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New Technology and Market Structure: Evidence from the Music Recording Industry

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Introduction

While the emergence and adaptation of new cultural forms as mass products in the music recording industry is well-detailed from an institutional and sociological perspective,ⁱⁱ the impact of new technology on the evolution of these culture-based products is largely unexplored. In this paper, I explore how new technology that lowered the cost and scale of production induced periods of de-concentration in the music recording industry by facilitating the entry of smaller new, product-innovating firms. Blair (1972) articulates an hypothesis on the potential effects of new technology on industry structure in the following way:

Like a river, technology can completely reverse its course. When an easier and simpler route presents itself, it can move in a direction opposite to what had been true of the past and would logically be expected for the future....new technologies [lower] barriers to entry, thus creating a potential stimulus to competition. (p. 95)

In a similar vein, Scherer (1987) states that "turbulent technology...creates many opportunities for innovative new entrants, and new entry can powerfully erode concentrated market structures" (p. 344).

Such views run counter to 'conventional' economic theory. Economists generally support the proposition that technological change is scale-increasing and leads to increased concentration within industrial market structures (Nelson and Winter, 1978; Levin, 1978). According to Mansfield (1983):

The common tendency among economists (is) to view technological change as a concentration-increasing force. (However) in some major industries, it appears that concentration-decreasing innovations are a very

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substantial proportion of the total. (p. 207)

Indeed, Blair (1972) is a notable exception to the conventional wisdom: he concludes that while scale-increasing technological change had been an important contributing factor in increased industrial concentration from the late 17th century to the early 20th century, many newer technologies had the opposite tendency by the middle of the 20th century. Mukhopadhyay's (1985) results provide empirical support for the view that rates of new entry are higher in technologically progressive industries.

In contrast to the conventional theories regarding technological change and increasing industry concentration, there is only modest support in the main of economic *research* that large firms or highly concentrated industrial market structures generate proportionately greater innovative activity than smaller competitors or less concentrated industries. For example, Scherer (1965), Mansfield (1968, 1983), and Mueller (1967) all conclude that large firm size and market concentration are, at best, weakly associated with inventive effort or innovative activity. In fact, Maclaurin (1954) suggests that ease of entry and entrepreneurial spirit, rather than firm size, are essential factors in successful innovation. Moreover, Aron and Lazear (1990) suggest that new markets are routinely opened by new entrants, in large measure because (1) trailing firms enjoy a relative benefit from high variance strategies; (2) cannibalization affects new entrants and existing firms asymmetrically; and (3) incumbents are affected by diseconomies of scope.

In this work, I explore how new scale-reducing technologies have induced entry into the music recording industry. The new firms were often product innovators, and their products became popular with consumers. Consequently, market share shifted from established firms to new entrants, changing the structure of the industry. Although one might expect significant new technologies to be endogenous (and hence proprietary), several important technological innovations in the music recording industry were, in fact, largely exogenous (e.g. state-of-the-art magnetic tape recorders).

Many of the sociological, institutional, and cultural factors which contributed to shifts in market structure and product innovation in the industry have been explored. My focus is the relationship between new (scale-reducing) technology and changes in market structure. As Mansfield (1983) states:

Although the effects of technological change on market structure are of

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fundamental importance, we know little or nothing about the effects of the various process and product innovations that have occurred in recent years in various industries. And we have very little information concerning the relationship between the rate of technological change in a particular industry and the changes in the industry's market structure. (p. 205)

In Section Two of this paper I give a brief historical overview of the music recording industry. In Section Three, I explore the development of new methods for mass producing prerecorded audio products. Foremost among these methods is the reverse metal stamper, whose development lowered the costs of recording and reproducing prerecorded music and immediately preceded the entry of many new firms into the industry. Some of these new firms were product innovators who introduced new culture-based products. In Section Four, I examine the development and use of magnetic tape recording machines. Magnetic tape recording machines lowered the cost of recording musical performances by providing an inexpensive method for editing flawed musical performances. They were also much less expensive to purchase than the pre-existing technology used to record musical performances. In the period following the magnetic tape recorders introduction, new entry again occurred on a large scale. Many of these new entrants promoted the development of new culture-based products, including rock and roll. In Section Five I explore the potentially de-concentrating effects of emerging digital delivery systems (or "information highways") on industry structure.

Historical Overview

The historical distribution of market share among major and independent firms in the domestic music recording industry shows two periods of relatively low concentration, preceded and followed by several periods of relatively high concentration (see Figure One). New production and manufacturing technology facilitated both significant waves of entry (the second half of the 1910s and 1950s), by lowering production costs and the minimum efficient scale of production. In both periods, the generally smaller new firms proved to be strong competitors with the existing larger firms, in part because they introduced innovative products that became popular with consumers. In turn, the introduction of new culture-based products into the mass market eroded the pre-existing structure of the music recording industry, and lowered the level of concentration within

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the industry.

New Manufacturing Technologyⁱⁱⁱ

In the industry's infancy (1890-1900), three major firms, Victor, Columbia, and Edison 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). Patents held by the three major firms proved to be a substantial barrier to entry of new firms with respect to the production of *playback devices*. This initial phase of high industry concentration was followed by a period of rapid technical innovation (1900-1910) and the expiration of key patents (1914), both of which led to the entry of many new firms, and a dispersion of market share.

From a technical standpoint, production and reproduction (i.e., development and manufacture) of the wax cylinders used for music playbacks was an impediment to firms who wished to enter the nascent recording industry, as each cylinder had to be individually produced. To make ten copies of a recording, the performer either had to perform the song ten times, or ten recorders had to be recording simultaneously (or some combination of the two). After recording the performance, the recorded cylinders were replaced with new cylinders and the song was performed again. If a mistake were made during the performance, all ten of the recording devices were stopped, the cylinders discarded and replaced, and the process began anew.^{iv}

Thus, the state of technology did not facilitate entry into this new industry because the costs of recording and mass-reproducing sound recordings were prohibitive. This limited the number of competitors and the quantity of new recordings produced. In 1892 for example, the total of original musical output consisted of approximately 320 minutes. By 1894, that figure reached 1000 minutes, or approximately 500 two-minute recordings. However, less costly methods for mass-producing cylinders emerged by 1901. One new manufacturing method employed a pantographic technique where a master recording was used to make copies by replaying the master as cutting devices reproduced the same sound vibrations on new cylinders. Each original master could be copied 25 times before the original wore out. A session using ten machines to record a single song could ultimately yield 250 cylinders, a 2500 percent increase over the original technique. Another, and more important, technique for mass producing cylinders utilized a reverse metal master stamper. Several thousands copies could be made from the original before the stamper wore down and had to be discarded.

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These techniques reduced the cost of manufacturing recorded products and also reduced the payments received by the performers, since it reduced the time they were required to be in a recording studio. Other production costs related to the recording process, including rental of the recording studio or the recording devices, were also diminished.

The introduction of new manufacturing techniques significantly reduced production and manufacturing costs. As well, these innovations likely stimulated increased demand for sound recordings because a greater quantity and variety of products were available. In fact, by 1916, the phonograph and phonograph records enjoyed a wide popularity. According to Shaw (1987), "By 1916, the phonograph...was a well-established appurtenance in middle-class homes, where recording by Caruso, Paderewski, Schumann-Heink, Mischa Elman, Galli Curci, and other concert luminaries enjoyed a great vogue" (p.12).

Meanwhile, the number of firms producing record players and records was rapidly increasing. In the five-year period between 1914 and 1919, the number of establishments manufacturing phonographs and records grew at an average annual rate of 44 percent (Table One). Competition in the industry was intensifying. Toll (1982) notes that "as demand for phonographs and recordings grew so did competition in the business. Records and record players were becoming big business" (p. 106). Unfortunately, the data in Table One are merged, and include the manufacture of both records and playback devices. Thus, the methodology for compiling census data distorts any accurate measurement of competition in the production of records at the producer level only. Consequently, the data in Table One represent a rough approximation of the extent of new competition in the music recording industry at the producer level.

However, there are some clues in the data. In 1914 and earlier, most manufacture and production was carried out by three large companies with over 1,000 employees each (Table Two). Since the manufacture of playback devices was in general a large-scale endeavor,^v it is possible that many of the new establishments present in 1919, especially those with five or fewer employees (a total of 30), were small independent firms focused on the more small-scale production of prerecorded music or music publishing.^{vi} If all establishments with 100 or fewer employees are put in this category, the total increases to 116.

Interpreted in this fashion, the data imply a relatively robust, if small-scale, competition at the producer level. In fact, some of the more significant new producers

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of musical products during this period included Bluebird, Okeh, Brunswick, Melotone, Perfect, Vocalion, Emerson, Gennett, Pathe, and Empire. Some new firms were promoting innovative culture-based products. As Fink (1989) points out "the expansion of recorded repertoire during the 1920s was significant. The first 'race' records began to appear. The commercial success [of some of these early recordings] was followed by the release of numerous other black recordings" (p. 7). New, smaller companies often pioneered these product innovations. Shaw (1987) notes that the first popular black female singer to be recorded was signed by Black Swan Records, a small, independent company, in 1920. Indeed, Toll (1982) states that "the innovators did things that were not generally accepted, and sometimes consciously challenged popular trends and tastes" (p.106).

These small, innovative producers led the way for other, often larger established firms who capitalized on these innovations.^{vii} Okeh Records, a subsidiary of Columbia, followed Black Swans release with *Crazy Blues*, a record that "sold so spectacularly that every record company quickly set about finding a female blues singer they could sign" (Shaw, p.69). Ultimately, as Shaw (1987) notes, "what started as a...phenomenon quickly became a...Tin Pan Alley development, and even invaded the Broadway musical theatre" (p.76). The new culture-based consumer products innovated by small new firms gained enormous popularity with the consumers of popular music in the early 1920s. And, as a result, they displaced many of the previously popular culture-based products in the process. As Shaw (1987) observes, ragtime music, the dominant popular music form up to that point, "sounded passe to a new generation responding to the hot sounds rearing out of New Orleans and Kansas City" (Shaw, p.13).

From 1919 to 1925 the number of firms producing record players and/or records declined at an average annual rate of 14.8 percent. While a handful of the small independents grew in size and importance, in general the number of small, independent record companies decreased. This decline can be traced, in part, to the imitation by established firms of the popular innovations of some of the smaller, independents.^{viii} Ultimately, as Chapple (1977) notes, "in 1929, most of the smaller companies went out of business or were bought by the larger ones" (p. 92). Horizontal mergers and the onset of the depression ensured the renewal of high levels of industry concentration.^{ix}

New Production Technology

From 1930 to 1945, the music recording industry was essentially dormant as measured by industry revenues. This dormancy was a residual of the depression of the 1930s and the hostilities of World War Two. Shellac, the prime ingredient for record manufacture, was extremely scarce during the war years.^x This shortage increased both the cost of manufacturing records and the purchase price. With the end of World War Two, the shortage of shellac abated. Perhaps more important for the music recording industry however, was another innovation in the technology of supply: magnetic tape recording.^{xi}

The introduction of magnetic tape recording technology, in conjunction with innovative musical forms, once again shifted the distribution of market share away from major firms towards new, independent firms.^{xii} The original technology used for recording musical performances was basically unchanged from 1890 until the introduction of magnetic tape in 1950. Essentially, the pretape technology was limiting in two ways: first, it was expensive to purchase and second, it was "unforgiving" in production. According to Gelatt (1954), tape technology radically changed this situation:

[The] economic attribute of tape recording transcended all others in its effect on phonographic history. Compared to the old method, tape was enticingly cheap. For an investment of a few thousand dollars one could buy a first-class tape recorder. [As a result], between 1949 and 1954 the number of companies in America publishing LP recordings increased from eleven to almost two hundred. (pps. 299-300)

In addition to reducing production costs directly, tape machines also induced indirect cost reductions by providing an easy way to edit musical performances and thus reduce the time spent rerecording music. Tape technology made it possible to correct mistakes cost effectively by rerecording the flawed passage properly and then cutting the tape and replacing the flawed passage with the correction.^{xiii} Sanjek (1983) states that "magnetic ribbons were easy to edit, and corrections of flawed performances or misspoken lyrics, impossible on the earlier glass-based master recordings, were easy to make and effectively reduced production costs" (p. 38). Consequently:

As tape equipment became more affordable, new recording studios sprang up around the nation. Many of the independents acquired tape machines

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themselves and learned recording techniques. As a result of these developments, the free-wheeling independents were now providing competition that could not be disregarded by Columbia, Decca, RCA Victor, and the new Capitol Label, which prior to 1948 accounted for three-fourths of all record sales. (p. 39)

Many of the new, independent record companies promoted an innovative product: rock and roll music. For example, Gelatt (1978) notes that Elvis Presley:

made his first records for a small Memphis label called Sun Records. Teenage idols were nothing new in the record field...but Presley was different: an outsider from the wrong side of the tracks, whose throbbing insolent music seemed almost like a deliberate affront. (p.304)

Presley's music was not the only new product innovated by small independent firms. Many other small new firms such as Atlantic, Savoy, King, Chess, Peacock, Modern, Imperial, and Specialty were all promoting new music. By 1956, independent firms accounted for approximately 52 percent of the recording industry's total market share,^{xiv} and by 1962, independent firms accounted for 75 percent of the recording industry's total market share. 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 new wave of take-overs and buy-outs of independent firms that has continued into the 1990s.^{xv}

Market Structure and Digital Technology

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. In the 1960s, major firms began purchasing successful independent distributors. ABC-Paramount (MCA), Capitol (EMI), and CBS (Sony) all made significant buyouts. The continuing 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 relied previously on independent distribution, but were now being

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distributed by the major firms. This change in the pattern of distribution put financial pressure on independent distributors, and in the 1970s, several of the largest went bankrupt. By the early 1980s this trend had accelerated and record distribution became even more highly-concentrated.^{xvi} The increasing concentration in the recording industry among record companies in the mid-1980s led to the bankruptcy of several remaining large independent distributors. Currently, the music recording industry is dominated by six large multi-divisional, multi-product firms, which together account for nearly all of the industry's market share when measured at the distributor level.^{xvii} These firms are Time/Warner, Sony/CBS, Thorn/EMI, Philips-Polygram/PMG, Bertelsmann Music Group/BMG, and Matsushita/MCA. Distribution is a significant barrier to entry into the music recording industry.

The network for distribution in the music recording industry is highly-concentrated, and many fringe firms and new entrants are unable to obtain national distribution. This tends to limit the extent of competition in the industry, and possibly reduces the diversity and variety of product offerings (in part, because small new firms tend to be product innovators). If a non-exclusive distribution network existed, fringe firms and new entrants might provide robust competition for market share in the industry. Because the products of the music recording industry are produced using digital sequences identical to those of computers, this distribution network might evolve as computer networks and digital information highways develop and deepen.

A digital delivery highway for the products of the music recording industry might take the following form. A distributor, or group of distributors, would transmit digital product samples to consumers via cable or telephone lines. The consumers could review the product samples (using their televisions or combination television/computers), and then inform the distributor (again, using their televisions or television/computers) which products they wish to purchase. These products would then be uploaded to the consumers, and a charge made to the consumers' account.

A distribution network of this type may potentially attenuate the effects of significant barriers to entry in the music recording industry. First, it could give firms (in particular fringe firms and new entrants) the opportunity to have their products distributed in a less-costly and non-exclusionary fashion. By providing product samples to consumers, the new distribution network would also transmit information relating product specifications. This would lessen the need for more traditional and less efficient techniques, such as radio airplay and other costly promotional activities, to inform

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consumers of the existence and nature of these new products. Given the modest marginal costs of adding a new product line to a digital delivery system, it is conceivable that the number of product offerings could increase exponentially. The costs of distribution should decline dramatically, as physical distribution at a national or international level has significant scale features. A competitive digital delivery system would reduce substantially the minimum efficient scale of distribution, and likely stimulate a highly competitive producer market.

IBM, Apple Computer, Bell Communications, Eastman Kodak and Philips Electronics are among the many major firms developing multi-media, digital distribution networks. These new digital delivery systems may also lead to structural turbulence in a range of other culture-based industries, including newspapers, book publishing, and motion pictures among others.

Conclusion

New scale-reducing technologies can erode existing market structures by facilitating new entry. As I have suggested, new technology has fostered two periods of significant structural turbulence in the music recording industry in which new firms, producing innovative products, displaced the existing firms. Re-concentration resulted from increased horizontal mergers among other factors.^{xviii} New digital distribution networks may promote greater competition in the industry, if they are non-exclusionary. This should promote greater levels of product diversity and variety in the offerings of the music recording industry.

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Notes

1. Assistant Professor of Economics, Ohio Wesleyan University, Delaware, OH, 43015. I thank William G. Shepherd, Linda Ewing, two anonymous referees and the editor(s) for helpful comments. Robert Nellson provided outstanding research assistance.
2. Gelatt (1977), Peterson and Berger (1975), Chappel and Garofulo (1977), Shaw (1987), Shore (1983), Schicke (1974), Toll (1982), Frith and Goodwin (1990).
3. The discussion of new manufacturing techniques draws from Gelatt (1977), Schicke (1974), and Chapple and Garofulo (1977).
4. Gelatt, (1977).
5. Gelatt, (1977).
6. It is also possible that the small firms were small-scale mechanical fabricators.
7. Chapple and Garofulo, (1977); Toll, (1982).
8. Shaw, (1987). Black and Greer (1987) make similar observations regarding the period from 1955-1960.
9. Gelatt, (1977); Chapple and Garofulo, (1977); Schicke, (1974).
10. Gelatt, (1977).
11. The modern prototypes were taken from Germany at the end of World War Two.
12. Gelatt, (1977); Schicke, (1974); Chapple and Garofulo, (1977); Shore, (1983); Sanjek, (1983).
13. The development of MIDI (Musical Instrument Digital Interface) in the 1980s has further reduced production costs while enhancing the quality of recordings. MIDI facilitates the coordination between numerous electronic devices (i.e. instruments and synthesizers) prior to and during the actual recording process. According to Goodwin (1990), the technique has several new advantages:

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Because nothing has to be committed to tape until the final (mixing) stage of production, a whole layer of tape hiss is eliminated, and the sound quality is much greater. MIDI allows musicians to bypass the professional recording studios until the very last moment (and sometimes entirely), thus making the creation of high fidelity recordings much cheaper.

14. Peterson and Berger, (1975).

15. Important technological advances continue to take place in the music recording industry. I have focused on two early periods because they are relatively underexplored from an economic standpoint, and also because barriers to entry were apparently lower in these periods.

16. Black and Greer, (1987).

17. Business Week (8/15/88, p.88) puts the six-firm market share at 100 percent.

18. Alexander, (1994).