_{gs}}{dQ} \equiv x_Q = \frac{1}{[.]^2}\left(-\frac{1}{(1+h)f}[.]exp\{.\}\right.$$

$$\left. - exp\{.\}\left(exp\left(\frac{Q}{n_g^*}\right) - exp\{.\}\right)\right)$$

$$= \frac{x_{gs}}{[.]}\left(-\frac{1}{(1+h)f}[.] - exp\left(\frac{Q}{n_g^*}\right) + exp\{.\}\right)$$

$$= \frac{x_{gs}}{(1+h)f[.]}\left(-(1+h)fexp\{.\} - n_g^* exp\left\{\frac{Q}{n_g^*}\right\}\right. \tag{43}$$

$$\left. - (1+h)fexp\left(\frac{Q}{n_g^*}\right) + (1+h)fexp\{.\}\right)$$

$$= \frac{x_{gs}}{(1+h)f[.]}\left(-n_g^* - (1+h)f\right)exp\left\{\frac{Q}{n_g^*}\right\}$$

$$= -\frac{N_{gs}x_{gs}}{(1+h)f[.]}exp\left\{\frac{Q}{n_g^*}\right\} < 0$$

From (42) the sign of dΓ/dQ is the same as that of

$$\frac{d}{dQ}\left(x_{gs}\left(1 - \left\{\frac{A_{gs} - Q}{(1+h)f}\right\}\right)\left(f' - (1+h)fx_{gs}\right)\right)$$

$$= \left(x_Q(1 - \{.\})\left(f' - 2(1+h)fx_{gs}\right)\right. \tag{44}$$

$$\left. + \frac{x_{gs}\left(f' - (1+h)fx_{gs}\right)}{(1+h)f}\right)$$

Suppose this is evaluated at the no-quota solution. At that point x=1/N_{gs} and (.)=(A_{gs}/N_{gs})=(Q/n_g^*). So

$$x_Q\big|_{no\ quota} = -\frac{x_{gs}exp\{.\}N_{gs}}{\left[N_{gs}exp\{.\}\right](1+h)f} = -\frac{x_{gs}}{(1+h)f} < 0$$

Then the sign of dΓ/dQ is the same as that of

$$\frac{1}{(1+h)f}\Big(-x_{gs}(1-\{.\})\big(f'-2(1+h)fx_{gs}\big)$$

$$+x_{gs}\big(f'-(1+h)fx_{gs}\big)\Big)$$

$$=\frac{x_{gs}}{(1+h)f}\Big(-(1-\{.\})\big(f'-2(1+h)fx_{gs}\big)$$

$$+\big(f'-(1+h)fx_{gs}\big)\Big) \tag{45}$$

$$=\frac{x_{gs}}{(1+h)f}\Big(\{.\}\big(f'-(1+h)fx_{gs}\big)$$

$$-(1+h)fx_{gs}(\{.\}-1)\Big)>0$$

where the sign comes from the fact that (.)<1 and (f'-(1+h)fx_{gs})>0.

That is, a tightening of the quota – a *fall* in Q – evaluated at the no-quota solution will induce an increase in the number of new domestic bands. Thus in steady state there is an increase in new entrants that flows through to the number of successful domestic bands, both on- and off-contract.

iii. Welfare effects of simple quota

From (38) and (39), by the envelope theorem,

$$\frac{d\pi_g}{dQ}=\frac{\partial\pi_g}{\partial Q}+\frac{\partial\pi_g}{\partial n_{g1}}\frac{dn_{g1}}{dQ}=k_2f\big(n_{g1}\big)\frac{dx_{gs}}{dQ}<0 \tag{46}$$

So a tightening of the quota (a fall in Q) raises the profits of the domestic record company.

For enthusiast consumers we have, from (14),

$$CS_{ge}=\mu_g\lambda_gL(T-p)\ln\left(n_{g1}exp\left(\frac{1}{n_{g1}}\right)\right) \tag{47}$$

The only impact of a reduction in Q on such consumers is through the increase in n_g that such a reduction induces. But

$$\frac{dCS_{ge}}{dn_{g1}} = \mu_g \lambda_g L(T-p)\frac{1}{n_{g1}}\left(1-\frac{1}{n_{g1}}\right) > 0 \tag{48}$$

For faddist consumers we have, from (15),

$$CS_{gf} =$$

$$(1-\mu_g)\lambda_g L(T^f - p)\ln\left[n_g^* exp\left(\frac{Q}{n_g^*}\right) + (1+h)f(n_{g1})exp\left\{\frac{A_{gs}-Q}{(1+h)f(n_{g1})}\right\}\right] \tag{49}$$

Thus:

$$\frac{dCS_{gf}}{dQ}\frac{[.]}{(1-\mu_g)\lambda_g L(T^f-p)} = \frac{\partial[.]}{\partial Q} + \frac{\partial[.]}{\partial n_{g1}}\frac{dn_{g1}}{dQ} \tag{50}$$

where the square bracket in (50) refers to the square bracketed term in (49). Differentiating the terms in CS_{gf} yields:

$$\frac{\partial[.]}{\partial n_{g1}} = (1+h)\left(f' exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\} - f exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}\frac{\{.\}}{f}f'\right)$$

$$= (1+h)f' exp\{.\}(1-\{.\}) > 0 \tag{51}$$

$$\frac{\partial[.]}{\partial Q} = n_g^* exp\left(\frac{Q}{n_g^*}\right)\frac{1}{n_g^*} - (1+h)f exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}\frac{1}{(1+h)f} = exp\left(\frac{Q}{n_g^*}\right) - exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}$$

This last expression is just $exp(a_g^*)$-$exp(a_{gs})$ and so is negative *iff* each domestic band gets more airtime, in equilibrium, than each foreign band. Clearly these two are equal when the quota is just binding and, if n_{g1} were unchanged, then each domestic band would get strictly more airtime than each foreign band as the quota were tightened. However, a fall in Q induces an increase in n_{g1}, as discussed earlier, so the overall effect is not immediately obvious. But the signing of new bands by the record company in response to a tighter quota only occurs because of the increased profitability of successful bands and that profitability is a monotonic increasing function of airtime for successful bands. Hence it cannot be the case that entry is

sufficient to reduce that airtime (and thus profitability.) All in all, the solution *cum* quota must be such that per-band airtime for successful domestic bands must be no lower than in the absence of any quota. Thus

$$\frac{dCS_{gf}}{dQ}\frac{\left[n_g^* exp\left(\frac{Q}{n_g^*}\right)+(1+h)f exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}\right]}{(1-\mu_g)\lambda_g L(T^f-p)}$$

$$=\underbrace{exp\left(\frac{Q}{n_g^*}\right)-exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}}_{(-)} \tag{52}$$

$$+\underbrace{(1+h)f' exp\{.\}(1-\{.\})}_{(+)}\frac{dn_{g1}}{dQ}$$

and a sufficient condition for faddist consumers to gain from a quota (a *reduction* in Q) is that a tighter quota induces entry: $dn_{g1}/dQ<0$. This is certainly satisfied when the quota is just binding, as demonstrated above.

All in all, then, a just-binding quota is welfare-improving, benefitting record companies and both faddist and enthusiast consumers.

Combining these effects,

$$\frac{dW_g}{dQ}\frac{1}{\lambda_g L}$$

$$=-(1-\mu_g)(p+\varphi c_g)f x_{gsj} x_g^*\left(\frac{n_g^*+n_{g2}(1+h)}{n_{g2}(1+h)}\right)$$

$$+(T-p)\left[\frac{\mu_g\frac{1}{n_{g1}}\left(1-\frac{1}{n_{g1}}\right)+(1+h)f' exp\{.\}(1-\{.\})(1-\mu_g)}{\left[n_g^* exp\left(\frac{Q}{n_g^*}\right)+(1+h)f exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}\right]}\right]\frac{dn_{g1}}{dQ} \tag{53}$$

$$-\frac{(1-\mu_g)(T-p)\left(exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}-exp\left(\frac{Q}{n_g^*}\right)\right)}{\left[n_g^* exp\left(\frac{Q}{n_g^*}\right)+(1+h)f exp\left\{\frac{A_{gs}-Q}{(1+h)f}\right\}\right]}$$

iv. Multiple record companies in a genre

Suppose that there are R_g record companies that operate in genre g. The problem facing the typical record company, analogous to (24), is:

$$\max_{\{n_{g1i}\}} \pi_{gi}(n_{g1i}) = \frac{n_{g1i}}{\sum_k n_{g1k}} k_1 + k_2 \frac{f(n_{g1i})}{\{(1+h)[\sum_k f(n_{g1k})] + n_g^*\}} - n_{g1i}F_1 - f(n_{g1i})F_2 \tag{54}$$

where $k_1 = pL\mu_g\lambda_g$ and $k_2 = (1-\mu_g)(p+\varphi c_g)\lambda_g L$ are the same positive constants as in the paper and k indexes the R_g record companies in the genre. This yields a FOC as follows:

$$\begin{aligned}\frac{dE(\pi_{gi})}{dn_{g1i}} &= \frac{\sum_{k\neq i} n_{g1k}}{(\sum_k n_{g1k})^2} k_1 + k_2 \frac{f'(n_{g1i})\left(\{.\} - f(n_{g1i})(1+h)\right)}{\{(1+h)[\sum_k f(n_{g1k})] + n_g^*\}^2} \\ &\quad - (F_1 + f'(n_{g1i})F_2) \\ &= \frac{\sum_{k\neq i} n_{g1k}}{(\sum_k n_{g1k})^2} k_1 + k_2 \frac{f'(n_{g1i})[(1+h)\sum_{k\neq i} f(n_{g1k}) + n_g^*]}{\{.\}^2} \\ &\quad - (F_1 + f'(n_{g1i})F_2) = 0\end{aligned} \tag{55}$$

In the symmetric equilibrium, however, $n_{g1i}=n_{g1k} \equiv n_{g1}$ for all k, so $\sum_k n_{g1k}=R_g$ and $\sum_{k\neq i} n_{g1k}=R_g$-1 so this becomes:

$$\begin{aligned}\frac{dE(\pi_{gi})}{dn_{g1i}} &= \frac{(\mathrm{R}_g - 1)}{(\mathrm{R}_g)^2 n_{g1}} k_1 + k_2 \frac{f'(n_{g1})[(1+h)(\mathrm{R}_g - 1)f(n_{g1}) + n_g^*]}{\{(1+h)\mathrm{R}_g f(n_{g1}) + n_g^*\}^2} \\ &\quad - (F_1 + f'(n_{g1})F_2) = 0\end{aligned} \tag{56}$$

Of course, this collapses to (25) when R_g=1. But when there is more than one record company we pick up a new term in the FOC (56) that is positive (albeit declining in n_{g1}) and indicates that an increase in new band numbers for a record company

provides a new source of additional profits, compared to the single company case, due to the increased share of first-period profits that it generates.

The SOC for the firm is, from (55) and suppressing the arguments of $f(.)$:

$$\frac{d^2E(\pi_{gi})}{(dn_{g1i})^2} = -2\frac{\sum_{k\neq i} n_{g1k}}{(\sum_k n_{g1k})^3}k_1$$

$$+ k_2\left[(1+h)\sum\nolimits_{k\neq i} f + n_g^*\right]\frac{f''\{.\} - 2(1+h)(f')^2}{\{(1+h)[\sum_k f] + n_g^*\}^3} - f''F_2$$

$$= 2\frac{(1-\mathrm{R}_g)}{(\mathrm{R}_g)^3}\frac{k_1}{(n_{g1})^2} \tag{57}$$

$$+ k_2\left[(1+h)(\mathrm{R}_g - 1)f + n_g^*\right]\frac{f''\{.\} - 2(1+h)(f')^2}{\{(1+h)\mathrm{R}_g f + n_g^*\}^3} - f''F_2$$

$$< 0$$

Differentiating (56) with respect to R_g yields:

$$\frac{\partial}{\partial \mathrm{R}_g}\frac{dE(\pi_{gi})}{dn_{g1i}}$$

$$= \frac{(2-\mathrm{R}_g)}{(\mathrm{R}_g)^3}\frac{k_1}{n_{g1}} \tag{58}$$

$$+ k_2 f'(n_{g1})\frac{(1+h)f(n_{g1})\left[(1+h)f(n_{g1})(2-\mathrm{R}_g) - n_g^*\right]}{\{(1+h)\mathrm{R}_g f(n_{g1}) + n_g^*\}^3}$$

Clearly this is non-positive for $R_g \geq 2$, implying that each record company's optimal choice of new bands to sign is decreasing in the number of record companies in the genre.

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