“The Fist in the Face of God”: Heavy Metal Music and Decentralized Cultural Diffusion

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Abstract
The purpose of this paper is to explain the timing and location of the diffusion of heavy metal music. We use data from an Internet archive to measure the population-adjusted rate of metal band foundings in 150 countries for the 1991–2008 period. We hypothesize that growth in “digital capacity” (Internet and personal computer use) catalyzed the diffusion of metal music. We include time-varying controls for gross national income, political regime, global economic integration, and degree of metal penetration of countries sharing a land or maritime border with each country. We find that digital capacity is positively associated with heavy metal band foundings, but, net of all controls, the effect is much stronger for countries with no history of metal music prior to 1990. Hence, our results indicate that increasing global digital capacity may be a stronger catalyst for between-country than for within-country diffusion of cultural products.

Keywords
diffusion, music, cultural globalization

The concept of “globalization” typically refers to a set of processes that have led to the increased integration of institutions and individuals throughout the world (Giddens 1990, 2002; Gopinath 2008; Harvey 1990). Although much of the scholarly and popular focus on globalization concerns economic factors of production, distribution, and consumption, theorists have argued that these forces have produced a concomitant integration of the globe along cultural lines, broadly construed (Appadurai 1996; Tomlinson 1999; Waters 1995). Global culture, according to some scholars, is becoming increasingly rationalized and standardized by the mass media and major corporations (e.g., Ritzer 1996). Moreover, World Polity theorists argue that international nongovernmental organizations (INGOs) play a key role in diffusing legal codes and public policies to different countries (Boli and Thomas 1997; Meyer 1980; Meyer et al. 1997), thereby homogenizing certain aspects of global culture. Still other scholars have made the case for “glocalisation” and cultural hybridity (e.g., Kraidy 2003) in which widely diffused innovations become adapted to local tastes.

Uniting much of the empirical globalization and global diffusion literature is a focus on the role of large, powerful actors like nation-states, corporations, and INGOs. Far less is known about

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processes of global diffusion that are not driven by large institutions or powerful actors, and less still about the diffusion of products that are primarily cultural and not economic in nature. We argue that these lacunae are both understandable and consequential for a full understanding of global diffusion processes. They are understandable in light of the paucity of data on the global spread of (typically hard to measure) cultural phenomena, particularly when large corporate actors advocating for their diffusion are few or relatively impotent. Yet, we argue, rigorous empirical investigations of the mechanisms by which culture spreads within and between countries promise to contribute to a thorough sociological understanding of globalization processes.

Our goal in the present study is to provide one such investigation. The central theoretical concern of this article is not the why of decentralized cultural diffusion but the how. Our case is heavy metal music, which we argue below is an appealing example of the decentralized diffusion of culture. In the remainder of this introductory section, we justify the selection of our case. In subsequent sections, we develop a fourfold typology of diffusion systems by cross-classifying the actors sponsoring the diffusion of an innovation \(^1\) with whether that innovation is meant primarily to provide economic returns or simply influence a political or cultural field. In addition to organizing the diverse diffusion literature, we believe this exercise brings into sharp relief the importance of a diffusion mechanism such as the Internet, at least for a relatively marginalized cultural product like metal music. Finally, we describe our data and methods, present findings, and discuss their implications for future research on decentralized cultural diffusion systems.

The Case of Metal Music

According to our estimates, as of 1980, roughly 3,200 heavy metal bands had ever been founded, primarily in Northern and Western Europe and North America. By 2008, that number had increased to nearly 75,000—with a total volume of recordings approaching 150,000 albums—located in some 130 countries. In light of ever-increasing international economic integration, it is perhaps not surprising that many cultural forms such as television, film, and pop music have spread throughout the world. Indeed, the 10 highest-grossing American feature films of 2010 reaped fully 62 percent of their box office returns from foreign ticket sales (Boxofficemojo.com 2011), and several of the most popular American songs of 2010 also ranked high on the British, Canadian, French, German, Japanese, and Latin American charts (Billboard.com 2011). However, certain aspects of heavy metal music distinguish it from other broadly adopted forms of popular culture, making the recent global diffusion of metal more puzzling.

Heavy metal emerged in the 1970s from the blues and hard rock but, especially since the late 1980s, has become sonically and aesthetically far removed from the pop music mainstream. Occasionally borrowing from jazz and classical music, contemporary metal music typically uses highly distorted guitars, rapid-fire “blast beat” drumming, complex time signatures, flamboyant instrumental virtuosity, and atonal or dissonant arrangements that are unappealing to many listeners (Berger 1999; Hagen 2011; Walser 1992).\(^2\) Metal vocalists eschew singing techniques more common in pop music (Chen-Gia Tsai et al. 2010), frequently growling or screaming, thereby rendering the lyrics unintelligible. Although for metal enthusiasts, the sonic extremity of the genre may reflect personal attitudes about radical individualism and serve as a stress reliever (Henry and Caldwell 2007; Rafalovich 2006), in general, metal music does not reduce stress as much as other types of music (Labbe et al. 2007).

Contemporary metal music explores aesthetic and lyrical themes that run counter to those found in more popular performing arts. The genre often celebrates the iconoclastic, violent, and grotesque (Halnon 2006) and is frequently anti-hegemonic (Rafalovich and Schneider 2005). Indeed, whereas Cushman (1991) discusses the diffusion of musical “revolutionary codes”—expressions of radical or subversive political ideas—in reggae in the United States and rock in the former USSR, metal music has what might be termed a radically “oppositional code.”\(^3\) This
code ranges in substantive content from ethno-nationalism and even extreme racism on the right (Avelar 2003; Kurtagic 2010; Mulvany 2000; Weston 2011) to extreme environmentalism on the left (Metal Archives [MA] 2011e, 2011d) but is perhaps most clearly and frequently manifested in its fascination with marginal religions like neo-paganism and Satanism, and confrontational stances against more established religions (Farley 2009; Granholm 2011). The actual nature of the alternative spiritual vision found in metal music varies widely and is not internally consistent. Rather, the genre’s obsession with occultism, paganism, and Satanism seems to be a product of its oppositional or transgressive ethos, not a clearly articulated alternative spirituality (Dyrendal 2008; Kahn-Harris 2007). As the seminal Norwegian black metal band Darkthrone sneered, “With my art I am the fist in the face of God” (Nagell 1993).

In sum, metal has diffused most rapidly during a period in which the genre’s sonic, lyrical, and aesthetic trends have pulled it far from the artistic conventions of mainstream pop music. It is true that metal enjoyed something of a commercial heyday in the late 1980s in which bands such as Iron Maiden and Judas Priest had a string of hit singles on album-oriented rock radio and “thrash metal” bands such as Metallica and Slayer garnered a rabid fan base and strong album sales despite limited radio play. Since that time, however, metal has waned in commercial popularity and therefore economic viability, at least for new metal acts. Hence, metal diffused throughout the globe precisely during the period where there was little pecuniary incentive to start a metal band. This, then, is the question this article attempts to answer: How did metal diffuse so broadly when it became aesthetically and economically so marginalized from its mainstream pop music relatives?

Hypothesis and Analytic Approach

We propose that the key to solving this puzzle is the coterminous diffusion of global “digital capacity” during the 1990s and 2000s. We argue that the rise of the Internet and personal computing catalyzed the diffusion of metal by capitalizing on and further cultivating a preexisting, loose network of “tape traders” in South America, Europe, and the United States (Ekeroth 2009; Weinstein 2011). That is, fans of metal music had already been participating in a (at that time technologically constrained) system of decentralized diffusion, and the increase in global digital capacity supercharged that extant system. Hence, we hypothesize that metal diffused more rapidly in countries with earlier and more complete adoption of the Internet and personal computing than in countries with less robust growth in digital capacity.

To test this hypothesis, we predict the population-adjusted yearly rate of metal band foundings in 150 countries during the 1991 to 2008 period. We rely on data from an Internet archive that exhaustively catalogs metal bands with at least one recorded album. To this database, we merged country-level data on digital capacity from the International Telecommunications Union, gross national income per capita from the World Bank, political freedom from the Polity Project, and global economic integration from the United Nations. We expect to observe significant positive effects of increases in digital capacity on the “new metal rate,” controlling for these confounding variables. In addition, we control for the degree of penetration of metal in countries sharing a land or maritime border with each country in our data set. Thus, we are able to compare the effects of countries’ spatial proximity to metal-adopting countries with the “deterritorialized” impact of digital capacity.

We believe this article makes several important sociological contributions. First, we contribute to sociological understandings of music itself. Although sociologists of music have studied how musical genres are formed and maintained by artists and enthusiasts (Lena 2012; Lena and Peterson 2007) and explored various cultural dimensions of metal music (Kahn-Harris 2007; Weinstein 2000), no research has quantified the diffusion of this or any other musical genre on a global scale. More broadly, as noted above, although a vast literature exists on the diffusion of a wide variety of innovations, relatively little attention has been paid to the diffusion of cultural products via decentralized mechanisms like the Internet. Hence, this research contributes to a
sociological understanding of international cultural diffusion and the role of information technology in decentralized diffusion systems. As such, we believe our research has broader applicability beyond the narrow and relatively arcane case of heavy metal music. For example, our findings suggest that the Internet may be a particularly effective mechanism for the diffusion of a variety of nonremunerative cultural products, especially socially marginalized products such as subversive political or religious doctrines, social movement tactics, or avant-garde art. To the extent that scholars can gather data on such innovations, we believe our article can inform further research on other examples of decentralized cultural diffusion systems.

Theoretical Background

Diffusion involves actors, innovations, and mechanisms that together form what Rogers (1983) calls a “diffusion system.” In this section, we identify and cross-classify two types of actors (to which Rogers 1983 refers as “centralized” and decentralized”) sponsoring an innovation with two types of innovations (to which we refer as “economic” and “political-cultural”). We use this typology to classify scholarly studies of diffusion and discuss further the mechanisms by which diffusion occurs in the cell of primary interest for this article—decentralized political-cultural diffusion systems. The purpose of this typology is to simplify a complex social phenomenon (diffusion systems) and organize a wide-ranging scholarly literature. Hence, it should be interpreted as a representation of ideal types for heuristic purposes. We begin by briefly discussing centralized and decentralized diffusion systems. We then discuss economic and political-cultural innovations and proceed to their cross-classification.

Centralized and Decentralized Diffusion

Centralized diffusion systems involve large institutional actors like nations or transnational corporations that wield substantial power to encourage or enact the adoption of a particular innovation. Wejnert (2002) explains that “high status actors” like governments or large corporations often adopt an innovation and impose its adoption upon less powerful actors. For example, the International Monetary Fund encourages a specific policy agenda of fiscal austerity in developing countries by requiring “structural adjustment” as a prerequisite for development loans (Chang, Park, and Yoo 1998). In contrast, in a decentralized diffusion system, there are no obvious power imbalances or coercive relationships between advocates and potential adopters of the innovation. Decentralized diffusion systems typically require a relatively broadly accessible mechanism through which an innovation can spread. For example, heterodox economic ideas have diffused through academic journals (Cronin 2010).

Economic and Political-cultural Diffusion

A second dimension of diffusion systems concerns whether the innovation is intended to produce economic returns or merely influence a political or cultural field. Of course, the actual distinction between economic and political-cultural innovations may be quite murky, but broadly speaking, economic innovations include products for sale in markets or technological innovations that are intended to increase productive efficiency. Examples include the diffusion of microbreweries (Carrol and Swaminathan 2000) and microprocessors (Bothner 2003). Political-cultural innovations, by contrast, are ideas, practices, or artistic forms that are not explicitly intended to produce economic returns (though there may be unintended or ancillary economic consequences). For example, the diffusion of laws (Grattet, Jenness, and Curry 1998; Kane 2007; Pegram 2010) and many artistic or cultural forms (Cushman 1991; Rao, Monin, and Durand 2003) represent political-cultural diffusion.
These two dimensions can be cross-classified into a fourfold typology of diffusion systems depicted in Figure 1. Like all typologies, ours simplifies the complexity of the empirical world, and the diffusion of some innovations may involve aspects of multiple quadrants. For example, a handful of popular early metal bands arguably belong in the centralized economic quadrant, although we argue below that contemporary metal music represents a case of decentralized political-cultural diffusion. Nevertheless, this abstraction helps provide coherence to a diverse body of literature and identify mechanisms in decentralized systems.

### Centralized Economic
- **Tobacco** (Sutton and Robinson 2004)
- **Microprocessors** (Bothner 2003)
- **Pop music** (Rossman et al. 2008)

### Centralized Political-Cultural
- **Western music** (Furmanovsky 2008)
- **Chinese music** (Lena and Peterson 2011)
- **Soccer** (Amara and Henry 2004)

### Decentralized Economic
- **Community supported agriculture** (Lyson and Gup til 2004)
- **Reggae** (Baulch 2010)
- **Microbreweries** (Carrol and Swaminathan 2001)

### Decentralized Political-Cultural
- **KKK klaverns** (Cunningham and Phillips 2007)
- **Unions** (Hedstrom 1994)
- **Rock music** (Cushman 1991)

*Articles described in text.*

**Figure 1.** Typology of Diffusion Systems with Examples from Published Literature.

**Typology of Diffusion Systems**

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**Centralized economic.** A broad range of literature examines the centralized diffusion of innovations with economic motivations or consequences. For example, Sutton and Robinson (2004) examined the diffusion of tobacco products to impoverished black neighborhoods through both traditional and street-level marketing campaigns. In this study, powerful actors (tobacco companies) were aggressively encouraging relatively powerless actors (persons in economically struggling neighborhoods) to adopt an innovation. Other examples of centralized economic diffusion include Ferraro (1993), who examined Health Management Organization adoption among physicians, and Bothner (2003), who studied the diffusion of microprocessors. In the arts, Rossman, Chui, and Mol (2008) studied the effects of payola (bribes given to radio stations by record companies) on the diffusion of pop songs.

**Centralized political-cultural.** This type of diffusion is often encouraged by large political actors like nation-states or other manifestations of government. As noted above, the diffusion of
political-cultural innovations is not driven by profit concerns but instead serves some cultural or political end for the actor encouraging the diffusion. For example, after World War II, the Japanese government actively encouraged the diffusion of American country and western music to foster compliance with the occupying U.S. troops during reconstruction (Furmanovsky 2008). Similarly, the Chinese government has historically supported music beneficial to the ruling Communist Party (Lena and Peterson 2011). Finally, Amara and Henry (2004) examined the Algerian government’s advocating for the diffusion of soccer.

**Decentralized economic.** Decentralized economic diffusion systems feature the adoption of innovations with pecuniary returns, but without a strong centralized advocate of the adoption, such as a large corporation. For instance, the rapid growth of microbreweries, which began in the late 1980s, was predicted by few leading brewing industry analysts and involved small firms with limited customer bases in a number of different locations. Initially, there were no large institutional backers and limited distribution of microbreweries to mainstream retailers (Carrol and Swaminathan 2000). As another example, reggae music came to Bali because local musicians found that tourists would pay to hear it performed live (Baulch 2003). As in the previous example, these musicians did not have any large institutional backing, but profit motives were important in catalyzing the diffusion process. Finally, Lyson and Guptill (2004) studied the social, economic, and demographic characteristics of communities that have adopted community-supported agriculture.

**Decentralized political-cultural.** In the final type of diffusion system in this framework, the innovation is political or cultural in nature, with limited or no economic incentives driving its diffusion. The actors involved are generally of similar status and power so that one actor cannot coerce another into adopting the innovation. For example, Cushman (1991) depicts the diffusion of rock music in the former USSR as largely decentralized, devoid of profit considerations, and heavily political. The diffusion of the Ku Klux Klan (KKK) in North Carolina during the Civil Rights era is another example of decentralized diffusion. Cunningham and Phillips (2007) found that the economic and demographic characteristics of particular counties predicted the incidence of KKK klavern formation, rather than, say, the execution of planned growth by centralized Klan leadership. In a similar analysis, Hedstrom (1994) argues that Swedish labor unions diffused through interpersonal contact, revealing a spatial pattern of diffusion that did not rely on the support of powerful institutions like governments or centralized union authorities.

We argue that metal music belongs in this quadrant of our typology because its diffusion occurred among decentralized actors (bands and enthusiasts) and with little profit motive, given the aforementioned marginalization of metal as a mainstream music genre. As metal diffused, it became adapted and changed based on local, regional and national proclivities, and a number of subgenres and scenes developed (Dairianathan 2009; Dunn 2004; Gligorijevic 2011; Granholm 2011; Kahn-Harris 2002; Lucas, Deeks, and Spracklen 2011; Moynihan and Soderlind 2003). Indeed, Kahn-Harris (2011) describes metal as a “translocal” subculture in which local tastes interact with and alter a global metal culture.

**The Internet as a Diffusion Mechanism**

Social theorists have argued that information technology like the Internet has ushered in a new stage of global capitalism (e.g., Castells 1996). However, there is limited empirical research considering the Internet as a mechanism in diffusion systems, and much of the scholarship can be found in the business literature (e.g., Lynch and Ariely 1998). Sociologists have studied the diffusion of the Internet itself (Wunnava and Leiter 2009) and examined its role in coordinating social movement mobilization (Burris, Smith, and Strahm 2000; Earl and Kimport 2009; Gelles
2010; Rosen 2011) but have not thoroughly considered the Internet as a mechanism for the decentralized diffusion of a cultural innovation. Two notable exceptions are qualitative analyses by Lee and Peterson (2004) and Moberg (2008) who studied the role of the Internet in creating the “alternative country” and Christian metal music scenes, respectively. Both articles find that artists and enthusiasts relied on the Internet to diffuse their music and develop a genre community.

As suggested by these latter studies, there are sound reasons to suspect that the Internet might be a particularly effective channel through which certain types of cultural innovations diffuse, especially innovations without a centralized advocate. This is not to say that the Internet plays no role in centralized diffusion systems; rather, we argue that the Internet is uniquely suited to diffusing innovations in a decentralized fashion. The Internet is accessible to a large number of people at almost any time and is relatively inexpensive. Rangaswamy and Gupta (2000) explain that “one way to view the Internet is as a vast repository of information that can be dynamically organized and retrieved in a multiplicity of ways according to the needs of individual users” (p. 77). Hence, Internet users can get information in ways that traditional mass media do not provide and the Internet allows for interpersonal contact across vast geographic distances. However, the Internet has engendered a new type of diffusion that is not simply the reinvention of traditional channels. In other words, the Internet is not simply a more complex version of the telephone or the television or merely a tool that expands or strengthens existing social networks. Instead, because individuals can organize information quickly and easily according to their specifications, the Internet allows for diffusion that does not occur via an established social network, the mass media, or change agents.

Given that metal music has little support from large institutions, and given that the production of metal music is not typically a profitable enterprise, we expect that metal music has diffused globally chiefly through the Internet. As previously mentioned, metal enthusiasts and bands relied on a decentralized diffusion system before the advent of the Internet through an elaborate, decentralized international network of “tape traders.” Ekeroth (2009) describes a process by which Swedish metal artists and enthusiasts would establish contact with metal artists in other countries and mail each other new recordings and low-budget “fanzines.” This process caused the diffusion of Brazilian metal in Sweden in the early 1990s and similar tape-trading systems undoubtedly existed between other nations. We argue that the Internet was an ideal mechanism for the diffusion of metal because of the template established by the tape traders. That is, the Internet is a supercharged version of a preexisting, technologically constrained, diffusion process. In the remainder of this article, we test this primary hypothesis—that metal diffused widely throughout the globe largely as a result of growth in global digital capacity.

**Data, Measures, and Method**

**Data**

The data analyzed in this article come from a variety of sources. First, metal band foundings come from the Web site “Encyclopaedia Metallum: The Metal Archives” (hereafter, the “MA”). The MA exhaustively categorizes metal bands from throughout the world based on a variety of criteria such as year of first release, metal subgenre, and lyrical content. The MA requires that each band have at least one material album that has been pressed and released by a record label. While some albums have limited quantities (some numbering only 50 copies), the MA does not accept bands whose music is available through bootlegs or Internet downloads only. Therefore, each band in the MA has released at least one physical album, and the site registers the year of release for all such albums. These data were provided by one of the Webmasters of the site in personal e-mail exchanges to the first author of this article.
Once the MA data were gathered and organized in country–year format, we appended information from the International Telecommunications Union, the World Bank, the Polity Project, and the United Nations. More detailed descriptions of the data sources appear in the sections on variables below. The final data set contains 203 countries over 18 years for a maximum of 3,654 observations. Several countries and country–year observations were deleted from the analysis because they were missing data on one or more of the independent variables. The resulting analytic sample comprised 150 countries and a total of 2,607 country–year observations. See the appendix for a list of countries in the final sample.

Advantages of the metal archives. Although there are a variety of other available sources of data on heavy metal and other genres of music, we are convinced that the MA is superior to other choices for several reasons. Practically, we are aware of no other data source that contains information by country–year on either the production or consumption of metal music from as wide a variety of countries as the MA contains. On the production side, for instance, the Web site Allmusic.com contains similar kinds of information as the MA; however, the data are not organized by country of origin of the bands or by year of debut album. Once a user knows the name of a band or album, one could retrieve this information, but it is not available ex ante. Moreover, we conducted a systematic comparison of the MA and Allmusic.com and estimate that 85 percent of bands appearing in the MA are not covered by Allmusic.com. Hence, we believe that the MA represents a more comprehensive record of the foundings of metal bands than does Allmusic.com.

On the consumption side, Nielsen SoundScan collects data on album and single sales from Canada, Japan, the United Kingdom, and the United States only, while the Recording Industry of America measures music sales from the point of view of units shipped by record labels minus returns, with no information on the location of the point of sale. Theoretically, however, even if it were possible to gather point of sale data in this fashion, it would still require someone—either staff at these firms or we, the authors—to determine what albums or bands “counted” as metal. Indeed, this problem obtains on the production side as well, as the Allmusic.com site simply lists bands as occupying one or more subgenres of metal music (or not), with no information on how these determinations were made.

To be sure, there is no single, clear definition of metal (nor very probably of any art form) and much discussion on the MA message board centers on whether or not a particular band or album is authentically metal. Indeed, the MA does not define what metal is but rather what it is not. In a “Rules & Guidelines” section, the Webmaster explains:

I do not accept mall-core, also known as “nu-metal” by some . . . metalcore . . . glam rock . . . classic rock . . . progressive rock . . . hard rock . . . hardcore . . . grindcore . . . punk . . . gothic rock . . .
industrial . . . cover/tribute/gimmick bands . . . . (Metal Archives 2012)

This filtering by the Webmasters is indicative of subcultural processes in which members of a subculture create barriers to entry to ensure authenticity (see Dale 2009; Force 2009; Hebdige 1979), with scholarly understandings of the manner in which communities of artists and enthusiasts collectively define musical genres (Ahlkvist 2011; Lena 2012). Thus, the crowd-sourced nature of the MA is a key advantage over other databases in that the metal bands included are defined as “metal” by fans and artists.

Limitations of the metal archives. Although we believe it to be the single best available source of data on the diffusion of heavy metal music, the MA is not without potential weaknesses. Most obvious is the question of coverage. The data have not been gathered and cataloged by professional social scientists or statisticians using probabilistic sampling techniques or other rigorous data collection strategies. Rather, bands are submitted via users and approved (or not) by the
Webmasters. This approval process not only ensures that the Web site is really a metal archive (as opposed to, say, a music archive with multiple genres, like Allmusic.com) but also means that the personal tastes of the Webmasters and users may affect what “counts” as metal. In addition, until very recently, the MA has rejected bands that do not have at least one physical release; thus, bands that have only released digital albums are excluded (but see Note 8). Finally, the countries excluded from our data due to missing information on the covariates tended to be smaller countries, which may have had lower levels of digital capacity.

To the extent that the MA systematically reject bands as inauthentic or due to digital releases only from countries with low levels of digital capacity, and to the extent that the missing data in our sample disproportionately affect countries with low levels of digital capacity, this would produce upwardly biased estimates of the effect of digital capacity. On the other hand, several scholars have noted the obsessive tendency of metal fans, suggesting that metal enthusiasts take their music very seriously and are willing to invest a significant amount of time into cataloging and analyzing metal bands and metal albums (e.g., Arnett 1996; Baulch 2003). Because metal enthusiasts are unlikely to approach the music casually and emphasize encyclopedic knowledge of the genre, we believe that the records from the archives are as accurate a reflection of empirical reality as is currently available.

A second potential source of bias in the data stems from the fact that the MA is itself an Internet-based repository. Hence, it is conceivable that metal bands or fans in countries in our sample with low levels of Internet penetration would not be able to submit those bands to the archives. This again would tend to upwardly bias the estimate of the effect of digital capacity on the metal rate. This is certainly a concern, and we know of no way to independently verify that there are, in fact, fewer metal bands in countries with lower levels of digital capacity (but see Note 9). It is important to note that many bands and albums have been submitted to the archives from users all over the world, and retrospectively, after the Internet reached most countries in the world at a relatively high level. This mitigates the problem that bands and albums could only make it into the data set because of the presence of the Internet in a particular country at a particular time. Nevertheless, the results we present should be interpreted cautiously in light of these potential data limitations.

**Dependent Variable**

As suggested by the foregoing discussion of the MA data, it is possible to conceive of a number of potential dependent variables to capture the theoretical concept of “diffusion.” We have indicated that reliable and valid data on the consumption of metal music by country–year is extraordinarily difficult to come by. Moreover, we argue that the local production of an art form indicates its more complete institutionalization in the material culture of a nation than does mere consumption. Put differently, we expect that countries that produce metal also consume it; hence, it is plausible to use the production of metal both as an indicator of production itself and as a proxy for consumption.

We operationalized the diffusion of heavy metal music with the new metal rate, or the population-adjusted count of metal band foundings in each country–year in the MA data. To calculate this measure, we summed the total number of debut albums in each country for each year, divided by the total population in that country–year (World Bank 2011c), and multiplied by 100,000, a commonly used radix in demography. The MA contains some information on the “founding date” of bands; however, we elect to use the date of the debut album because it avoids ambiguity in determining when a particular band was founded, given that a musician could claim to have started a band at any point in time if he or she simply intended to make music. In preliminary analyses, we experimented with a second dependent variable—the total number of albums released per year—but found that this variable was correlated with debut releases at about 0.90. Hence, little new information was to be gained by including these analyses. Moreover, we prefer
metal band foundings to total album production because the former does not conflate the expansion of metal music to new producers (which is in line with scholarly definitions of diffusion) with the intensification of music output by existing producers.

In the analyses presented below, the new metal rate was measured in year \( t \), while all time-varying predictors were measured in year \( t - 1 \). Descriptive statistics for all variables used in the analysis are shown in Table 1. As suggested by this table, for some countries and years, the new metal rate was at or near zero, while in others, it is substantially higher. For example, in 2005, Finland had the highest new metal rate in the data set at 4.4 debut albums per 100,000 people.

### Focal Independent Variable

The focal independent variable for this study is digital capacity, a scale created from time-varying country-level data on Internet users per 100 people and personal computers per 100 people. Internet usage data were retrieved from the World Bank Web site (www.worldbank.org), but the data are developed by the International Telecommunications Union (ITU). The ITU is an UN-sponsored agency that collects a variety of data related to communication technologies such as radio,

<p>| Table 1. Descriptive Statistics of Variables—First Three and Last Three Years of Period Under Analysis (( N = 2,607 )). |</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>1990 to 1992</th>
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<td>M</td>
<td>SD</td>
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<td>Dependent variable</td>
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<td>New metal rate</td>
<td>0.061</td>
<td>0.162</td>
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<td>Independent variables</td>
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<td>Digital capacity</td>
<td>0.91</td>
<td>2.13</td>
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<td>GNI per capita (in $000)</td>
<td>4.91</td>
<td>7.50</td>
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<td>Political regime</td>
<td>1.9</td>
<td>7.1</td>
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<td>Economic integration</td>
<td>-0.25</td>
<td>0.83</td>
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<td>Proximate metal rate</td>
<td>0.053</td>
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<td>Western Asia</td>
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<td>Caribbean</td>
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<td>Central/South America</td>
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<td>Western Europe</td>
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<td>North America</td>
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<tr>
<td>Oceania</td>
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</tr>
</tbody>
</table>

Note. GNI = Gross National Income.

aSee the appendix for a list of countries within each subregion.
telephones, and the Internet. To be counted as an Internet user, an individual must have used the Internet within the past 12 months. Data on personal computers per 100 people were compiled from several international organizations and retrieved from the United Nations (2011). Personal computers per 100 people and Internet users per 100 people were strongly correlated ($r = .86$), so we averaged the variables for country–years that had observations for both indicators and used each variable to impute the value of the other for missing observations on either variable. Hence, the theoretical range of the variable is 0 to 100, though the maximum was 89, in Iceland in 2007.

**Control Variables**

**Gross national income.** The levels of Internet and personal computer use in a country are related to its economic growth (Choi and Hoon Yi 2009; Kenny 2003; Noh and Yoo 2008). Furthermore, producing metal music requires at least some investment in guitars, amplifiers, drums, and either studio time or recording equipment and music software. Deeply impoverished nations might have low metal rates simply because few people can afford to purchase the equipment necessary to record music of any sort. Hence, we control for a country’s economic standing with Gross National Income (GNI) per capita). There was some missing GNI data, and if a majority of a country’s observations were missing on GNI per capita, the country was deleted from the analysis. More often, however, we imputed missing data based on the average of the three years prior to or following the missing datum (since most missing data were either at the beginning or end of the 1990 to 2008 period). We imputed 339 out of 3,654 possible observations for this variable with this method, and we include a dummy variable in all regression analyses to indicate imputed GNI data. Finally, we multiplied the GNI measure by 1,000 to produce coefficients interpretable in terms of thousands of U.S. dollars.

**Political regime.** As noted above, metal music is oppositional and frequently critical of the cultural and political status quo of its nation of origin. Totalitarian countries may curb efforts to produce subversive art or, at the very least, political repression may create an environment that discourages musicians from producing deviant or oppositional recordings, even if not expressly forbidden by the state. Scholarly research has indicated that music is often deemed subversive by totalitarian regimes (Keller 2007), and metal music in particular may agitate totalitarian or conservative regimes, as indicated by moral panics and state-sponsored backlash in Malaysia (Liew and Fu 2006) and parts of the Arab world (Levine 2009). In addition, repressive regimes may censor Internet content (Palfrey 2010). Hence, if metal chiefly diffuses through the Internet, this lack of access would also put downward pressure on the metal rate.

These considerations led us to control for the degree of democracy and general freedom in each country. We operationalized the openness of the political regime with data from the Polity IV Project (2011). The Polity IV data have been used in a number of social science publications (e.g., Boehmmer 2008; Carlton-Ford 2010; Johnstad 2010) and contain a variety of political variables extending over a hundred years into the past. Most relevant to this analysis, the Polity project codes the authority characteristics of countries in as many years as possible. The developers of the Polity project generated a summary scale that runs from −10, representing a hereditary monarchy or “fully institutionalized autocracy” to +10, representing an open democracy, with scores in the middle indicating mixed political systems.

**Global economic integration.** We control for the extent to which a country’s economy is dependent on international trade, both because metal may have diffused via conventional trade channels rather than through the Internet, and because there may be a correlation between global economic integration and digital capacity. At the low end of the scale, Ethiopia in the early 1990s devoted less than 10 percent of GDP to either imports or exports. At the other end of the spectrum, island
nations such as Singapore and Aruba featured percentages of imports well in excess of GDP. To control for such integration, we generated a standardized index of the percentage of a country’s GDP that is accounted for by imports and exports (World Bank 2011a, 2011b). Hence, the metric of this variable is $z$-scores (standardized Cronbach’s $\alpha = .862$).

**Early adopters.** Countries that adopted metal music early in the history of the genre may be more likely to have higher metal rates simply because they were early adopters and have a developed metal subculture. To isolate this effect, we created a dummy variable coded 1 for “early adopters,” or countries with a nonzero metal rate in any year from 1980 to 1990 and 0 for countries with a zero metal rate from 1980 to 1990, to which we refer as “late adopters.” We then interacted this dummy variable with our measure of digital capacity to test whether the effect of growing digital capacity differs for early versus late adopters of metal.

**Geographic subregion.** We controlled for the geographic subregion of each country by constructing dummy variables for 17 such subregions, derived from the United Nations Statistics Division’s (2011) classification. These variables provide a level of control for unobserved, fixed characteristics of subregions. For example, net of all other predictors, the results in Table 2 indicate that the otherwise unmeasured political, cultural, economic, climatic, or other characteristics of countries in Northern Europe (the omitted category) are associated with higher metal production than other subregions of the world. See the appendix for a list of countries in each subregion.

**Spatial proximity to metal.** Finally, as a further control for the relationship between digital capacity and the metal rate, we calculated the proximate metal rate, or the average yearly metal rate of all countries sharing a land or maritime border with each focal country. We then summed these rates and divided by the number of borders. For example, for Poland in 1995, we summed the 1995 new metal rates for the seven countries sharing a land border (Belarus, Czech Republic, Germany, Lithuania, Russia, Slovakia, and Ukraine) and the two sharing a maritime border (Denmark and Sweden), and divided by nine. When this variable is included in regression models, it allows us to determine the extent to which metal has diffused in more spatially bound clusters versus via the “deterриториализовань” effects of digital capacity. This spatially bound diffusion may occur via one or more of several mechanisms. First, bands from one nation may tour in adjacent nations, spurring citizens to follow the example set by a metal band from a neighboring country. Second, population flows across borders may bring the innovation of metal music to new territories.

**Method**

Because our dependent variable is the yearly population-adjusted count of debut albums, a regression model for count data is required. Diagnostic tests indicate that the distribution of the new metal rate is consistent with a Poisson distribution (where $E(y|\mathbf{x}) = \text{Var}(y|\mathbf{x})$ for all $\mathbf{x}$); hence, we use Poisson regression techniques (see Long 1997). The coefficients derived from the Poisson model require some transformation to yield substantively useful results. In the “Findings” section, we compute percentage changes in the expected metal rates per unit change in the independent variables (Long 1997:225). These computations follow the form:

$$100\% \left[ \frac{E(y|\mathbf{x}, x_k + \delta) - E(y|\mathbf{x}, x_k)}{E(y|\mathbf{x}, x_k)} \right] = 100\% \left[ \exp(\beta_k) - 1 \right],$$

where $\delta = 1$ (for a one-unit change) and $\beta_k$ is a Poisson regression coefficient.
Table 2. Coefficients and Robust Standard Errors from Poisson Regressions of the New Metal Rate on Digital Capacity and Control Variables, 1991 to 2008.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th></th>
<th>2</th>
<th></th>
<th>3</th>
<th></th>
<th>4</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>SE</td>
<td>Coefficient</td>
<td>SE</td>
<td>Coefficient</td>
<td>SE</td>
<td>Coefficient</td>
<td>SE</td>
</tr>
<tr>
<td>Digital capacity</td>
<td>0.052</td>
<td>0.005 ***</td>
<td>0.087</td>
<td>0.007 ***</td>
<td>0.086</td>
<td>0.015 ***</td>
<td>0.050</td>
<td>0.016 ***</td>
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<td>Early adopter</td>
<td>—</td>
<td>—</td>
<td>3.385</td>
<td>0.312 ***</td>
<td>2.587</td>
<td>0.307 ***</td>
<td>1.613</td>
<td>0.317 ***</td>
</tr>
<tr>
<td>Early × digital capacity</td>
<td>—</td>
<td>—</td>
<td>—0.053</td>
<td>0.006 ***</td>
<td>0.066</td>
<td>0.013 ***</td>
<td>0.039</td>
<td>0.015 ***</td>
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<td>GNI per capita</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>0.018</td>
<td>0.014 ***</td>
<td>0.025</td>
<td>0.011 **</td>
</tr>
<tr>
<td>Political regime</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.146</td>
<td>0.031 ***</td>
<td>0.065</td>
<td>0.022 **</td>
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<td>Economic integration</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.163</td>
<td>0.074 *</td>
<td>0.040</td>
<td>0.120</td>
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<td>Proximate metal rate</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>0.867</td>
<td>0.342 **</td>
<td>5.646</td>
<td>1.098 **</td>
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<td>Central/East Africa</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1.821</td>
<td>0.685 **</td>
</tr>
<tr>
<td>Northern Africa</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>2.429</td>
<td>0.571 **</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.646</td>
<td>0.610 ***</td>
<td>1.651</td>
<td>0.617 ***</td>
</tr>
<tr>
<td>Western Europe</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1.233</td>
<td>0.496 **</td>
</tr>
<tr>
<td>Central Asia</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>2.938</td>
<td>0.648 ***</td>
</tr>
<tr>
<td>Eastern Asia</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.868</td>
<td>0.391 *</td>
<td>1.142</td>
<td>0.498 *</td>
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<tr>
<td>Southeastern Asia</td>
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<td>—</td>
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<td>0.651</td>
<td>0.424</td>
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<tr>
<td>Southern Asia</td>
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<td>—</td>
<td>—</td>
<td>0.052</td>
<td>0.351</td>
<td>0.113</td>
<td>0.363</td>
</tr>
<tr>
<td>Western Europe</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—0.594</td>
<td>0.284 *</td>
</tr>
<tr>
<td>North America</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—0.822</td>
<td>0.421 *</td>
<td>—0.488</td>
<td>0.423</td>
</tr>
<tr>
<td>Oceania</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—0.800</td>
<td>0.000</td>
</tr>
<tr>
<td>Year</td>
<td>−0.102</td>
<td>0.024 ***</td>
<td>−0.049</td>
<td>0.026 *</td>
<td>−0.020</td>
<td>0.030</td>
<td>−0.008</td>
<td>0.017</td>
</tr>
<tr>
<td>Internet imputed</td>
<td>−2.127</td>
<td>0.317 ***</td>
<td>−1.111</td>
<td>0.272 ***</td>
<td>−0.721</td>
<td>0.257 ***</td>
<td>−0.702</td>
<td>0.198 ***</td>
</tr>
<tr>
<td>GNI imputed</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>−0.112</td>
<td>0.248</td>
<td>−0.404</td>
<td>0.376</td>
</tr>
<tr>
<td>Regime imputed</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>−0.336</td>
<td>0.489</td>
<td>−0.617</td>
<td>0.413</td>
</tr>
<tr>
<td>Constant</td>
<td>−2.011</td>
<td>0.248 ***</td>
<td>−5.014</td>
<td>0.368 ***</td>
<td>−5.723</td>
<td>0.468 ***</td>
<td>−3.981</td>
<td>0.594 ***</td>
</tr>
<tr>
<td>Log pseudo likelihood</td>
<td>−681.0</td>
<td>−600.1</td>
<td>−580.0</td>
<td>−523.5</td>
<td>−580.0</td>
<td>−523.5</td>
<td>5.1083</td>
<td>5.1083</td>
</tr>
<tr>
<td>Wald chi-square</td>
<td>225.1</td>
<td>373.7</td>
<td>363.7</td>
<td>5.1083</td>
<td>363.7</td>
<td>5.1083</td>
<td>363.7</td>
<td>5.1083</td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td>0.248</td>
<td>0.337</td>
<td>0.359</td>
<td>0.422</td>
<td>0.359</td>
<td>0.422</td>
<td>0.359</td>
<td>0.422</td>
</tr>
</tbody>
</table>

Note. $N = 2,607$ for all models. GNI = Gross National Income.

*** $p < .001$. ** $p < .01$. * $p < .05$, two-tailed tests.
Finally, we provide two notes on the standard error estimates. First, because each country contributes 18 observations to the data, we adjusted all standard errors for clustering using the vce, cl subcommand in Stata/SE 11. Second, however, the countries in our data set do not comprise a probabilistic sample; in fact, if data availability on GNI per capita, political regime, and global economic integration had been available for some 50 countries, we would not have had a sample of countries at all. Hence, the standard error estimates we report do not represent the kind of sampling error typically found in most analyses. We recommend that they be treated cautiously and more as indicators of the reliability of measurement of the point estimates, rather than as conventional estimates of sampling variability. Nevertheless, for purposes of exposition, we include asterisks for conventional significance levels in the tables and refer to our findings as “statistically significant” or not. Finally, we performed standard multicollinearity tests and found no evidence of a problematic degree of multicollinearity.

Findings

The results from the Poisson models are shown in Table 2. We begin by estimating and interpreting the bivariate relationship between digital capacity and the metal rate, with a dummy variable indicating whether Internet percentage was imputed, and a parameter estimating the secular trend in metal rates. We then add the interaction between early adopter status and digital capacity to derive a baseline estimate of the difference in the effect of growing digital capacity for countries with and without a history of metal production. In Model 3, we add our three substantive control variables—GNI per capita, regime, and global economic integration—and assess the extent to which they explain any observed relationship between digital capacity and metal diffusion. In Model 4, we include the geographic subregion dummy variables and assess the extent to which metal has diffused in a spatially contingent fashion by including the proximate metal rate variable.

The coefficient on digital capacity in Model 1 indicates that, controlling for imputed Internet use and the secular trend in new metal rates, the new metal rate changes with respect to digital capacity at a rate of 5.3 percent per unit increase in digital capacity. This effect can be interpreted either in terms of between-country or within-country diffusion. Within countries, a one-year increase of one unit in digital capacity (roughly one percent more Internet or personal computer users on average) is associated with a 5.3 percent increase in the expected population-adjusted count of new metal bands. Between countries, those that differ by one unit in their digital capacity are expected to differ by 5.3 percent in their new metal rates.

In Model 1, the effect of digital capacity is constrained to be the same for both early and late adopters of metal, that is, countries with and without a history of metal bands prior to 1990. In Model 2, we relax this constraint by interacting early adopter status with digital capacity. Due to the coding of the early adopter measure, the coefficient on this variable is interpreted as the gap in the log of the expected new metal rate between early and late adopters when digital capacity is zero. This would correspond roughly to the pre-1990 period when, by definition, the metal rate for late adopters was zero. Therefore, this coefficient is not particularly meaningful because it merely indicates that early adopters had a much higher metal rate than the (by definition zero) metal rate of late adopters.

Of much greater interest is the coefficient on digital capacity, which now refers to the effect of a one-unit increase in digital capacity on the log of the new metal rate for late adopters. The sum of this coefficient and the interaction effect is interpreted as the digital capacity slope for early adopters. We find that, for late adopters, the new metal rate increases with respect to digital capacity at a rate of 9.1 percent per unit increase in digital capacity. For early adopters, this effect is about 60 percent lower, or 3.4 percent per unit increase in digital capacity. Hence, we find that, although the new metal rate is significantly associated with increases in digital capacity for...
both early and late adopters, this effect is much stronger for late adopters of metal. This finding suggests that growth in Internet and personal computer use catalyzed the spread of metal into new countries and to a lesser degree intensified the adoption of metal within countries.

Of course, this finding and preliminary conclusion derive from a model with no substantive control covariates. The remaining models in Table 2 test alternative explanations for the effect of digital capacity, first by controlling for GNI per capita, political regime, and international economic integration, and finally adding measures of geographic subregion and the proximate metal rate. The results in Model 3 indicate that, all else equal, countries with higher per capita incomes do not produce significantly more metal; however, more democratic and economically integrated countries do. The inclusion of these variables slightly weakened the effect of digital capacity for late adopters and weakened the effect for early adopters (to 2.0 percent, \( p = .023 \) [see Note 20]). However, controlling for these time-varying characteristics did not entirely explain the effect of digital capacity, suggesting that growth in the Internet and personal computing still played an important role, especially for late adopters.

Model 4 adds 16 geographic subregion variables, with Northern Europe the omitted category. Net of all other variables in the model, we find that Northern European countries on average produce the most new metal bands, particularly in comparison to African countries. Net of their tendency to be poorer, less democratic, and less economically integrated, African nations had new metal rates that were substantially lower than Northern European nations over the past 18 years.\(^{23}\) The inclusion of the subregion dummies reduced the effect of digital capacity for late adopters (from \( \beta = 0.86 \) in Model 3 to \( \beta = 0.50 \) in Model 4); however, digital capacity effects for both late and early adopters remain statistically significant. Controlling for geographic subregion intensified the effect of GNI per capita, reduced the effect of political regime by about two-thirds, and fully attenuated the effect of economic integration.

Finally, the results in Model 4 indicate that the new metal rate increases at a rate of 138 percent per unit increase in the spatial proximity measure. In practical terms, this means that when the new metal rate for countries sharing a land or maritime border with a focal country increases by an average of one new band per 100,000 people, the expected new metal rate more than doubles. This might seem like an improbably large association; however, note from Table 1 that from 2005 to 2007, the standard deviation of the new metal rate was 0.267. This means that in these years, it would take an increase of about three and a quarter standard deviations in the proximate metal rate to produce the effect of a one-band increase. In any event, our findings suggest that metal diffusion was highly spatially contingent, with new metal rates in adjacent nations strongly correlated with the rates in focal nations.

Nevertheless, the effect of digital capacity remains significant for late adopters, suggesting that spatially contingent diffusion was not the only mechanism for the diffusion of metal to new countries. The effect of digital capacity for early adopters also remains statistically significant, though small—1.1 percent per unit increase in digital capacity—suggesting that the Internet was not as strong an independent force of diffusion in countries with a history of metal, net of the correlation between digital capacity and the pre-1990 spatial clustering of metal. Put more narratively, we know that the Scandinavian countries had an established metal subculture prior to 1990. Our analysis suggests that this scene continued to flourish during the same period that digital capacity grew in Scandinavia and that the independent effect of growth in digital capacity is small, above and beyond the path dependency of this thriving metal scene.

**Conclusion**

In this article, we investigated the role of the Internet as a mechanism in decentralized political-cultural diffusion systems. This type of diffusion is difficult to study because of data limitations, and diffusion studies often do not specify a particular mechanism for diffusion. The regression
results reveal that digital capacity likely had an important effect on the diffusion of metal music and that there is evidence for diffusion both within and between countries. The strong effect of the Internet for late-adopting countries is suggestive of between-country diffusion. For late adopters, a one-unit increase in digital capacity was associated with a more than 5 percent increase in the population-adjusted rate of metal band foundings in the fullest model in our analysis. For early adopters, the effect of digital capacity in the final model was more modest, around 1 percent per unit increase in digital capacity.

We cannot ascertain how musicians in these countries initially learned of metal music. However, the strength of digital capacity as a predictor of the new metal rate and previously discussed theoretical concepts related to decentralized political-cultural diffusion point to an important role for the Internet. With few exceptions, metal had no large institutions encouraging its diffusion to late adopters and did not usually diffuse through more traditional mechanisms such as record stores, music television, and mainstream radio. Hence, our hypothesis that the Internet is associated with the diffusion of metal is supported statistically and theoretically.

This study makes important contributions to the existing sociological literature on diffusion. In a general sense, the results suggest that the Internet is a viable mechanism for global diffusion. Though sociologists have used the Internet as a source of data since the 1990s, we believe that the Internet, and Web sites similar to the MA, is still a largely untapped resource that can provide new research opportunities. Our results suggest that the Internet could be a mechanism of diffusion for a wide assortment of cultural items, practices, and ideas. Researchers could mine the Internet for data and uncover new patterns in global cultural diffusion. Indeed, Internet data sources may be especially useful for determining both the velocity and intensity of decentralized diffusion systems as the Internet facilitates low-cost and relatively easy maintenance of large amounts of data.

Second, this article adds to our limited understanding of decentralized political-cultural diffusion systems. In particular, the manner in which metal is adapted to country-specific or local preferences suggests that advocates who seek to diffuse an innovation, but have little power or access to centralized mechanisms of diffusion, may do well to relinquish some control over their innovation. For example, politically marginal actors like environmental groups who want to encourage ecologically conscious public policies may find more success if they allow their policy innovation to be adapted to local preferences. In other words, innovations that are adaptable may be more likely to diffuse.

We could not explicitly control for the cultural preferences of the citizens of any given nation because of data limitations. However, it is reasonable to assume that metal music may not fit into the cultural milieu of some countries, and therefore not attract enthusiasts or musicians. For example, most of the highest metal rates are concentrated in European countries, and specifically, the Scandinavian nations of Finland, Norway, and Sweden. These countries, in addition to having high digital capacity, high GNI per capita, and liberal democratic political regimes, may have cultural characteristics that are conducive to the diffusion of metal music. Countries that are politically, economically, and technologically very similar to the Scandinavian countries, such as Switzerland and the United States, may possess cultural traits that are not conducive to metal. For example, in 2005, the United States recorded a new metal rate of only 0.39, which, while representing the highest new metal rate in recent U.S. history, still paled in comparison to Finland, whose rate reached 4.4 in 2005.

Finally, the research in this article suggests that theorists of global culture can avoid the pitfalls of a “homogenization versus hybridization” dichotomy. The first of these competing frameworks argues that globalization erodes (or violently eliminates) cultural diversity in the face of market forces or rationalization (e.g., Ritzer 1996), while the latter argues that globalization involves the interaction of cultures, which creates new hybrid forms that borrow elements from each original culture (e.g., Kraidy 2003). To help consolidate these views and avoid theoretical
rigidity, cultural scholars can use our approach of employing a continuous cultural outcome variable with a time-lagged continuous predictor. Such techniques can allow scholars to discern both the velocity and the intensity of diffusion, that is, the speed at which an innovation diffuses and how much it diffuses.

There are several reasons why these results should be approached with caution. First, the dependent variable does not fully capture the global diffusion of metal because the new metal rate is calculated from physically released metal albums, due to the aforementioned ambiguity surrounding the timing of a band’s “founding.” Certain countries may have a large number of metal bands who chose to offer their music available for download on the Internet and completely eschew traditional recording media such as CDs or cassettes. This scenario may be especially likely in developed countries in which album sales have been declining for years, and the Internet is easily accessed. However, a similar process may occur in more autocratic nations, where the Internet may offer a veil of security because of the relative ease in concealing digitally stored files compared with CDs or tapes. Under autocratic rule, metal musicians may have no venues to sell their music and operate on an Internet-only basis. Long-term autocratic rule may also create an atmosphere of conformity in which individuals are unlikely to produce oppositional art, and this effect could persist even after a nation has democratized. Also, the metal rate does not adjust for new bands that are formed from members of previous bands and then release a debut album. Hypothetically, a small cadre of metal musicians might continually form and reform metal bands and subsequently increase the metal rate in one or more countries.

Second, digital capacity as calculated in this article is not the optimal focal independent variable. Recall that the Internet usage data measure counts anyone who has accessed the Internet within the past year as a user. A better measure would have captured the amount of hours that the average citizen of any country spent on the Internet over the course of a year, but such data were unavailable for many countries. It seems unlikely that sporadic Internet usage will lead to the diffusion of metal music. Unfortunately, data limitations may not allow for future scholars to develop a better measure of Internet usage.

Finally, this article explains much of how metal diffused through the mechanism of the Internet and other conventional routes but does not explain why metal music diffused globally. While we have demonstrated some of the conditions under which metal is adopted, we cannot explain why this process occurs. The global diffusion of metal occurred during an era of rapid modernization and global economic, social, and cultural integration. Most of the nations that produce a large volume of metal are technologically advanced, politically democratic, and wealthy. Metal music may be a cultural response to changing economic, social, or cultural conditions and may reflect global power dynamics (Kahn-Harris 2011). As nations industrialize and enter the global economy, metal seems to become part of that nation’s cultural makeup. Individuals in a globalizing world may need an oppositional form of expression, and metal as a music genre provides a platform to express ideas or explore topics outside the mainstream of society and, in an indirect sense, a critique of modernity and globalization. These oppositional ideas are expressed in lyrics that range from Satanism, paganism, white nationalism, radical leftism, or overt gore and deliberate offensiveness. In sum, this article contributes to our understanding of the how of metal diffusion. Beyond some case study research (e.g., Baulch 2003; Moberg 2008), the why of metal’s global diffusion is still largely unexplained and could be a fruitful research area for future scholarship.
Appendix

Countries Included in the Analysis by Geographic Subregion

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<th>Central/Eastern Africa</th>
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Notes
1. The term “innovation” has been broadly used in scholarly literature to refer to everything from consumer products to cultural norms to public policies. Rogers (1983:11) defines an innovation as “an idea, practice, or object that is perceived as new by an individual or unit of adoption.” Thus, innovations range from the highly abstract, such as theories or doctrines, to the highly concrete, such as consumer goods for sale in markets.
2. Survey research indicates that metal is the most disliked musical genre (Bryson 1996) and conservative respondents dislike metal the most (Lynxwiler and Gay 2000).
3. We use the term “oppositional code” to refer simply to extreme—though not necessarily well articulated or internally consistent—stances against elements of a mainstream national culture, such as politics, religion, or even standards of good taste, broadly defined. Thus, the aesthetics of metal do not form a coherent culture as the term is typically used in the social sciences; rather, metal music is a diverse and loosely organized “ideoscape” (Appadurai 1990).
4. In addition to literally thousands of explicitly anti-Christian bands, there are other manifestations of religious opposition. For example, the Israeli band Arallu advocates for “Satanic War in Jerusalem” (Metal Archives [MA] 2011a); the Lebanese band Ayat recorded a song titled “All Hail Allah the Swine” (Metal Archives 2011b); and the Iraqi band Janaza recorded a song titled “Burn the Pages of the Quran” (Metal Archives 2011c).
5. The diffusion of metal music does not imply simultaneous change in the popularity of other types of music. An abundant sociological literature regarding cultural omnivorism suggests that music enthusiasts may enjoy seemingly divergent and inconsistent types of music (e.g., Peterson and Kern 1996; Rossman and Peterson 2005; Van Eijck 2001). Hence, there is not necessarily a trade-off between the consumption of metal music and the consumption of other types of music, and we should not expect that one type of music will decline because another has diffused more widely. While recent evidence suggests that cultural omnivorism may be waning (Peterson 2005; van Eijck and Knulst 2005), we do not think this bears directly on our central research question—how did metal diffuse so widely during the 1990s and 2000s?
6. We note up front that this hypothesis is fraught with ecological inference problems. Even if we establish a correlation between country-level Internet use and country-level metal adoption, we cannot say for sure that people starting metal bands “got the idea from the Internet.” Although it is likely that many individuals discover and start recording metal music through exposure to metal band, fan, and file-sharing Web sites, message boards, blogs, and videos, we have no direct evidence of these mechanisms. We discuss the Internet as a mechanism for diffusion in the following section.
7. A thorough discussion of the local–global interaction within metal music is beyond the scope of this paper; however, a few examples might be illustrative. Dairianathan (2009, 2012) describes the “Vedic Metal” of Singaporean metal band Rudra. Rudra’s music mixes influences from Scandinavian death metal with Hindu spirituality and traditional regional music. Similarly, Mulvany (2000) and Weston (2011) describe European metal artists who rely, to varying degrees, on folklore, mythology, and nationalism for lyrical inspiration and occasionally incorporate folk musical arrangements and
instrumentation into an otherwise metal musical style. Thus, as metal has diffused, artists commonly adapt, change, and hybridize the genre with disparate musical, literary, and ideological influences.

8. As of January 1, 2013, the MA Webmasters may accept some online-only bands. However, the data used in this paper were provided to the authors before this rule change. This may reflect changing norms within the metal subculture.

9. We conducted a cross-check of bands in the MA by first dividing into quartiles the 193 countries on which we had valid data on gross national income. We then randomly sampled 50 bands from each quartile and searched for these 200 bands in Allmusic.com. We found that in the lowest three quartiles, between 2 percent and 14 percent of bands selected from the MA could be found in Allmusic.com. In the richest quartile, 20 percent could be found. After weighting by the fraction of total bands in each quartile, we estimate that only about 15 percent of bands in the MA are included in Allmusic.com. Hence, not only is the MA far superior to Allmusic.com in terms of overall coverage, the MA does a much better job of capturing bands from poorer countries who likely have low album sales and international exposure. Details of this analysis are available from the authors upon request.

10. Indeed, a reviewer suggested that a measure of album downloads might be a better indicator of the diffusion of metal music. There are at least two reasons why we believe our measure is preferable to album downloads as a dependent variable. First, because of the abundance of online blogs, file-sharing services, and pay sites like Amazon.com and iTunes (not to mention music streaming services like Pandora, Spotify, and I Heart Radio), constructing a country–year-specific “number of downloads” variable for tens of thousands of metal albums across dozens of sites would be practically impossible. Second, as noted in our discussion of the MA data, such an approach would require the authors to define the boundaries of metal music and exclude albums or bands based on the authors’ definition of metal.

11. Missing population data were imputed by averaging the two years closest to the missing observation; only 44 country–year observations were imputed.

12. There was some missing data on these variables; fortunately, the missing data points tended to occur between two valid observations for a given country. For example, a country might have Internet usage data for 1999 and 2001, but the data for 2000 are missing. Because the rate of Internet users per 100 people tended to increase linearly over time, we imputed the missing value by taking the average of the preceding and following years. In total, the data set contains 3,654 observations of Internet usage, with imputed values for 829 of these observations.

13. We used GNI per capita adjusted with the Atlas method, which is designed to reduce the impact of exchange rates.

14. We ran some preliminary analyses using Freedom House’s index of press freedom but found that these data would have severely limited our sample size due to missing observations. Also, the Freedom House index was strongly correlated with the Polity Project Index.

15. The Polity IV data also include special codes for nations that are experiencing political transitions. Nations that were in a transitional phase for only a few years during the period of analysis were coded with a “0,” but nations that were transitioning for most or all of the period were dropped.

16. It might be more accurate to call countries with a zero metal rate from 1980 to 1990 “non-early adopters” since, although some “late adopters” did in fact adopt metal, a nontrivial fraction did not, at least by 2008. However, we considered the term “non-early adopters” too cumbersome and opted for “late adopters” instead. So 1990 was chosen as the cutoff year for two key reasons. First, in the 1980s metal experienced a commercial heyday and was, at times, diffused through more centralized mechanisms. Second, the Internet did not exist in the 1980s, at least in a format that could be accessed by most citizens; hence, metal could not have diffused through the Internet during this period.

17. In particular, we believe these dummy variables control for relatively similar national cultural stances toward self-expression and deviant art, a characteristic that is exceedingly difficult to measure in 150 countries over 30 years. We examined data from the World Values Survey (World Values Survey 2011) but found that the survey generally did not contain data for enough countries or years to serve as a measure of a national culture.

18. Land boundaries are considered to include lakes and rivers, whereas maritime boundaries are those recognized by the United Nations Convention on the Law of the Sea and include territorial waters, contiguous maritime zones, and exclusive economic maritime zones.

19. We recognize that there are more sophisticated techniques such as spatial lag models (Anselin 1988) and geographically weighted regression (Fotheringham, Brunsdon, and Charlton 2002) that can be
employed to model the influence of space on diffusion. However, for the purposes of this paper, we are only interested in controlling for spatial proximity to metal, not fully elaborating spatial patterns of diffusion. Thus, for our purposes, our simple indicator of spatial proximity is adequate.

20. Although many diffusion studies employ an event-history framework (e.g., Braun and Koopmans 2010; Vasi and Strang 2009), we believe our modeling strategy makes more sense for this particular case because it allows us to capture not simply whether a country had at least one metal band over the 30-year period but rather how much metal was adopted by each country. In this respect, our study is similar to the framework employed by Cunningham and Phillips (2007) in their study of the diffusion of KKK klaverns throughout North Carolina.

21. See Equation 1 above. In this case, $100\% \times [\exp(0.052) - 1] = 5.34\%$.

22. Here, $100\% \times [\exp(0.087 - .053) - 1] = 3.42\%$. We used Stata’s lincom postestimation command to verify that this effect is significant at the .001 level.

23. This is not to say that Africa has no metal at all, however. Indeed, the Swedish photojournalism agency Kontinent recently profiled a band from Botswana called Wrust (Kontinent.se 2011). Other African metal bands include the Algerian band Nihil, founded in 1999, the Ugandan band Vale of Amonition, founded in 2009, and the Angolan band Nebline, founded in 2000.

24. Though we believe our measure of political regime and the geographic subregion variables do a reasonable job of capturing broad national cultural differences.

25. For example, documentary filmmaker Sam Dunn (Dunn and McFayden 2008) interviewed Norwegian academics, journalists, and black metal artists to explain the cultural conditions that were conducive to the rise of Norwegian black metal, perhaps metal’s most notorious subgenre. The documentary argues that a culture of marked conformity, coupled with Norway’s indigenous Viking mythology, helped engender the individualistic and iconoclastic ethos of Norwegian black metal.

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