Exploring the Dynamics of Music Piracy

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Abstract

Recently sales of physical music media have declined along with music industry revenues – the reasons are complex and poorly understood. We present three models exploring claims made in the conversation over piracy and the music industry's future. We model stakeholder perspectives rather than the full industry to identify their assumptions and the implications of their views, including: (1) Music industry labels claim music piracy directly supplants music sales; (2) Artists claim free music distribution can increase artist revenue through concert sales; and (3) Some academics claim reduced music sales revenue is attributable to other market changes (e.g., increased entertainment competition) rather than piracy. Modeled results suggest that, for each claim respectively: (1) Music labels' mental models are simplistic and do not reflect current research findings; (2) Artists can enhance their concert revenues through piracy as free marketing; and (3) competition with other media explains part of declining music industry revenues.

1.0 Introduction

The music industry arose in the mid-20th century from the ability to inexpensively mass-produce vinyl records. Over the years, revenues continued to climb as technology shifted from vinyl to cassette tapes and then to compact discs. All three utilized a common business model, allowing the industry to maintain its existing infrastructure. Over the past decade, however, sales of music via physical media have declined sharply along with music industry revenues. Despite this, more consumers report spending money on music than ever before.

Unfortunately, the reasons for this decline are complex and poorly understood (Connolly & Krueger, 2005; Liebowitz, 2006). In response, researchers, and particularly economists, have begun to look at the effects of file sharing on CD sales. Various effects have been suggested,

though empirical studies are ambiguous and have found different directions (Bhattacharjee et al., 2006a; Hui & Png, 2001; Oberholzer & Strumpf, 2005; Peitz & Waelbroech, 2005; Rob & Waldfogel, 2006; Zentner, 2006). Gopal, Bhattacharjee, & Sanders (2004) present a sampling argument, whereby file sharing has a positive effect on CD sales by allowing potential customers to hear new artist and music before purchasing them. Conversely, a substitution process would have an opposite effect, where downloaded music replaces purchased CDs.

Due to ambiguous theoretical predictions, mixed evidence, and opposing interests, various groups within the industry operate with different mental models of the situation, leading to differing policies and claims. System dynamics affords the opportunity to evaluate these claims, establish any assumptions and implications they might embody, and, potentially, recommend policies that would result in better outcomes.

The dominant view point is that online piracy has offered consumers an alternative way to obtain music that undermines the industry's revenues, potentially to the point of destroying it. In their 2009 Digital Music Report, the International Federation of the Phonographic Industry clearly stated this claim, saying "The vast growth of unlawful file-sharing quite simply threatens to put the whole music sector out of business" (IFPI, 2009). Liebowitz (2006, Figure 3 p.14), in reviewing the drop in music sales, shows that the drop in music sales occurred at the same time as online peer to peer music sharing services began to operate, starting with Napster.

Alternatively, various scholars (e.g., Oberholzer & Strumpf, 2004), artists, and Internet activists have suggested that the decline in music revenues derive instead from changes in consumer demands, expectations of digital distribution, and the growth of other forms of entertainment competing for the consumer's money (Peitz & Waelbroech, 2004). Some have even gone so far as to suggest that music piracy can actually be good for the industry, at least with regards artists. In these arguments, music piracy is considered a form of free marketing that allows artists to sell more concert tickets and merchandise (Gayer & Shy, 2006; Peitz & Waelbroech, 2005).

Given the complexity of this issue, and the fact that consumer behavior is poorly understood in this area (Gopal et al., 2002), we did not attempt to create a single authoritative model describing the industry. Instead, we sought to model the specific claims made by various stake holders. By doing so, and by examining the implicit assumptions and implications, we discuss the feasibility of each claim, and make recommendations accordingly.

1.1 Stakeholders

The music industry includes several different groups, each with their own perspectives and motivations. For clarity, we distinguish between

- **Artists** – individuals or groups who create and music
- **Labels** – companies who provide recording, distribution and promotional services to artists
- **Retailers** – companies who engage in the legitimate distribution of music.

- **Consumers** - individuals who acquire music for listening
- **Pirates** – individuals who seek to profit in some way from the illegal distribution of music.

1.2 Problem Constraints

To keep the problem tractable, we constrained our investigation and discussion as follows:

- We have primarily focused on the music industry within the United States of America. Partly this was due to a lack of good data concerning international music sales and piracy, and partly because we wanted to avoid the much greater variability in consumer behavior that we expect exists worldwide. Nonetheless, we expect that our findings will be at least somewhat generalizable.
- We have not delved into issues of ethics or legality, nor do we consider qualitative aspects of the music such as improved diversity, novelty, and accessibility.
- We focus only on the direct consumption of music by consumers. We have not considered music licensed for re-use in movies & advertising, for re-use as samples in music, or for public broadcast or performance.

1.3 Problem Statement

We have selected three specific claims to model:

- The claim by labels that music theft directly supplants music sales, and that pirates can be converted into consumers who, instead of stealing, will buy the same amount of music
- The claim by some artists that free distribution of music, through piracy or by choice of the artist, can increase revenue to artists through concert sales, merchandise, and the sale of other works
- The claim that reduced industry revenue is attributable not to piracy, but to market changes such as increasing entertainment choices and changes in consumer expectations.

2.0 Model 1 - Relationship between sales & piracy, as understood by labels

Our first model diagrams the mental model of large music labels − namely that pirated music directly replaces a music sale, and in turn that reducing piracy will result in increased music sales. In modeling the music industry's view we have relied mainly on their testimony and the methodology of their cited data sources. For instance, in a recent trial with The Pirate Bay, a peer-to-peer torrent sharing site, "… John Kennedy, the chief executive of the International Federation of Phonographic Industries, testified that people would have purchased every music track they got free file sharing. Kennedy answered an affirmative 'Yes' to Pirate Bay defense attorneys when asked whether that was true." (Swartz, 2009).

Further, upon reviewing the RIAA's claims of lost revenue due to piracy they note: "One credible analysis by the Institute for Policy Innovation concludes that global music piracy causes $12.5 billion of economic losses every year." (http://www.riaa.com/physicalpiracy.php). Upon

reviewing the report, data for the estimates of units sold if piracy were nonexistent are based on "…absent piracy, consumers of pirated products would substitute legitimate purchases for all or nearly all of the pirate purchases that they now make." (IPI, 2007, p.7).

Based on these testimonies and analytical approaches, our model reflects how labels conceive of pirates and consumers. The total population is divided into people who are either pirates or are consumers, and every album pirated is a lost sale from the total pool of "potential sales." By making the reasons to be a consumer outweigh the reasons to be a pirate, the flow of people will be from pirate to consumer (Bhattacharjee et al. 2006b). In this way, the labels will recoup their lost potential sales and increase revenues. Below we discuss portions of the model separately for ease of presentation.

2.1 Assumptions

We have assumed that the average popularity of recorded music increases linearly with time. This assumption matches the predicted increase in sales according to Liebowitz (2006). We also assume that consumers' incentives to pirate music began in the year 2000, and have been increasingly linearly since. These incentives include the spread of piracy technologies and people's awareness of these technologies. Finally, we've assumed that the music industry's reaction to piracy, in the form of anti-piracy actions, will be maintained proportional to the rate of piracy.

2.2.1 Sub-model 1 Music Production-Consumption

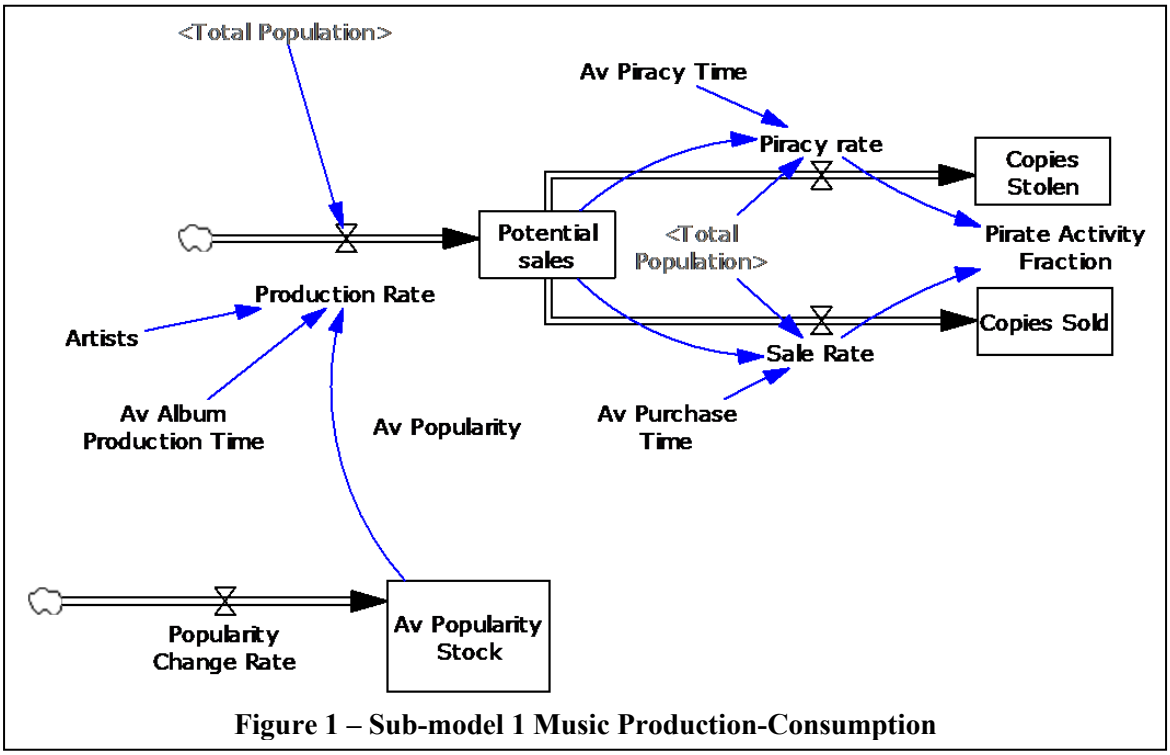

Figure 1 – Sub-model 1 Music Production-Consumption

This sub-model reflects the mental model of how the music industry defines potential sales lost to piracy. The potential sales stock reflects the music labels' perceived value of their products in the current market. These potential sales are defined by the number of artists producing music, how quickly they can produce albums, and the number of potential customers in the market, as well as a linearly increasing coefficient of the average popularity of music. As per the claim this model is based upon, given that there is no piracy, all potential sales are converted into actual sales. As piracy increases, though, the potential sales are instead converted into copies stolen. The change in Potential Sales is measured by the Sales Rate and the Piracy Rate of albums.

2.2.2 Sub-model 2 - Pirates-Consumers

This sub-model focuses on the division of the music industry market into those who are pirates and those who are consumers. Together these two groups make up the Total Population of the market. The conversion rate is defined as how quickly people move between the two groups, and in which direction. This rate depends on the various incentives for becoming a music pirate and the incentives for becoming a music purchaser, or anti piracy factors and pro piracy factors respectively. A high anti piracy factor might reflect very tough laws against piracy combined with advances in technology to stop piracy. The steady linear increase in the pro piracy factor of our model, simulated as beginning in the year 2000, reflects the constant advances in the technology of piracy and consumer access to it. This allows our data to roughly correlate to the sales data of the RIAA. These two competing factors are then used to determine the direction and magnitude of change in the pirates and consumers stocks, based on whether the environment is relatively favorable or hostile for pirates.

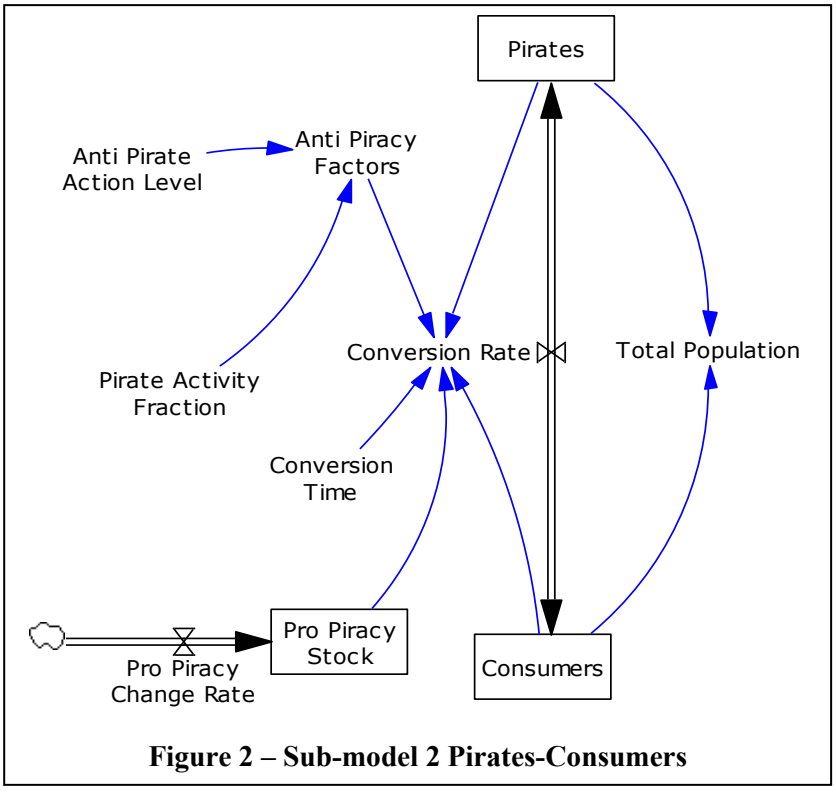

Figure 2 – Sub-model 2 Pirates-Consumers

2.2.3 Full Model

Integrating the two sub-models, gives us the following full model.

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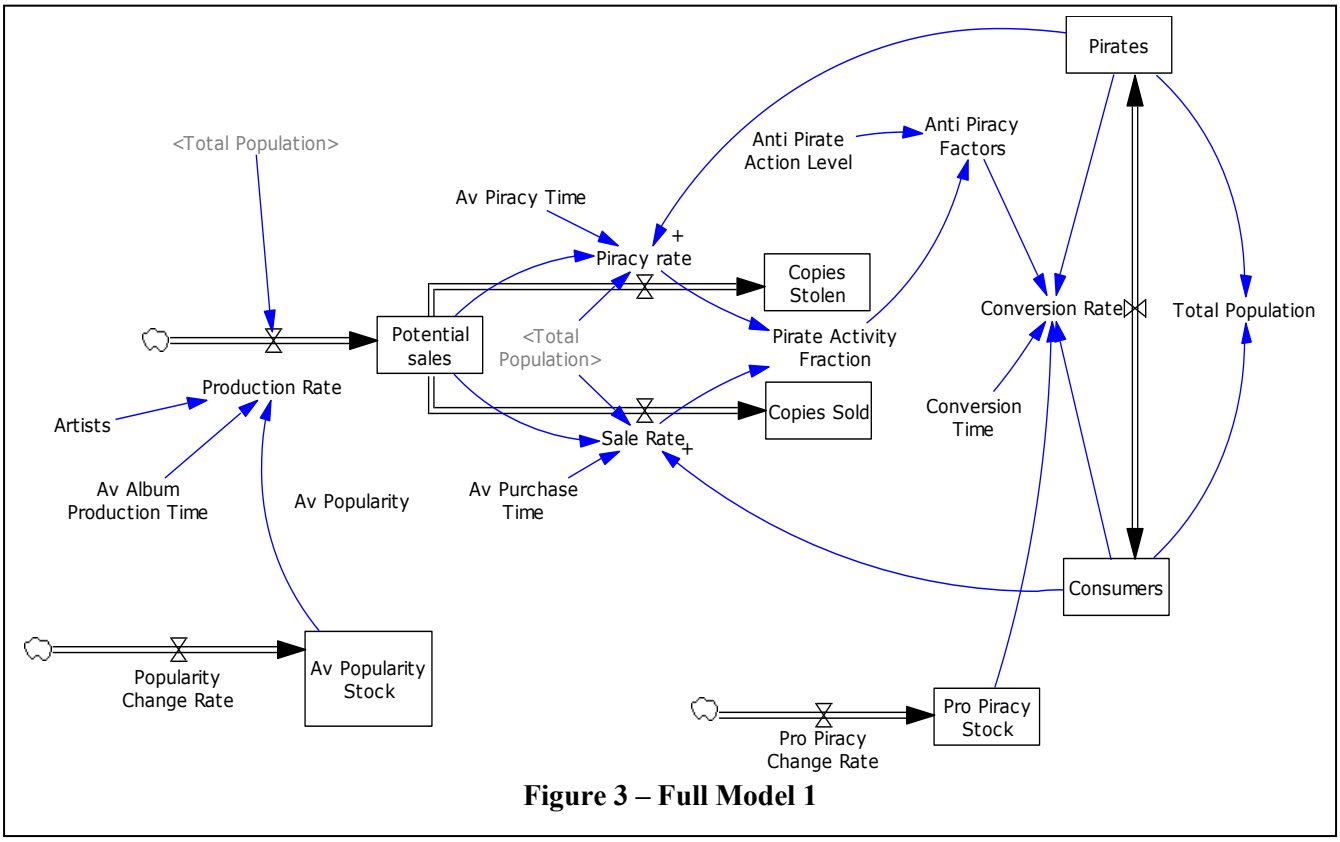

Figure 3 – Full Model 1

2.3 Model testing

To critically assess the model we followed Sterman's guidelines for model testing (Sterman, 2000, p.852).

2.3.1 Purpose, Suitability, and Boundary

We used our reference mode behavior to determine the appropriate time horizon for the model, ranging from 1973-2005. The below model boundary chart describes the boundary of the model. As our goal for model 1 was to explicitly model the assumptions of the recording industry's argument for the decline in music sales, the exogenous and excluded variables are appropriate. Moreover, the model excludes many important system feedback loops, which correspond with omissions in the industry's position.

Table 1. Model 1 boundary chart

Endogenous	Exogenous	Excluded
Potential sales	Population growth	Limit to growth in potential sales
Average purchase and piracy time	Supply	Effect of price
Copies stolen and sold	Demand	Competition
Anti & Pro Piracy factors		
Pirates and consumers		

2.3.2 Physical and Decision-Making Structure

A review of the structure of the model showed that it conforms to basic laws and is dimensionally consistent. The model excludes time delays and other constraints as well as decision-making behavior because these are not taken into account in industry arguments.

2.3.3 Robustness and Sensitivity to Alternative Assumptions

We varied each parameter in the model using Vensim's simulation feature to ensure that its range of values generated expected behavior in the stocks and flows. The model appears robust to our initial testing.

2.3.4 Pragmatics and Politics of Model Use

To develop and test the model we used several estimated parameters and ranges from the literature, including:

- Potential sales (Liebowitz, 2006)
- number copies stolen (HUI & Png, 2001; Rob & Waldfogel, 2006)
- average period of popularity (Bhattacharjee et al., 2006b)
- conversion rate for anti-piracy factor (Bhattacharjee et al., 2006a)
- number of artists (Gopal, Bhattacharjee, & Sanders, 2004)
- number of albums (Gopal, Bhattacharjee, & Sanders, 2004;Rob & Waldfogel, 2006)
- number pirates (Liebowitz, 2006)

2.4 Results

We have simulated the mental model of the labels regarding how they perceive piracy's impact on their business. In the following two graphs, we have assumed that the average piracy time and average purchase time remains moderate. The conversion time from pirates to consumers and vice versa also remains moderate. However, we have varied the anti piracy action level from one extreme value to another. The anti piracy action level describes the magnitude of the industry's response to the existence of music piracy.

As we can see from the graphs, as the anti piracy action level is increased, the sale rate has also been increased.

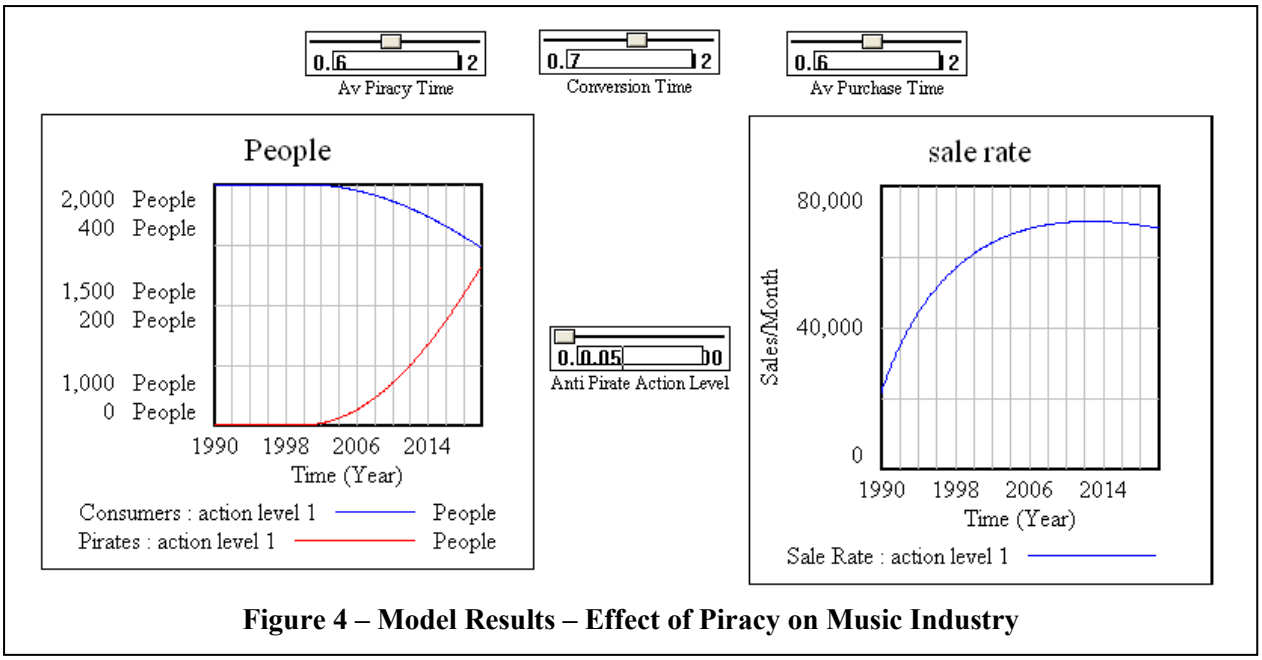

Figure 4 – Model Results – Effect of Piracy on Music Industry

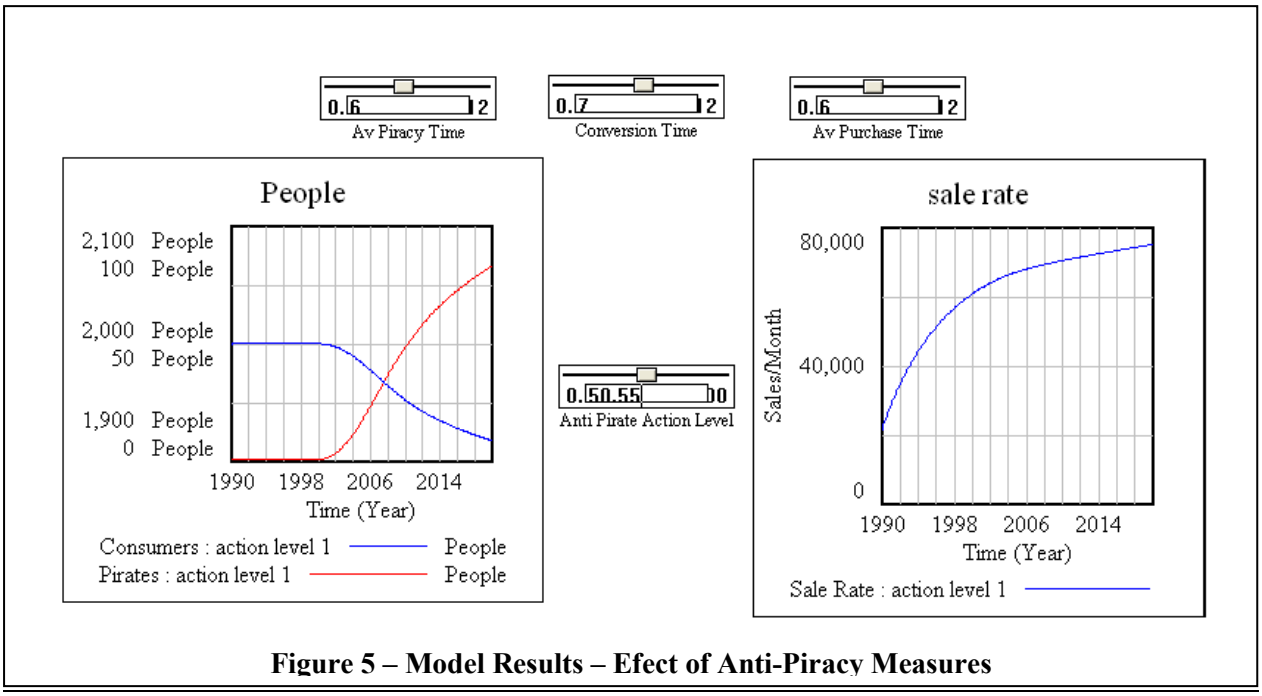

Figure 5 – Model Results – Efect of Anti-Piracy Measures

2.5 Conclusion

We have modeled the labels' claims regarding the impact of piracy on music sales. Some of the assumptions in this mental model do not hold up well to scrutiny. For example, though it is indicated that music popularity will continue to increase indefinitely, this is impracticable over any lengthy amount of time. Also, the claim states that as pirates are converted into consumers, they purchase the same number of albums they would have pirated. This is how our model calculates the labels' perceived amount of potential sales. In reality, there does not seem to be any evidence to support this claim. The rate at which people pirate music does not have a 1-to-1

correlation to the rate at which they would otherwise purchase music. Our recommendation to the segment of the music industry maintaining this claim would be to reconsider their assumptions. By expressing these views to the public at large, their case against piracy is not strengthened and may, in fact, be compromised.

3.0 Model 2 - Effect of unpaid distribution on artist revenues

Our second model addresses the claim by artists that the free distribution of albums, through piracy or by choice of the artist, can increase revenue to artists through concert sales, merchandise, and the sale of other works. Alan Krueger, a Princeton economist, refers to this claim as the "David Bowie" hypothesis, based on a famous quote:

"Music itself is going to become like running water or electricity… You'd better be prepared for doing a lot of touring because that's really the only unique situation that's going to be left."
− David Bowie , *New York Times*, June 9, 2002

In order to investigate this claim, our reference mode data refer to the actual impact of concert income on total artist revenue at present. Data based on Pollstar from Krueger (2004) shows that for the top bands concert income is indeed their main source of revenue by a factor of 7.5 to 1.

Furthermore, there is a large disparity between popular superstar-type bands and smaller ones. Krueger (2004) shows that the top 1% of bands control over 50% of the revenue from concerts.

Given these data, our dynamic hypothesis is that free distribution of music online will generate increased artist revenue through concerts. To assess the face validity of the hypothesis, we developed an operational model of artist music production, distribution, and income for an individual artist/ band.

For ease of understanding, we will discuss this model in stages before integrating it together into a single model.

3.1.1 Sub-model 1 - Viable Music

First, let us consider the artist's music catalog. Instead of considering the total amount of music created by the artist, we model only music that is viable - worth promoting and performing. Music is produced according to the band's desire to produce music and the affordability of music production.

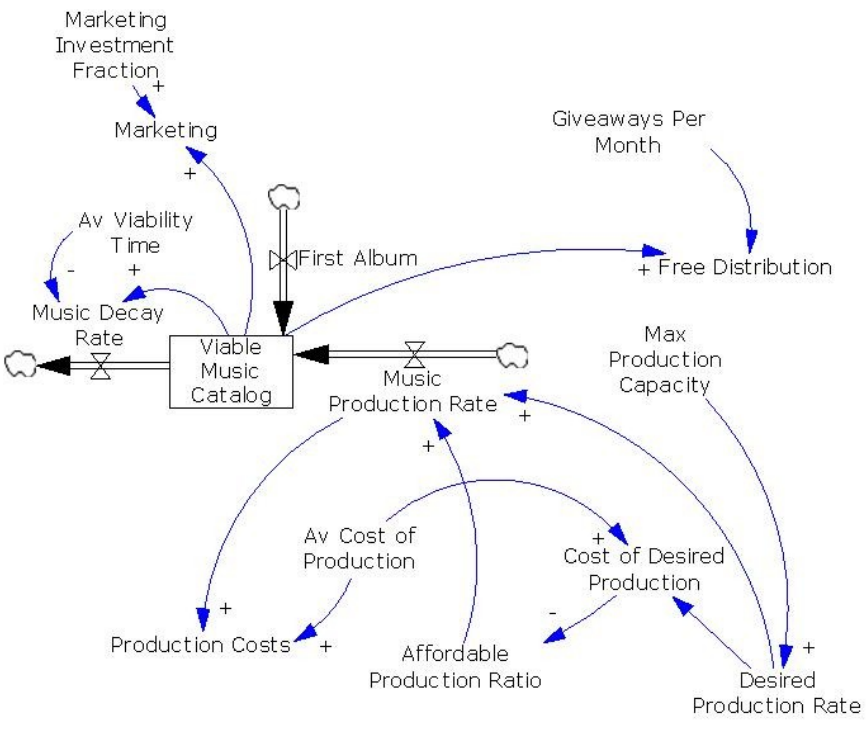

Figure 6 – Sub-model 1 Viable Music

Viable music decays over time according to a first order delay. This accommodates the fact that the longevity of each track is highly variable - some tracks become classics while others are forgotten almost immediately.

The amount of viable music in an artist's catalog directly affects how much marketing they employ and how many tracks they give away for free. It is important here to distinguish clearly between viable music and total music as a band whose music has become non-viable is unlikely to engage in marketing.

3.1.2 Sub-model 2 - Fans

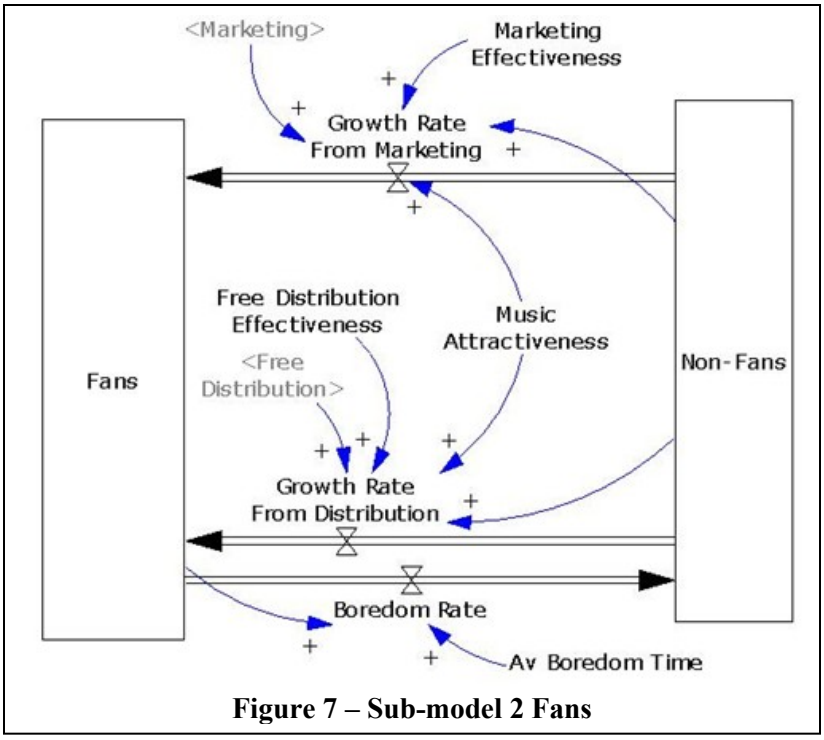

Figure 7 – Sub-model 2 Fans

Based on marketing effectiveness and general attractiveness of an artist's music, money spent on marketing leads to a growth in the number of fans. Similarly, sampling consumers who come across the band's music available for free may become fans. Over time, fans become bored with a band's music. The number of fans directly affects sales of both albums and concert tickets. Fans also affect artist motivation, as artists are assumed to be partly motivated by having their music be considered popular.

3.1.3 Sub-model 3 - Money

Artists acquire money primarily through sales of their albums and sales of concert tickets, depending on the profit margins of each of these. Artists may also profit from merchandise sales at concerts; for simplicity, this is considered part of their concert profits. Money is spent on either marketing or production.

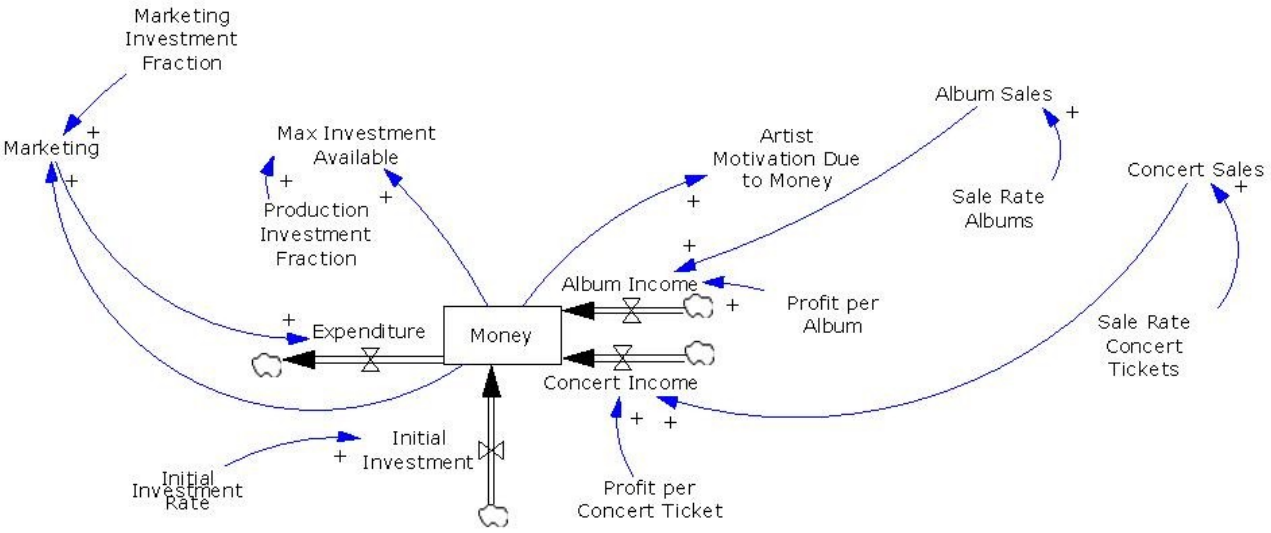

Figure 8 – Sub-model 3 Money

The amount of money available directly affects spending on both marketing and production depending on the desired level of reinvestment. Similarly, money contributes to a band's motivation, and may constrain their production activities.

3.1.4 Sub-model 4 – Production

Thus far, we have discussed the model's three stocks (viable music, fans, and money), as well as the linkages between viable music and fans, and fans and money. The rest of the model concerns the impact of money and fans on the production of new music and is somewhat complex. Firstly, artists are assigned a 'desired production rate'. This rate is increased by their motivation due to money and popularity, and constrained by the average time it takes music to be produced. In addition, it is clamped to a maximum production capacity, for no matter how enthusiastic the band may be, they cannot produce more than one or two albums at a time.

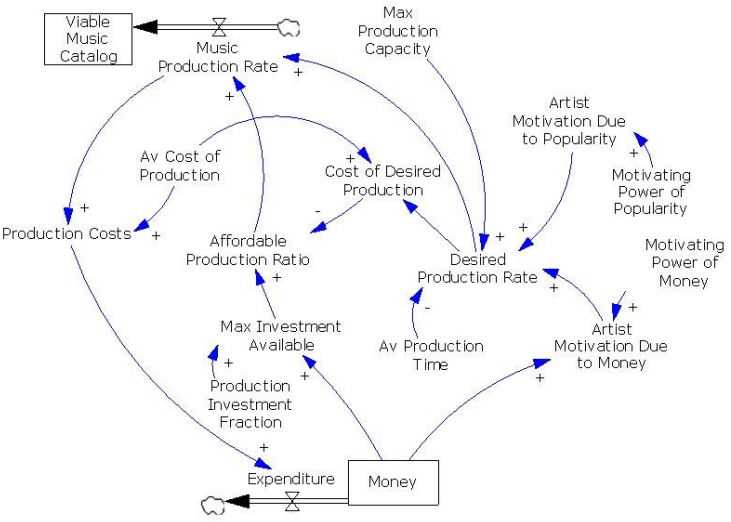

Figure 9 – Sub-model 4 Production

Next, the maximum amount of funds available for production is calculated and divided by the cost of desired production, giving us a ratio of affordable production. This is combined with the desired rate of production to give the actual rate of production. Finally, the cost of actual production is calculated and applied as expenditure.

3.1.5 Full Model

These four Sub-models integrate together into a single model as shown below with the addition of a few extra constants to control various auxiliary variables.

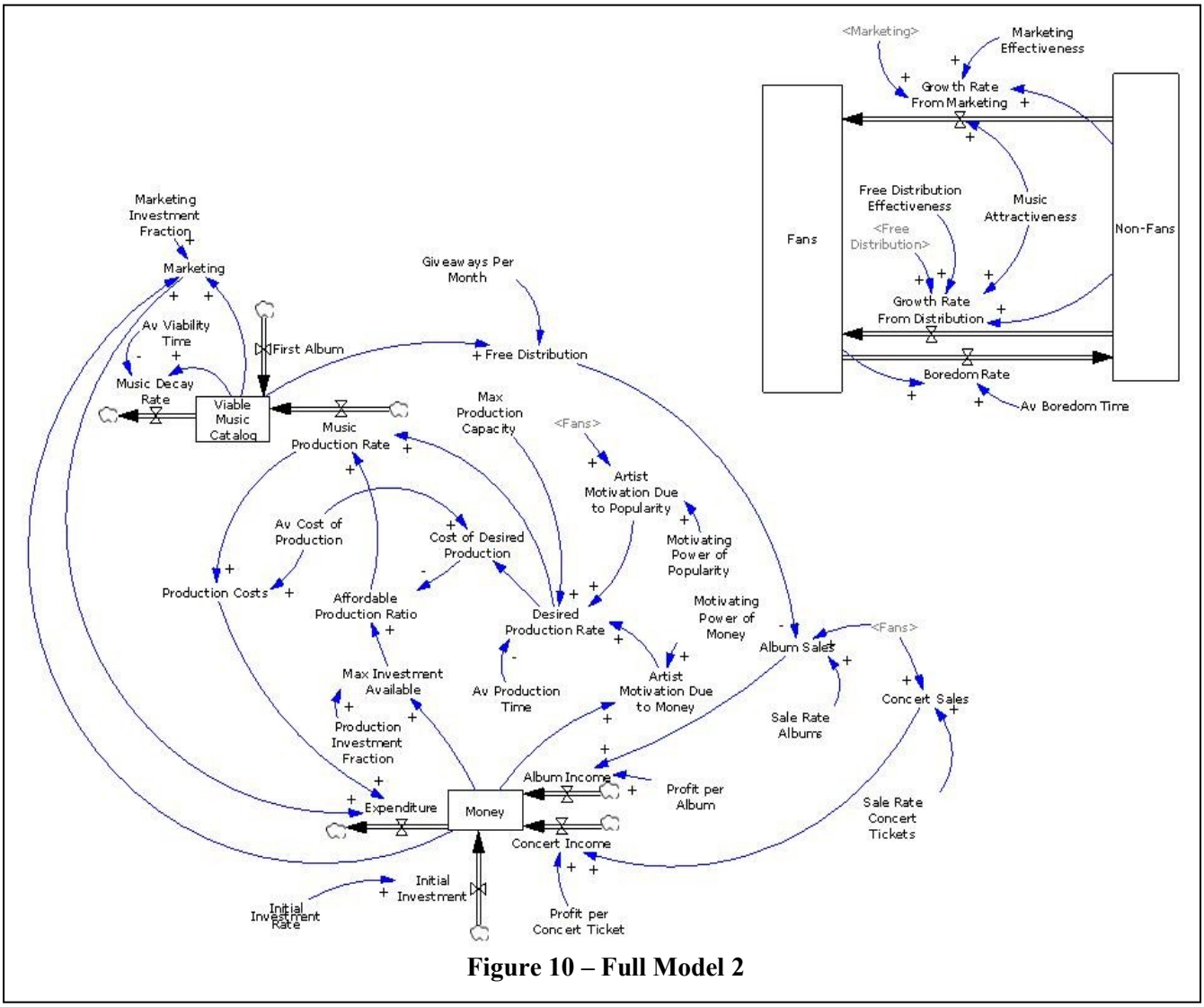

Figure 10 – Full Model 2

3.2 Model testing

We again followed the guidelines issued by Sterman (2000, p.852) for testing model 2. As the model tests a hypothetical fan population and individual artist, we assigned a time horizon of 1-100 months for the model to assess both short and long-term trends. We also fixed the hypothetical fan population at 10,000 for illustrative purposes.

3.2.1 Purpose, Suitability, and Boundary

We varied the time horizon in this model to evaluate the effects of short and long-term views on the hypothesis modeled since the artist assumption is not explicit. The below model boundary chart describes the boundary of the model. We were unable to disaggregate the marketing process of the music industry due to lack of available information or insider knowledge, this is a recognized limitation of the model. Further, due to lack of systematic data, we were unable to model the costs and profits of concerts more explicitly.

Table 2. Model boundary chart

Endogenous	Exogenous	Excluded
Music production	Music viability and marketing	Less aggregated marketing effects
Music distribution/ marketing	Distribution effectiveness	Limited number of fans
Artist income	Concert profit and sales rate	Concert timing with album release
	Growth and decay in fans	Marketplace and competition

3.2.2 Physical and Decision-Making Structure

A review of the structure of the model showed that it conforms to basic laws and is dimensionally consistent. The model excludes time delays and other constraints. Further, we were unable to generate a decision-making structure for music fans due to a lack of consensus on how individuals select their music (e.g., the economics literature is divisive on this issue). As Sterman (2000) notes, in order to model mental data information must be elicited through interviews and other methods beyond the scope of this project. While these are limitations, the model is still representative of the claim by artists that we are attempting to model.

3.2.3 Robustness and Sensitivity to Alternative Assumptions

We varied each parameter in the model using Vensim's simulation feature to ensure that its range of values generated expected behavior in the stocks and flows. The model appears robust to our initial testing, however, given the large number of parameters, it is difficult to assess every possible scenario.

3.2.4 Pragmatics and Politics of Model Use

To develop and test the model we used several estimated parameters and ranges from the literature, including:

- Concert sales (Lewis, 2006)
- Profit per album in general (Sandoval, 2007)
- Profit per concert in general (Lewis, 2006)
- Av sales per person per month (Hui & Png, 2002)
- Music Decay Rate (Rob & Waldfogel, 2006)
- Average viability time (Sandoval, 2007)

3.3 Results

To test the face validity of the claim and our dynamic hypothesis, we explicitly modeled two case scenarios: (1) a small, relatively new and unknown band; and (2) a large, experienced and popular band. Our rationale in selecting these examples as cases was to assess whether or not there was a differential effect of free distribution on concert revenue based on band parameters.

3.3.1 Small band

The figure below presents the results for a small band. In selecting parameters, we allowed "giveaways per month" and "free distribution effectiveness" to remain the same as for the large band. This is to allow for a direct comparison of the effects of free distribution on concert revenue between the two cases. Since the band is small, we set that they had no investment in marketing. Finally, we lowered their parameters relative to the large band for the following: profit per album, profit per concert ticket, music attractiveness, average viability time, average cost production, sale rate concert tickets and albums. Again, this was to reflect that the band is less popular, is likely not producing as quality of music as a large band, and is less able to demand higher prices for their products.

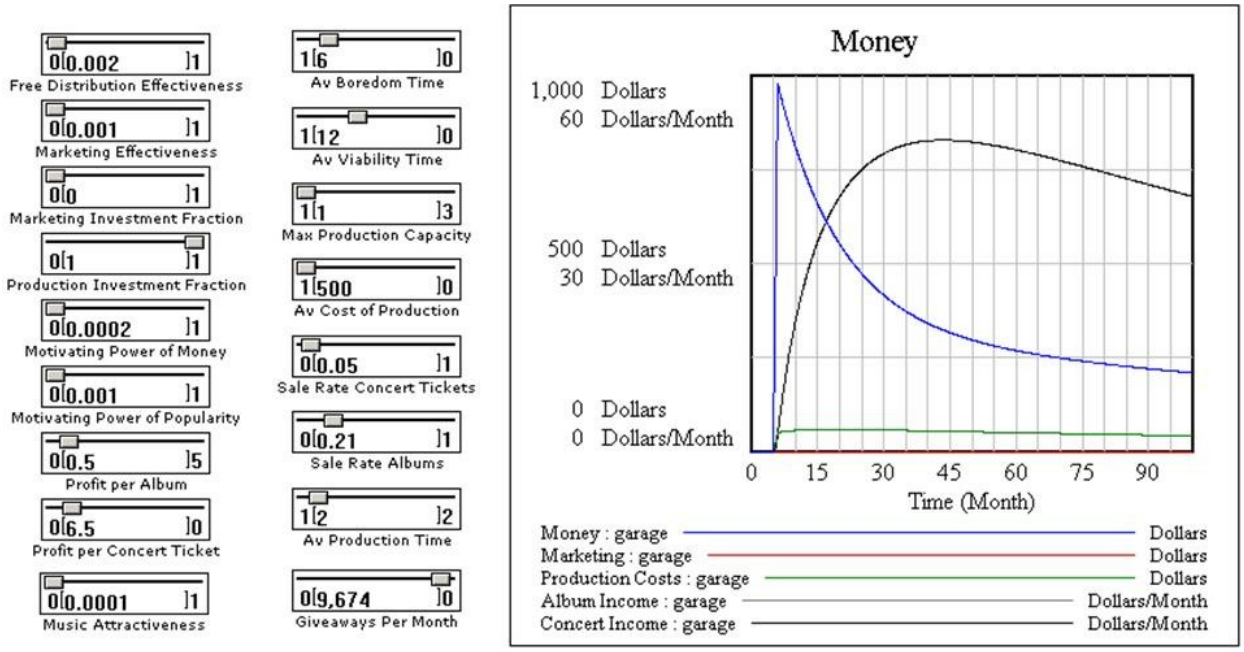

Figure 11 – Small Band Revenues

From the results, we see that concert sales are the bulk of the band's income, though it decreases over time due to their music being less viable. Given that these bands have low production costs (e.g., by leveraging new electronic technologies), they are also likely to be producing new music more frequently than a larger, more established band.

3.3.2 Large band

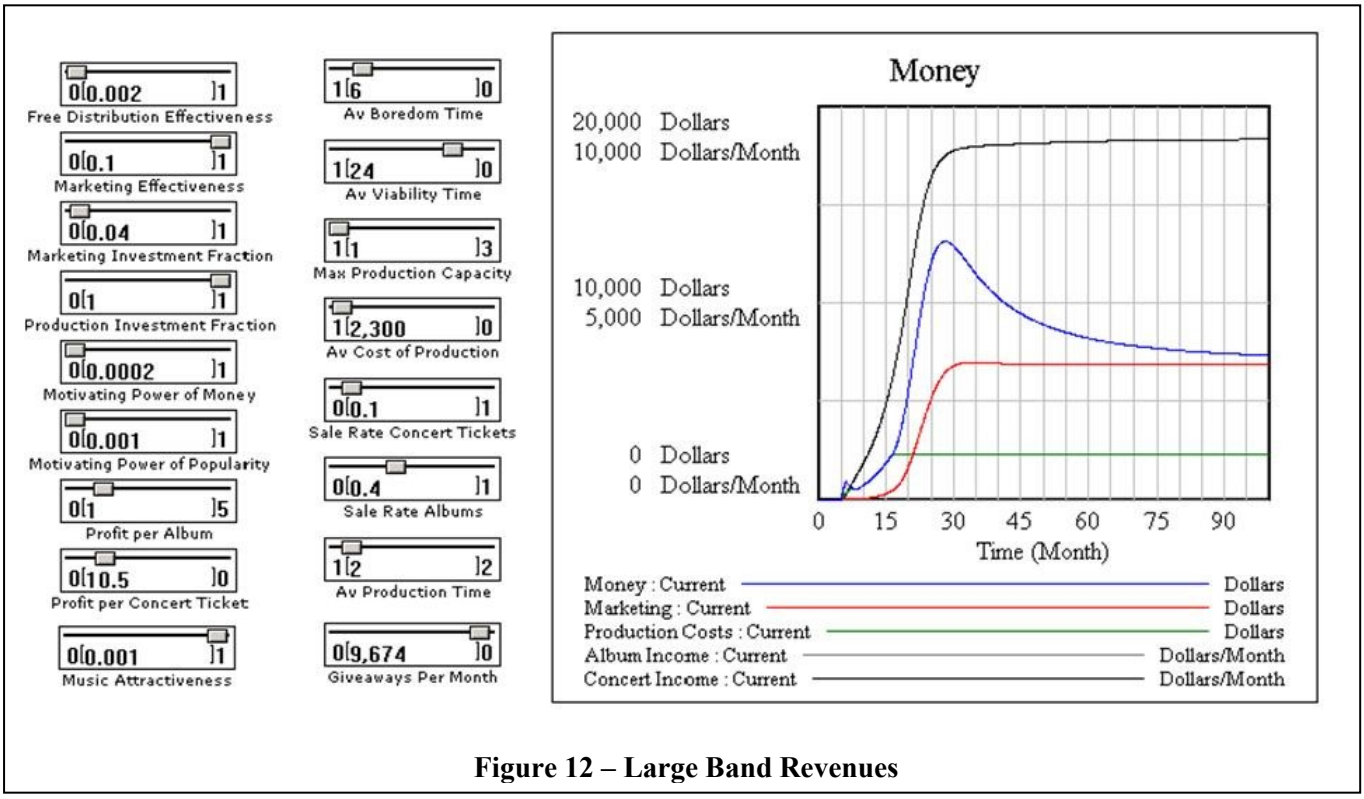

Figure 12 – Large Band Revenues

The next figure presents the results for a large band. Parameter selections for this band were the same as the small band scenario for "giveaways per month" and "free distribution effectiveness" to permit comparisons. Further, we allowed the large band to have investment in marketing as they are more popular. Finally, the following parameters were larger relative to the smaller band: higher profit per album, profit per concert ticket, music attractiveness, average viability time, average cost production, sale rate concert tickets and albums. These parameters were increased since the band is more popular and has a more long lived music catalogue due to having several "hit" songs. Also, they are able to negotiate higher prices for their concerts. Finally, since they are likely recording in a studio, their production time and costs are also higher than the small band scenario.

Similar to the small band results, we see that the large band's income is largely driven through concert sales. However, this income shows a goal-seeking behavior, suggesting that a large band can maintain a certain level of revenue due to their greater popularity and amount of music that is viable.

3.4 Conclusions

It appears that the assumption has at least face validity -- free distribution can increase the fan base through sampling, in turn increasing concert sales and a band's income. While both big and small bands can benefit from these effects, increasing adoption of this technology by smaller bands along with decreased production costs may increase the competition among artists in the

marketplace. We might expect in the future that the percentage of total concert revenue captured by the biggest bands will decay over time as more artists are able to compete. Indeed, the literature has documented a greater amount of competition just in billboard listings over time from smaller, alternative labels (Bhattacharjee et al., 2006b). However, our model is unable to address these postulations due to excluding the marketplace and competition effects. A logical extension of the model would be to include marketplace effects to better understand how free distribution might affect bands differently. Further, future work could treat the population of fans and pricing as endogenous factors. For instance, as a band grows in popularity over time and its fan base ages, we would expect increased demand for concerts and therefore increased prices for tickets (see Krueger, 2004 for a detailed discussion).

Finally, our model assesses the network effects for artist stakeholders only. A more complete view of the competing interests of other stakeholders would allow us to analyze differential network effects based on free distribution. For instance, Gayer and Shy (2006) built a model assessing free distribution effects for artists as well as music publishers. Their results suggest a conflict of interest, where artists benefit due to other revenue streams (e.g., concerts) while recording publishers net a lower profit. Including other stakeholders would thus allow us to endogenously model the role and network effects of interventions such as copyright enforcement.

4.0 Model 3 - Albums sales affected strongly by non-piracy factors

This model shows the claim made by some academics, such as Oberholzer and Strumpf (2004), that the causes and effects of music piracy are largely independent of music sales. That is, even though music piracy may raise or fall dramatically, it will have only a minimal effect on sales. Academics do cite two main connections between piracy and sales, though: a decrease via substitution and an increase via sampling. The debate still continues as to the magnitude of these forces, as well as their relative strength.

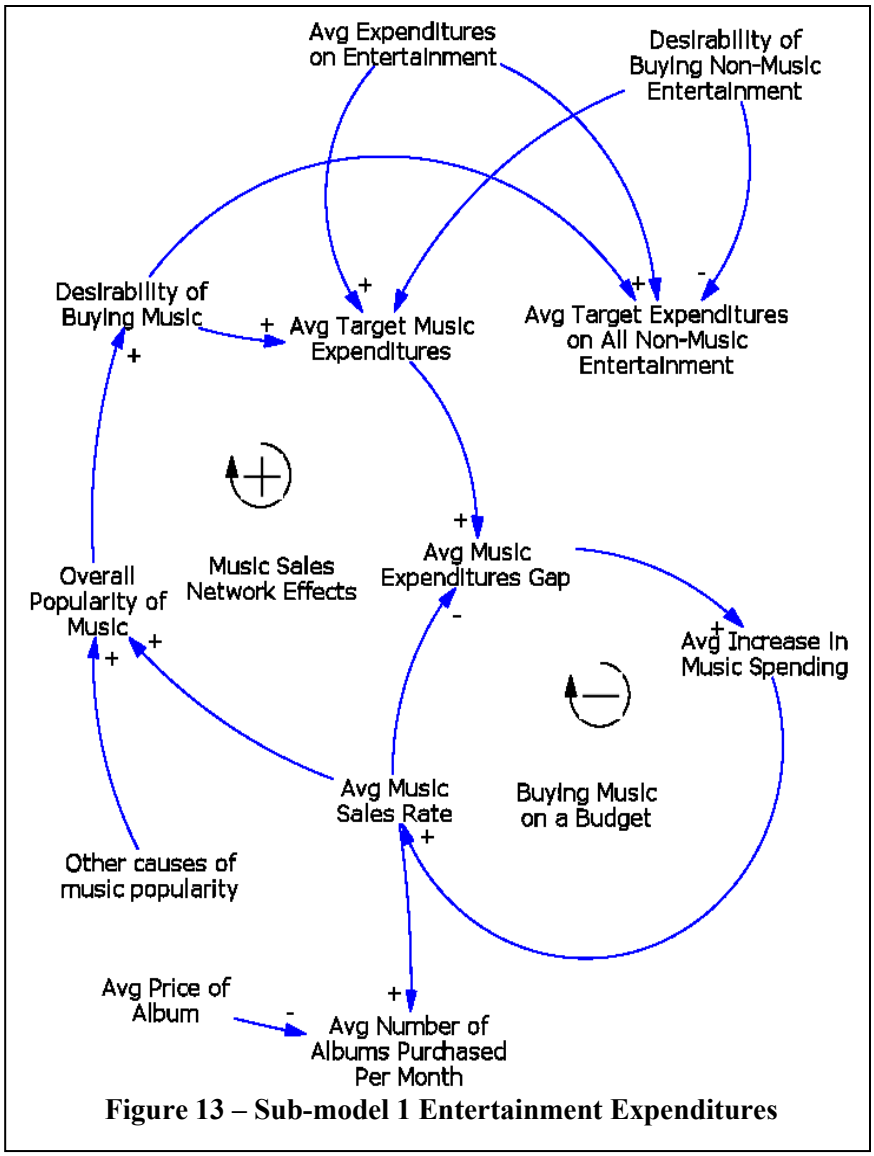

Figure 13 – Sub-model 1 Entertainment Expenditures

4.1.1 Sub-model 1 - Entertainment expenditures

First, a consumer's average expendable income is considered to be relatively fixed from individual to individual. Therefore, average expenditures on entertainment must be divided between expenditures for music and expenditures for all other types of entertainment. The money allocated to each is largely dependent on the relative desirability of buying music versus other entertainment related expenses. This mental model implies that looking at music industry revenue in isolation is avoiding the larger picture of consumer spending. Take, for example, the video game industry, which has shown a marked increase in sales over the past ten years, according to NPD data (Matthews, 2009).

Video games reflect just a single industry competing for consumers' expendable income. Other competing industries include movies, both in theaters and on DVD, cable and satellite television, broadband Internet, and various live events. As consumers decide to purchase other types of entertainment related goods and services, their funds available for music purchases are offset. As consumers have less money allocated to music purchases, they necessarily buy fewer albums. This balancing action overcomes any positive network effects of music purchasing that the industry has typically relied upon.

4.1.2 Sub-model 2 - Music Piracy

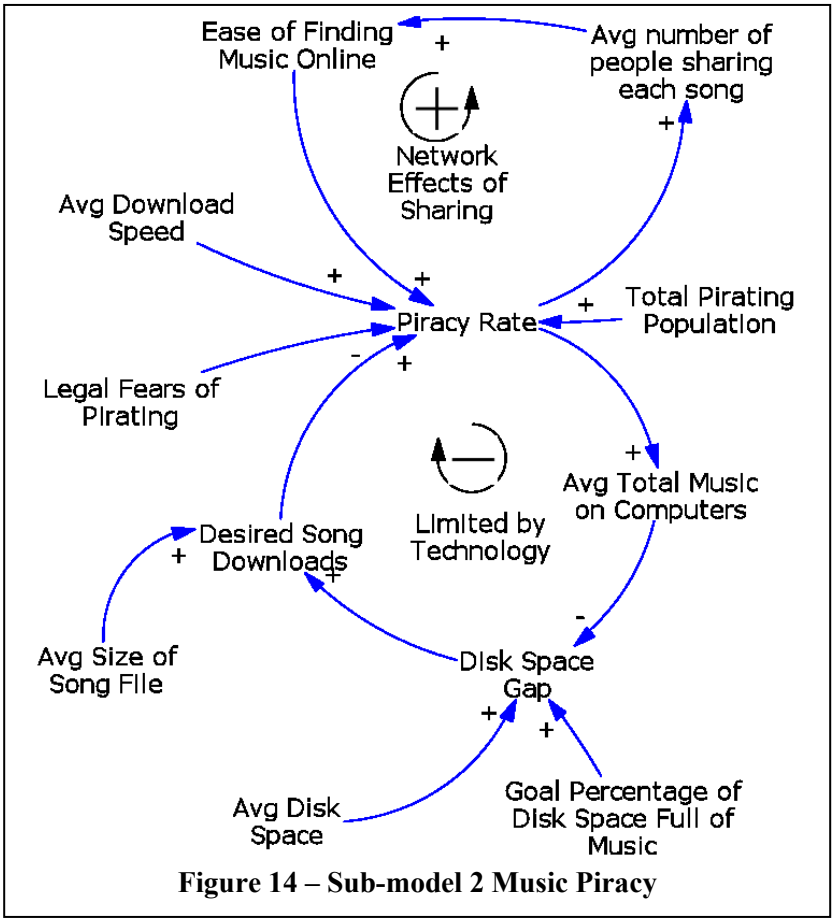

Figure 14 – Sub-model 2 Music Piracy

In this causal loop diagram, the primary causes of piracy are considered separately from the music industry as a whole. As more people download music illegally, there are more people sharing each file, making it easier to pirate music. This the Network Effect of Sharing reinforcing loop. Other factors for piracy include the total pirating population and legal fears of piracy, both considered exogenous to our model.

The primary balancing loop in this mental model is the physical and technological limitations of computers. In following with Moore's law, the speed and capacity of computers has been rising constantly for over two decades. As people are enabled to download a greater quantity of music and store it on their personal computers, this mental model implies that they will proceed to do so until they are satisfied with the amount of music they possess. Our causal loop diagram shows the effect of the amount of available hard drive space dedicated to digital music on music piracy. Following Moore's & Kryder's laws, the amount of hard drive space on new computers has been increasing exponentially, from hundreds of megabytes in the mid 1990s to terabytes today.

Though this technical capacity may eventually level off, it has far exceeded the amount needed to download many thousands of songs illegally, leaving much capacity left over for other typical

uses of personal computers. Other technological factors that affect the rate of piracy include average size of song files and average Internet download speed.

4.1.3 Full Model

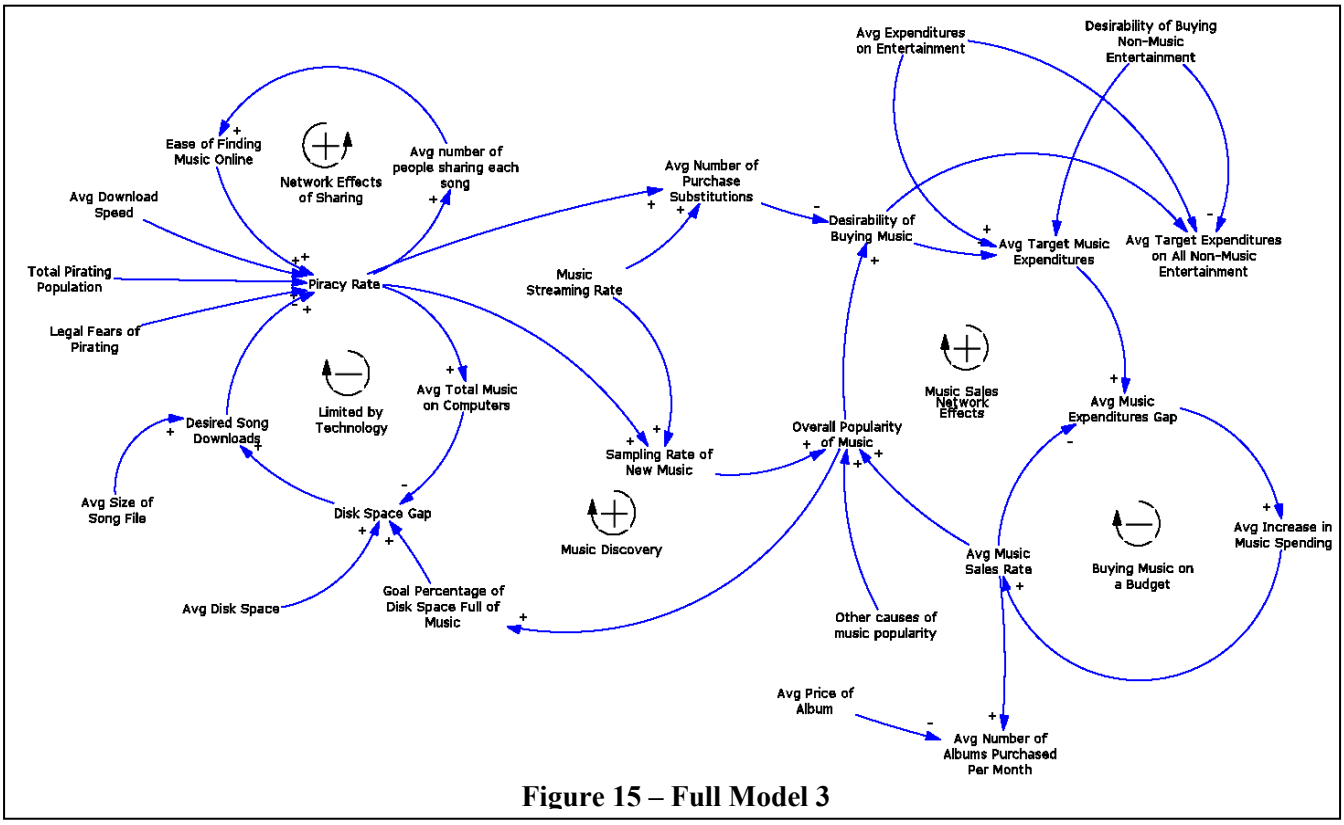

Figure 15 – Full Model 3

As can be seen in the full causal loop diagram, this mental model includes two primary interactions between entertainment expenditures and music piracy. The first is the average number of purchase substitutions: as people have the files on their computers, this may act as a substitute for purchases, causing a reduced desire to buy more. The second is the sampling rate of new music: as people discover music online, the overall popularity of music increases. This can cause both more pirating, and more purchases of music via the Music Discovery loop. Similarly, as the Music Sales Network Effects cause more Popularity in Music, people will pirate more as well. In this model, the effects of piracy can be compared to those of the Music Streaming Rate (i.e.: listening to music on the radio, on TV, or streaming online). As previously mentioned, the magnitude of these effects is much debated. It appears that customer behavior greatly depends on individual preferences and smaller group dynamics.

4.2 Model testing

Since this model is only a CLD, our testing was limited to the critical assessment of its boundaries and assumptions as listed in the chart below. In particular the decision-making model of consumers is left exogenous due to limited data; this is a recognized limitation of this model, and a major reason that it was not developed into a full working model.

Table 3. Model boundary chart

Endogenous	Exogenous	Excluded
Piracy Rate	Average computer size/speed	Effect of new sales on overall piracy
Network Effects on piracy	Pirating population	Music quality effects on sales
Hard drive limitations	Average entertainment expenditure	Legal mp3 purchases
Budget for music purchases	Alternative entertainment	Non-music listening population
Desirability of buying music	Music Streaming Rate	
Overall popularity of music		
Effects of piracy on music sales		

4.3 Conclusions

The claim that music purchasing and music piracy are only indirectly related, upon being diagrammed, appears to be a possibility. Record labels recently have committed tremendous resources to increasing computer users' legal fears of piracy. Though this potentially may have the effect of reducing the rate of increase of piracy, this policy's impact on music sales is indeterminate. As music sales depend more directly, according to this model, on how buying music compares to other alternatives for consumer spending, music labels may better spend their resources pursuing improving that comparison. By focusing on increasing the value of their product for consumers, music labels can increase revenue. For example, by including special promotional items in music packaging, that could raise interest in those products. Also, by ensuring that a purchased piece of music is able to be played in the various ways that consumers desire it to be, including at home, on mp3 players, and as ring tones, the value of music might offset more consumer dollars.

5.0 Conclusion

This report outlines our investigation of the problem of music piracy and declining revenues within the music industry from several perspectives. It discusses three claims made by labels, independent artists, and academics and internet activists respectively, and attempts to determine their feasibility and implications.

5.1 Claim 1

By modelling the simple relationship between consumers and pirates as professed by labels, we see that, unless piracy is stopped, the music industry will collapse. However, mass online music piracy has existed for almost a decade, and this prediction has not come to pass. Furthermore, there exist presently a number of new business models within the music industry, many integrating music with social networking, that are thriving. This suggests that the mental model on which this model based is flawed. In turn, this implies that the business decisions made by music labels also rest on uncertain ground.

Our model does not conclusively prove that this understanding is flawed; however, it does make it clear that this mental model is extremely simplistic, with simplistic implications. This emphasizes that the situation is far more complex than the statements of various labels and industry groups would indicate they understand.

5.2 Claim 2

Using our model, we have been able to demonstrate that, when treated as free marketing, piracy can actually enhance the revenues of artists by increasing their popularity and thus increasing their revenues from the performance of music. This reveals that piracy is chiefly a problem for labels – if claim two is indeed correct, it is in the artist's interests to encourage the distribution of their music by whatever means possible, including piracy.

One interesting implication of this is that piracy can act to level the playing field for small bands and independent artists. No longer is massive marketing provided by a label required to promote an act and compete for listener's ears; artists with access to the internet are able to market themselves. This will most probably be good for consumers, too, as it will result in increased music diversity, increased availability of music, and more fair competition amongst artists leading presumably to music of higher quality.

5.3 Claim 3

Our model of the third claim, being non-functional, is unable to give us firm conclusions. Nonetheless, it suggests that declining revenues in the music industry are at least partly due to factors other than piracy. In particular, music now competes with other entertainment media such as video games and DVDs for the consumer's dollar. Piracy may have an impact on sales, but it is not the only factor, and most likely not the most important.

Given this observation, the current strategies employed by labels of aggressively prosecuting consumers and asserting intellectual property rights may not be the best use of resources, and may in fact be causing more harm than good by alienating the consumer base. Our model implies that instead, labels should instead re-examine the quality and value that they offer to consumers, in order to compete more effectively with other forms of entertainment, Additionally, labels should continue to leverage synergies that exist between their products and those of other entertainment providers, and should aggressively explore new distribution mechanisms and internet driven business models.

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