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Entry Barriers, Release Behavior, and Multi-Product Firms in the Music Recording Industry

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Introduction

The relationship between industry structure and product variety is of interest to economists, in large measure due to the explorations of Edward Chamberlin (1933), who developed the pioneering theory of monopolistic competition. Continued interest in the relationship between industry structure and product variety has led to other notable contributions from Lancaster (1979), Spence (1976), Scherer (1979), Eaton and Lipsey (1975), Schmalensee (1978), Dixit and Stiglitz (1977), and Koenker and Perry (1981) among others. Despite the progress that has been made in this general theoretical development, important theoretical gaps remain. For example, Lancaster (1987) notes that, "If the market structure is that of a single multi-product firm, the degree of variety offered will always be less than it would be under monopolistic competition. No clear results are available for an industry composed of a few multiproduct firms, although this is a very important real case" (p. 989). As Lancaster implies, studies of industries composed of a few multi-product firms may yield some useful insights into the relationship between market structure and product variety.

In this paper, I explore the effects of oligopolistic industry structure on product diversity and variety, taking the music recording industry as a case study. A central focus of the paper is to explore how the product release behavior of multi-product, oligopolistic firms affects the aggregate number of new products issued.¹ Oligopoly models are the appropriate focus, since a small handful of firms dominates the music recording industry. In Section Four of this paper, I develop a simple Cournot-type quantity model (where quantity is the number of new releases) to show that the aggregate number of new products issued in the industry is in part contingent on whether the firms act independently with respect to release behavior, or apportion the market among themselves in some fashion. Following Stigler (1964), "the present paper accepts the hypothesis that oligopolists wish to collude to maximize joint profits" (p. 44). I conclude that if the firms use their oligopoly position to apportion the market, they will introduce fewer new products than if their release behavior is strictly independent. In Section Five, I explore entry-deterrents that may promote the stability of an (implicit) apportionment agreement among the major firms in the music recording industry.

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Concentration in the Music Recording Industry

The distribution of market share among major and independent firms in the domestic music recording industry has shown fluctuations approximating the shape of a (W), with two periods of low concentration, preceded and followed by several periods of high concentration. In the industry's infancy (1890-1900), three major firms produced the output of most audio related products, both in terms of the playback devices (i.e., cylinder and record players) and the audio products themselves (i.e., cylinders and records). This initial phase of high industry concentration was followed by a period of rapid technical innovation in manufacturing technology (1900-1910) which led to the entry of many new firms, and a dispersion of market share. In the nine-year period between 1914 and 1923, the number of firms manufacturing phonographs and records grew at an average annual rate of 20%. However, in the six-year period from 1923 to 1929, the number of firms producing record players and/or records declined at an average annual rate of 11%. Horizontal integration explains much of the renewed high levels of industry concentration.

From 1930 to 1945, the music recording industry was again highly concentrated. A collapse in record sales from \$75 million in 1929 to \$5 million in 1933 accelerated the rate of industry concentration. Recovery in the industry was hampered by the onset of World War II, which caused a shortage in the supply of shellac needed to produce records. However, in the late 1940s, another significant technological innovation emerged: magnetic tape recording. This new cost-reducing innovation induced entry on a massive scale. While major firms gained 75% of the industry's market share in 1948, that total fell to 48% by 1956 and 25% by 1962. However, in the period after 1962, and continuing to the present, major firms reacquired market share. Horizontal integration explains much of the current structure of the recording industry, as the mid-1960s marked the beginning of a wave of take-overs and buy-outs of independent firms that has continued into the 1990s.

Two central themes emerge from the proceeding discussion. First, new production and manufacturing technology facilitated both significant waves of entry (late 1910s/early 1920s and 1950s), by lowering production costs and the minimum efficient scale of production. In both periods smaller new firms proved to be strong competitors with the existing firms, in part because they introduced innovative products that became popular with consumers. In turn, this new competition eroded the pre-existing structure of the music recording industry, and lowered the level of concentration within the industry. Second, horizontal integration accounts for the renewal of high levels of industry concentration in both periods.

Currently, the music recording industry is dominated by six large multi-divisional,

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multi-product firms, which together account for almost all of the industry's market share when measured at the distributor level.ⁱⁱ Given the apparently modest costs of entry into this industry, the current degree of industry concentration is surprising. In Section Four, I explore one effect of a highly-concentrated industry structure, in terms of the number of new releases issued by the firms in the industry. As I suggest in Section Five, distributional and promotional entry barriers provide some insights for understanding the industry's current structure.

Assumptions of the Modelⁱⁱⁱ

The firms in these models are multi-product profit maximizers with interdependent products, i.e., there is some degree of substitution among the various products. Because the products of the firms are imperfect substitutes, each new release generates diminishing returns for all other previous releases.^{iv} Also, firms order their new product releases according to anticipated revenues, ranging from highest anticipated revenue to lowest.

Prices and costs are assumed constant across new releases. The assumption of constant prices is reasonable, given industry pricing behavior: prices for new releases do tend to be uniform, reflecting pricing focal points.^v Although the assumptions about costs are somewhat strong, they permit the central focus to remain on release behavior. Most importantly, in this model the decision variable is not price or simple quantity. Instead, the decision variable is the number of new products to introduce.

A Model of Release Behavior in the Music Recording Industry

In this section, I examine two possible types of release behavior of oligoplistic firms in the music recording industry. The first is a simple Cournot-like, where firms do not recognize their interdependence. In the second, firms recognize that their release behavior will influence the release behavior of their competitors. The model suggests that if firms are able to coordinate their release behavior, the number of new releases will decline relative to a situation in which the firms' release behavior is strictly independent.^{vi}

The revenue ordering for a multi-product firm in this model may be written as:

$$(1) \qquad q(h, r)$$

which gives the revenue from the h^{th} release, given that r total releases are issued. There

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are two important properties of this function. First, $q(h,r)$ is decreasing in h . This follows directly from the assumption that firms array their products from highest to lowest according to expected revenue. Second, $q(h,r)$ is decreasing in r because the products are imperfect substitutes that generate diminishing returns for all the previous releases. Thus, the greater the number of releases, the less revenue each of the previous releases brings. The total revenues of r releases, $Q(r)$, equals:

$$(2) \quad Q(r) = \int_0^r q(h,r) dh$$

while profits are given by:

$$(3) \quad P(r) = Q(r) - C(r)$$

where $C(r)$ is the total cost of producing r releases. The number of releases, r , that maximizes profits (call it r^*) satisfies:

$$(4) \quad P'(r^*) = Q'(r^*) - C'(r^*) = 0$$

or

$$(5) \quad Q'(r^*) = C'(r^*)$$

The marginal cost, $C'(r^*)$, is assumed constant across releases.

If we assume that a firm adopts a simple Cournot-like behavior, it acts as if a change in the number of its releases is not tied to a release response from its competitors, i.e., the firm takes its rivals' output as given. Thus, the revenue function:

$$(6) \quad q(h, r; r_1, \dots, r_n)$$

equals the revenues from the individual firm's h^{th} release, given that the firm releases r releases, and the other firms continue to release (r_1, r_2, \dots, r_n) ; that is, all the variables are mutually independent. Total revenue for the firm becomes:

$$(7) \quad Q(r; r_1, \dots, r_n) = \int_0^r q(h, r; r_1, \dots, r_n) dh$$

with maximum profits determined by the solution r^* , to the equation:

$$(8) \quad \frac{\partial Q}{\partial r}(r^*; r_1, \dots, r_n) = C'(r)$$

Alternatively, if the firms recognize their interdependence, they may adjust the

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level of their releases so that the (r, r_1, \dots, r_n) are interdependent. This recognition of interdependence can most simply be incorporated into the previous model by letting (r_1, \dots, r_n) depend explicitly on r , via the increasing functions $r_j = r_j(r)$. The total revenue function is still given by:

$$(9) \quad Q(r; r_1(r), \dots, r_n(r)) = \int_0^r q(h, r; r_1(r), \dots, r_n(r)) dh$$

and profits will be maximized for the solution, $r = r_c$, to the equation:

$$(10) \quad \frac{dQ}{dr}(r^*; r_1(r), \dots, r_n(r)) = C'(r)$$

The left-hand side of (10) can be rewritten as:

$$(11) \quad \frac{dQ}{dr} = \frac{\partial Q}{\partial r} + \sum_{j=1}^n \frac{\partial Q}{\partial r_j}$$

where the r_j are the releases of the other firms. The expression dr_j/dr can be thought of as a proportionality factor relating the market shares of the firms. We note that:

$$(12) \quad \frac{\partial Q}{\partial r_j} < 0$$

because as r_j increases, Q , the revenues of the first firm decrease, while

$$(13) \quad \frac{dr_j}{dr} > 0$$

because $r_j(r)$ is increasing. Therefore:

$$(14) \quad \sum_{j=1}^n \frac{\partial Q}{\partial r_j} \frac{dr_j}{dr}$$

is negative. We can conclude that for every value of r :

$$(15) \quad \frac{dQ}{dr} < \frac{\partial Q}{\partial r}$$

It is clear that $R_{\text{Cooperate}} < R_{\text{Cournot}}$, and that aggregate releases decrease when the firms apportion the market with respect to the simple Cournot-like outcome. In turn, this implies that $q(h, r_{\text{Cooperate}}) > q(h, r_{\text{Cournot}})$, i.e., revenues, and thus profits per release, increase in the apportionment model with respect to the Cournot model, because there

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are fewer substitutes for each release.¹

Entry Barriers and Release Behavior

The behavior of oligopolistic firms within a multi-product industry influences the level of new product releases. While it is plausible that oligopolistic firms in some multi-product industries may "pack the product space" (Schmalensee, 1978), I have suggested that under reasonable assumptions a different outcome is also feasible. As I showed in the previous model, if the firms behave in a simple Cournot-like fashion, they will release more new products than if the firms' behavior is consistent with joint maximization or apportionment.

Although the standard view is that cooperative arrangements are unstable,^{vii} there are conditions under which they can be stable. In this section, I show how barriers to entry and other structural characteristics of the recording industry result in high levels of industry concentration and possible accommodation with respect to product release behavior.

Production The technology of supply in the music recording industry has undergone significant transformations which have had the effect of potentially reducing production costs. For a major firm, the production costs for a single recorded product range from \$100,000 to well over \$500,000. Production costs for small firms are typically much lower, with a general range from \$4,000 to \$25,000.

Since the major firms spend more per product on production than smaller firms and have a larger market share than the smaller firms, one might assume that this larger market share results from greater expenditure at the production stage (i.e., a quality effect). However, there is little evidence that this is the case.^{viii}

In fact, it has become a common practice for small firms to affiliate with major firms through so-called pressing and distribution deals (P&Ds) whereby major firms use the master tapes created by small, independent firms for final use in the manufacture of musical products. Through the use of these tapes, the major firms implicitly

¹ New product releases by the major firms in the industry declined at an average annual rate of 9% from 1978-1984, while revenues per release increased at an average annual rate of 7.2% (1982 dollars) in the same period.¹ This finding is consistent with the apportionment theory. Unfortunately, release data for other years are not available to the public, nor is there an effective way of counting releases from published sources.

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acknowledge that they are of a sonic quality sufficient for use in mass production. Thus, a link between expenditures at the production stage and market share is tenuous.

Distribution The function of record distributors is to make available to record retailers the products of the recording industry. After a product is manufactured, units are shipped from the record company to distributors who make copies available to retail outlets. Once the records have been distributed to the retail organizations, the record company receives compensation from the distributors for the units sold.

The structure of the distribution network in the recording industry has undergone substantial increases in concentration since the 1950s. In the 1950s, although major firms had their own distribution network, independent distributors were a significant alternative channel. Chapple (1977) illustrates the general situation:

In the fifties the major companies--Columbia (CBS), RCA-Victor (BMG), Decca (MCA), and Capitol (EMI)--distributed through factory-owned branches. Independent distributors handled the majority of independent record labels. Each distributor carried a number of labels such as Atlantic, Dot, and Jubilee, and sometimes larger firms such as MGM and London.
(p. 24)

In the 1960s, major firms began purchasing successful independent distributors. ABC-Paramount (MCA), Capitol (EMI), and CBS (Sony) all made significant buyouts.

The shift from primarily independent distribution to integrated distribution was, in part, a residual of the wave of horizontal mergers that occurred in the 1960s and 1970s. The independent firms that were purchased by the major firms had previously relied on independent distribution, but were now being distributed by the major firms. As Greer (1984) notes:

Concentration at the distribution level was fostered by the fact that distribution of the independent labels, which was formerly done by independent distributors, was automatically shifted to the majors' distribution networks for those independents that were acquired by majors.
(p. 32)

This change in the pattern of distribution put financial pressure on the independent distributors, and in the 1970s, several of the largest went bankrupt. In the early 1980s this trend accelerated and record distribution became even more highly-concentrated, as several of the remaining large independent distributors, among them Jem, Sounds Good and Greenworld, went bankrupt.

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According to an industry source at Warner Communications one consequence of this increased concentration at the distribution level is that "the competition among the distributors that have survived is less significant. The remaining distributors can now demand things like exclusivity, special pricing, special dating." Moreover, an independent firm utilizing a major firm for distribution may lose contractual control of their roster of artists. Loss of contractual control of the firms' inputs (i.e., the recording artists) is a consequence of the contractual obligations the independent may be compelled to enter for distribution services with a major distributor. In return for manufacturing and/or distribution services, the independent firm is generally obligated to yield the contracts of the distributed inputs to the major firm at some specified future date. As Greer (1984) notes, "the independent labels must increasingly rely on the majors for various services like distribution, a dependency that permits the majors to obtain contractual options on the acts of independent labels" (p. 53). Industry sources also state that major firms may require the independent firm to grant them contract options on additional inputs in return for distribution services.

Fringe firms and new entrants have few alternatives to distribution through a major competitor. For example, the cost of integration into distribution at the national level has been estimated at \$100 million (Greer, 1984). Moreover, all of the independent distributors of national scale have been purchased by one of the six major firms. Some of the small firms in the industry have responded by going direct to retail, i.e., directly contacting retail outlets and arranging to send shipments to these outlets. To the extent that more time and money must be spent arranging these smaller shipments, the per-unit transaction costs are higher than a competitive intermediate market for distribution.

Promotion A prerecorded audio product is a peculiar commodity. Unlike many produced goods, its characteristics are not readily apparent to the consumer. A consumer in a record store cannot discern and evaluate a prerecorded audio product's attributes by touch, visual inspection, smell, or any of the other means commonly used to inspect products. A prerecorded audio product must be heard in order to be evaluated: audio presentation is a prerequisite for most purchases. Consequently, radio airplay tends to be the most effective means of informing consumers of the existence and nature of new products. Quasi-control of radio airplay by the existing firms would provide an ideal mechanism for thwarting new entrants or fringe firms. How might control of the radio airwaves be obtained?

Influence over the content of radio airplay may result from "payola" expenditures.^{ix} Typically, payola involves firms or their representatives making payments to radio disc jockeys or station managers in return for airplay of the firm's

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products. According to Coase (1979) payola has been used since the inception of the industry, frequently by small new entrants attempting to gain market share. Coase notes that:

There can be no doubt that *the new companies*, which entered the business in the 1950s and succeeded in securing such an important share of the record market, *relied on payola* to obtain "exposure" for their records. These companies lacked the name-stars and the strong marketing organization of the major companies, and payola enabled them to expand their sales by making similar efforts in other markets. (pps. 315-316, italics added)

This situation had changed by the late 1970s. Dannen (1990) hints that the large firms now used payola to exclude fringe firms and new entrants:

Bigness provided few competitive advantages at least in terms of having hits. In fact it could be a disadvantage. The small labels were often quicker to spot a trend, and they could make a record as cheaply as a big company. The record companies understood on some level that if radio airplay were not free, it would mean a major competitive advantage. The large companies had the money, [and their representatives] plied station program directors with cash, cocaine, expensive gifts, and hookers. After 1978, records put out by small labels began to vanish from the Top 40 airwaves. (pps.14,15)

Is it possible that the major firms in the music recording industry utilize payola as an entry barrier of the Salop and Scheffman (1983) variety: a barrier that raises rivals' costs, the rivals being small fringe firms or new entrants? According to Salop and Scheffman, for the strategy of raising rivals' costs to be profitable, it must shift up the "aggressive" firm's residual demand curve more than it shifts up the firm's average cost curve, measured at the original level of output. Importantly, Salop and Scheffman note that strategies that raise rivals' costs are rational and credible because "these strategies do not require a sacrifice of profits in the short run, but allow profits to be increased immediately, [thus] the would-be predator has every incentive to carry out its threats." (pp. 267-268) However, if the major firms can use payola to have their products played, why don't the fringe firms or new entrants simply pay to have their products played over-the-air as well? While this topic merits an in-depth treatment, I offer the following brief explanations of conditions that may prevent fringe firms or new entrants from using payola as an effective counterstrategy.

Capital markets may be "imperfect": smaller firms may have a greater cost of obtaining capital because (a) a risk premium is attached to their cost of borrowing (Scherer and Ross, 1990), or (b) credit markets may decline to lend funds to "lower

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quality" borrowers at any rate of interest (Stiglitz, 1987), (c) lenders may refuse to lend to borrowers who have different levels of risk than the lenders (Gintis, 1989), or, (d) banks base their lending rates on the salvage value of the borrowers assets. Assuming that promotion costs for firms are sunk and the salvage values are zero, the interest rate on borrowed funds will tend towards infinity.

Alternatively, the major firms may be able, via payola, to purchase "exclusionary rights" that prevent their competitors from obtaining radio airplay. That is, perhaps payola purchases both radio airplay and the option to exclude new entrants and fringe firms from the airwaves. According to a highly-placed industry source at a major label (who asked to remain anonymous), the major firms use payola not only to gain airplay, but to deny airplay to competitors. As Krattenmaker and Salop (1986) note:

Vertical restraints and contracts can be fertile ground for raising competitors costs. By contracting with one or more suppliers to exclude rivals, either by dealing with them on discriminatory terms or refusing to deal with them altogether, a firm sometimes can increase its rivals' costs. (p.109)

One might argue, as Krattenmaker and Salop (1986) suggest, that rivals can counteract the exclusionary strategies of the large firms:

It might be argued that such exclusionary conduct would always fail for two reasons: the excluded rivals would have available effective counterstrategies to prevent their own exclusion; and input suppliers would have no incentives to reduce their sales by excluding some customers. (p.109)

This does not appear to be the case in the music recording industry.

As Dannen (1990) observes, contact between the major firms and radio stations during the late 1970s and 1980s was indirect. A small group of promoters who referred to themselves as the "Network" were paid to represent the major firms' interests directly to radio station operators. According to Dannen:

Though the term 'Network' conjured images of a powerful, secret society, it referred to the tendency of the promoters to work as a loosely knit team. Each member had a 'territory,' a group of stations over which he claimed influence. If a record company wanted national airplay for a new single, it could choose to hire one of the Network men, who would in turn subcontract the job to other members of the alliance. (p.11)

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The Network was a club i.e., a voluntary group sharing excludable benefits, where membership was restricted to major firms, or firms distributed by a major firm. Importantly, the Network provided firms with protection from potential federal prosecution on payola charges.^x Dannen notes that the major labels "could not allow their staff people to make payments to radio stations. It had become too risky (because of the new RICO laws). The Network provided the ideal insulation." (p.14) It also provided a mechanism for the major firms to increase the cost, relative to major firms, of fringe firms and new entrants from obtaining radio airplay.

The costs of payola, with and without the Network, can be modelled in the following way. Assume ϕ is the number of major firms, λ the number of releases by the major firms, β the total payola paid by the major firms, and θ the total cost of Network services. We can derive:

$$(16) \quad I/\phi\lambda$$

where P is the amount of payola paid by the Network to radio operators, per new release. Let ε be the transactions cost (actual, not implicit^{xi}) of payment to a radio station, μ the probability of being detected paying payola, α the penalty costs of being detected paying payola, where ε , μ , and α are > 0 . The resulting expression:

$$(17) \quad I/\phi\lambda(\beta - (\varepsilon + \mu\alpha)) = C$$

yields the per release cost of payola of the firms not using the services of the Network. As long as:

$$(18) \quad I/\phi\lambda((\varepsilon + \mu\alpha) - \theta) > 0$$

the major firms will utilize the Network, since the transactions costs (explicit and implicit), exceed the cost of going direct to radio operators. In this case, a new entrant or fringe firm pays C (non-Network rates) for radio airplay, while a major firm pays P (Network rates), where $C > P$. Fringe firms and new entrants pay more per release for radio airplay than the major firms.

As well, and irrespective of intent or design, the Network provided a mechanism that facilitated the leveraging of the *combined* financial resources of the large firms to deny smaller firms radio airplay. Because the Network often represented most (or all) of the major firms simultaneously, the major firms may have utilized the Network to obtain from radio station operators both radio airplay and exclusionary rights (i.e., the capacity to exclude fringe competitors or new entrants from obtaining radio airplay).

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For example, suppose the Network threatened radio stations with withdrawal of Network payola if the station played the products of smaller firms or fringe competitors. Then, even if the smaller firms were to offer payola in return for radio airplay, the station operators would have to weigh the value of these payments with respect to the combined payments of the Network that represented the major firms. It seems fairly obvious that the threat by the Network to withhold payments would be most effective in radio markets that were competitive. In a monopolistic market, the threat to withhold payment would be less credible. Importantly, it would be simple for the Network to monitor an agreement of this type with radio station operators: a violation of the agreement would involve playing the product of a non-Network firm over the air (and, radio airplay figures are listed in *Billboard Magazine* and other trade journals of the music recording industry). While this analysis is conjectural, it provides a plausible explanation for the paucity of significant new entrants in the music recording industry.

Conclusions

The model presented in this paper demonstrates how under reasonable assumptions the behavior of oligopolistic firms in the music recording industry affects the number of new products issued by this industry, and implicitly the diversity and variety of product offerings. As was shown in Section Four, if the firms act in a Cournot-type fashion they will release more new products than if the firms apportion the market among themselves. There is evidence to suggest that many of the necessary conditions for cooperative behavior are present, including a tight market structure and possibly significant entry barriers. This may result in an apportionment of new releases among major firms, with fewer new product releases as a consequence.

The paper explored possible barriers to entry into the recording industry, including payments by record companies to radio stations. By raising the costs of potential competitors and even denying them airplay, payola by major firms effectively thwarts new firms from entering the industry. Government regulation (RICO laws) has possibly had a substantial impact on the structure of the music recording industry, because the RICO laws increased the cost of payola and gave rise to the Network. It is plausible that the intermediation of the Network facilitated the leveraging of the combined assets of the major firms to deny smaller competitors from obtaining radio airplay. This may have resulted in increased industry concentration, and fewer new product releases than a competitive structure would provide.

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Notes

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i. The physical output of the music recording industry takes the form of pressed vinyl (albums), magnetically coated tape (cassettes) and digitally sequenced, laser-read compact discs (CDs). New product releases are a regular feature of this industry. I define a new release as a composition that has not been previously recorded by another firm or artist. A less restrictive definition might define a new release as any product issued by the industry, irrespective of whether the release contains compositions previously recorded and released by other firms. Implicitly, the former definition is a more robust measure of research and development by the firms in the industry than the latter. Since the new product is the performance itself and not the physical form that the product takes, a new release that is issued on several different formats (e.g. cassettes and compact discs) is counted only once.

ii. These firms are Time/Warner (WCI), Sony/CBS (CBS), Thorn/EMI (EMI), Philips-Polygram (PMG), Bertelsmann Music Group (BMG), and Matsushita/MCA (MCA).

iii. The model draws on the work of Black and Greer (1987), Koenker and Perry (1981), and Waterson (1984).

iv. By contrast, in Schmalensee's (1978) model of firm release behavior, product rivalry was localized, and each new product release by a firm only affected the revenues of the products directly adjacent in product space to the new product release. However, as Schmalensee notes that in, "models with four or more characteristics, the theoretical possibility emerges that the average brand might have a large number of direct competitors." (p.309) The products of the music recording industry, even across genres, embody at least six or seven readily apparent characteristics.

v. In general, three price levels are present: new releases, older mid-line, and discontinued product.

vi. The purely competitive level of new releases would be strictly greater than the level issued by the current oligopolistic structure, given either a simple Cournot-type or joint-maximizing release behavior. This is most easily shown by letting the number of

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Cournot firms tend toward infinity.

vii. See, for example, Varian (1992) or Tirole (1988).

viii. For example, the Cowboy Junkies, a musical group under contract with BMG, recorded The Trinity Sessions in 1989 for \$250. This recording has sold over 1,000,000 copies. Similarly, Bruce Springsteen recorded his Nebraska album for CBS on a very inexpensive four-track cassette-based recording machine, while Treat Her Right, a group under contract with BMG, recorded their first album for \$1,000. In addition, Tim Simenon produced the 1989 hit record Beat dis using a home computer and a budget of \$350.

ix. The history and mechanics of payola are documented in Coase (1979), Sidak and Kronemyer (1987), and Dannen (1990).

x. See Sidak and Kronemyer (1987) for a treatment along these lines.

xi. I define the "actual" transaction cost as the simple cost of the transaction, and the "implicit" transaction cost as the cost of being detected making an illegal transaction (e.g. legal fees, jail sentences).