Business Dynamics of a Record Company As Influenced By Online Channels

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In this study, we investigate the business dynamics of a hypothetical record company. The recent declining trend in musical industry in many countries has brought up the issue of free sharing of musical content. A system dynamic approach was taken to imitate a setting where there are both legal and illegal ways of obtaining an album. Special attention was paid to the self-marketing effect of the musical content present in the market. The life cycle of a particular album that has a high potential of being popular is simulated. Despite the outstanding self-marketing effect of the shared content, the record company's profits decrease following the decline in sales due to diversion of people to illegal ways of obtaining the album. Scenario analyses showed that the company's benefit from free sharing depends on how the increasing illegal content affects the market. If the diverting effect of illegal content is low, the demand generated is realized as legal sales to a satisfactory extent and thus the company actually profits.

Keywords: System dynamics, Music industry, Free sharing

1. INTRODUCTION

In the past, before the widespread of personal computers and personal use of internet, the lifecycle of any album (in CD format) was similar to that of any entertainment product (such as a book, a video cassette, etc.). It was launched to the market, promoted by advertisement and practically could only be purchased in retail stores.

In the last decade, with the rapid improvement in network infrastructures around the globe, many businesses were affected in many ways; new businesses emerged or some became obsolete. Music industry is one of the sectors which have sustained substantial damage in correlation with growing interest in file sharing. Before 1999, the music industry grew by 10 percent each year on average in the U.S since 1992 (Rob and Waldfogel 2004; Tomikawa 2003). However, a decline in sales is observed since 1999 (Liebowitz 2004). Some studies in U.S. claim that this decline in album sales is not merely correlated with the increase in file sharing but also there exists a causal relation (Clark 2000; Liebowitz 2005a). There have been numerous studies showing different facets of file sharing. Gopal et al. (2006) approach the issue from the perspective of welfare. On the other hand, Liebowitz (2004) considers the situation as it affects only copyright owners.

Proponents of file sharing claim that free sharing has enabled the spread of any musical content to a larger group of people due to artists becoming known (Gopal et al. 2006). Blackburn (2004) argues that the effect of file sharing has two sides. First one is the

substitution effect on sales as people download instead of purchasing. The second one is the "penetration effect" which helps the artist become more known. Hence, Blackburn asserts that file sharing is beneficial for new artists but harmful to previously known artists. Another study by Liebowitz (2005b) supports Blackburn's assertion by stating that network effects can positively affect the sales under certain circumstances.

Rather than addressing the problem from a macro perspective, this study proposes a system dynamics model which investigates the dynamics of an album from the viewpoint of a record company. The model captures both sides of online file sharing. Hence, it enables simulation experiments under different climates.

2. PROBLEM DEFINITION

In this study, we investigate the profitability of a hypothetical album project. We assume that the album has a high demand initially. That is, the album will become popular. We assume certain market conditions and simulate the life cycle of the album. Note that the dynamics of an unsuccessful album is not interesting since the company will surely lose money. The album is launched both in CD format and also in digital format which can be purchased over the internet. We assume that purchasing single songs is not possible.

2.1. Perspective

The model is built from the perspective of a hypothetical record company which invests in the production and marketing of the album. The company earns from CD sales in retail stores and also from online sales. The model focuses on the economic decision making process of the company throughout the life cycle of the album. In particular, we focus on the cash balance of the company. The objective is to analyze the advantages and disadvantages of illegal content sharing and how the record company should act in these circumstances.

2.2. Time Horizon

The time unit of the model is selected to be months since the major time delays and the rates of changes are measured in terms of months. The time horizon is two years assuming that an album loses popularity after this much time.

2.3. Model Boundary

The model focuses on the factors that influence the demand for the album. It does not include dynamics of price regulation. All prices and costs are exogenous constant variables. The model includes self marketing effects of both legal and illegal content. It also includes advertisement efforts of the company. There are three ways to obtain the album: Buying the CD from a retail store, purchasing it over the internet (e.g. from itunes.com), or downloading it using P2P software.

2.4. Dynamic Hypothesis

The demand for a popular album increases continuously since it promotes itself. However, as it is shared illegally, this way of obtaining it becomes more appealing and thus steals from legal sales. However, the shared content has a higher self-advertising effect than that of the legal content since the downloader may also decide to purchase the album. As a result, the self-marketing effect, where the illegal content contributes more, would increase the demand for the album. A portion of this demand would be realized as legal sales rather than illegal downloads. Nevertheless, we argue that free sharing reduces the company's revenue.

3. OVERVIEW OF THE MODEL

3.1. Causal Loop Diagram

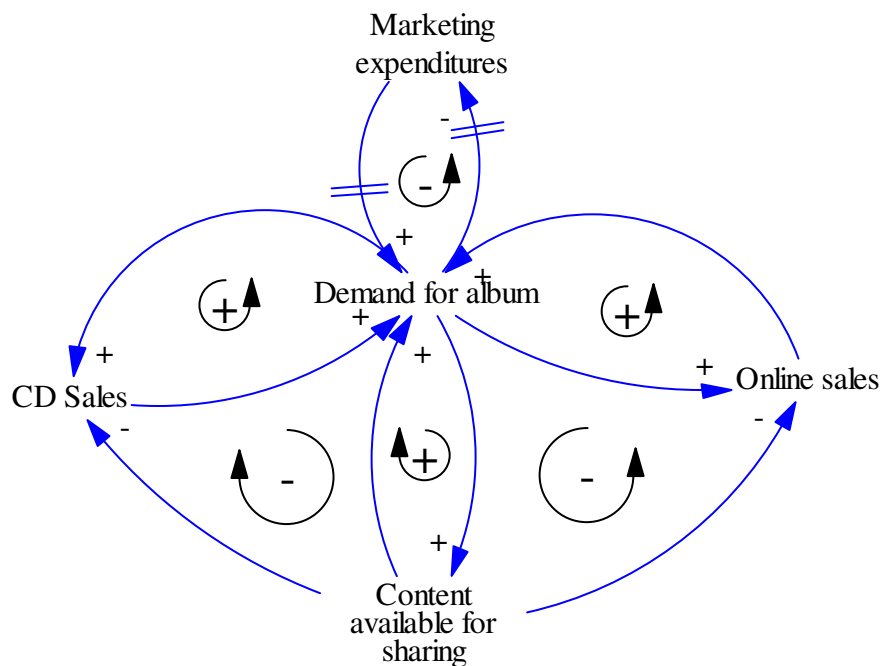The causal-loop diagram is shown in the below figure.

Figure 3.1. Causal Loop Diagram of the model

There are three main positive feedback loops. These are the self-marketing of the album in all three possible ways. Besides these, there is the suppressing effect of illegally shared content on legal activities (i.e. CD sales and online sales). The more illegal content available, the less the people will be willing to pay for legal content since obtaining the album freely will be more appealing.

Marketing expenditure is a decision of the company by which it can affect the demand. The company employs a strategy of increasing its marketing expenditures when demand is lower than a desired level and decreasing it when it approaches this goal.

The time horizon is chosen as two years considering the typical life time of an album on the market.

3.2. Stocks

There are six stocks in the model. The three major stocks are *Number of CDs Sold*, *Number of albums Sold Online* and *Number of contents available for sharing*. They are non-decreasing throughout the album's life cycle. *Number of CDs sold* and *Number of albums sold online* have direct relevance to the company's cash balance. The other stock, *Number of contents available for sharing*, affect legal sales and thus affect the company's cash position indirectly. The stock *Marketing budget*, on the other hand, has only an outflow. It starts from an initial value and decreases as the company incurs marketing costs. The remaining two stocks *Realized marketing* and *Traditional demand* are merely smoothed versions of some key variables in the model. The stock-flow diagram of the model is given in Figure 3.2.

Figure 3.2. Stock-flow diagram of the model

Number of CDs sold: It stands for the total number of CDs sold legally (e.g. in retail stores) since the album is launched. It simply accumulates monthly CD sales.

Number of albums sold online: It stands for the total number of albums sold online. We assume that no single songs are sold. It accumulates monthly sales over the internet.

Number of Contents Available for Sharing: It is the total number of P2P users who have the artist's album on their hard drives. These users are assumed to have either ripped the album to their hard drives or downloaded it from other users. The album on the hard drive is available for share with other users. Once again, we assume that the album can only be downloaded as a whole. It only has inflows "ripping rate" and "P2P downloads" which stand for the number of albums ripped and number of albums downloaded by new users in a month, respectively.

Note: These four stocks are in units of "albums". They have only inflows so they don't decrease during the simulation. Their initial values are 0.

Marketing Budget: It stands for the total available marketing budget that the company has allocated. This is one of the economic decisions of the company (i.e. It is a policy variable). It is depleted by marketing expenditures. It has units of YTL.

Realized Marketing: This stock represents the delay between the time at which the marketing expenditure is physically incurred and the time at which this expenditure actually affects the demand. It is a generic first order smoothing process.

Traditional Demand: This stock is a generic first order smoothing of actual legal demand for the album. It represents the delay in the company's retrieval of demand information. In other words, it is the perceived demand. It has units of albums/month.

3.3. Other key variables

Demand for the album: It is the monthly number of albums that are demanded. We assume that a person demanding the album will surely obtain the album. We assume 100 people demanding the album initially.

Legal fract of demand: It is the fraction of the demand that is committed to obtain the album legally (i.e. by either buying the CD or purchasing over the internet). Initially we assume that all demand is legal and thus this variable is set to 1. We further assume that initially, the legal demand is equally divided between those who would like to buy the CD and those who would prefer online purchase.

To clarify further the use of these variables, please refer to Appendix A for model equations.

4. MODEL DESCRIPTION

In this section, we will try to clarify the key portions of the constructed model.

4.1 Demand

Demand for the album is a central variable in the model in that it directly influences major stocks. It is affected by three factors: Marketing expenditures of the company, the self marketing effect of the total number of legal copies of the album, and the self marketing effect of the number of contents available for sharing. Equation 4.1. gives the demand for the album as a function of these three factors.

Demand for the album = Initial demand + Marketing effect of illegal content
+ Marketing effect of legal_content
+ Effect of marketing on demand (4.1)

The major dynamics generated by the model originate from this variable. In the following subsections, we will explain the terms in the equation, together with how *Demand for the album* is used by the model.

4.2. Marketing expenditure

As mentioned previously, the company gives the decision on marketing expenditures according to a demand goal. If the demand estimated is below this goal, a certain expenditure is incurred and as the goal is approached, expenditure is cut. Note that the company can only estimate the legal portion of the demand since it is impossible to know the rate at which content is being shared via P2P in a given instance. Besides, this information is not of value to the company since file sharing does not contribute to its revenue. We use a generic floating goal structure to model the demand goal as a variable that is a weighted average of the traditional demand and an externally stated demand. We assume that the company wants to achieve the goal of twice the initial demand.

We use the graphical function given in Figure 4.1 for *Effect of demand goal on marketing exp* to capture the policy of the company to increase the marketing expenditures when the traditional (estimated) demand is below the demand goal and cutting the expenditures as the goal is approached. This effect formulation can also be interpreted as the company's marketing response to the difference between the demand and its goal.
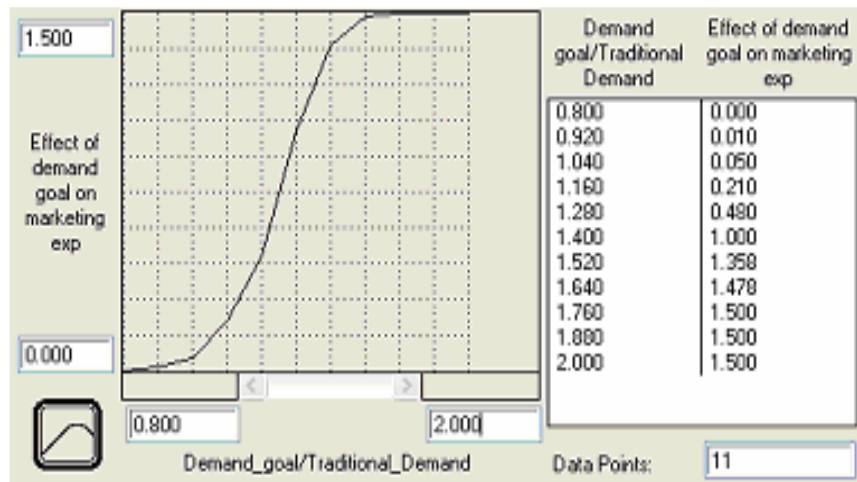
Figure 4.1. Effect of demand goal on marketing expenditures as a function of demand goal/traditional demand.

In formulating *Effect of marketing on demand* seen in equation 4.1, we again use a graphical function. It is given in Figure 4.2.
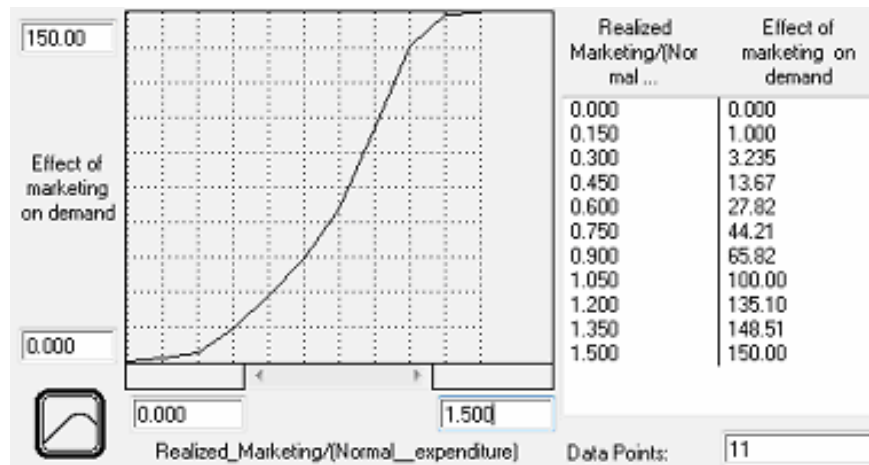

Figure 4.2. Effect of marketing on demand as a function of *Realized Marketing/Normal Expenditure*.

If nothing is spent, there will be no effect. We assume that a normal monthly expenditure will result in 100 more people demanding the album. On the other hand, an aggressive marketing expenditure (50% more than normal) is assumed to increase the monthly demand by 150 people.

4.3. Self-marketing effects of legal and illegal content

The following causality underlies the self marketing effects: The more albums sold, the more will be the demand for the album due to its increasing popularity. We again use graphical functions for these effect formulations. They are given in Figures 4.3. and 4.4.
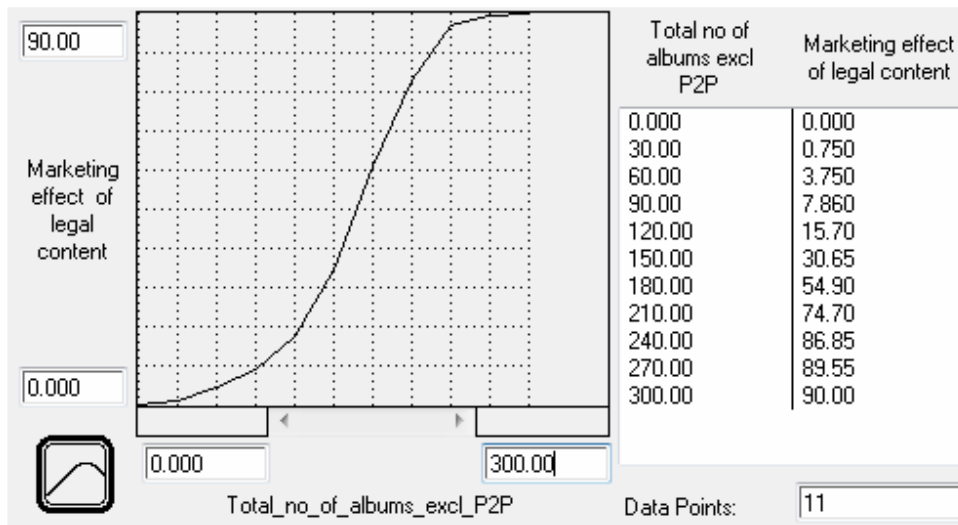
90.00	
Marketing effect of legal content	
0.000	
0.000	300.00

Total no of albums excl P2P	Marketing effect of legal content
0.000	0.000
30.00	0.750
60.00	3.750
90.00	7.860
120.00	15.70
150.00	30.65
180.00	54.90
210.00	74.70
240.00	86.85
270.00	89.55
300.00	90.00

Total_no_of_albums_excl_P2P   Data Points: 11

Figure 4.3. Marketing effect of legal content as a graphical function.

This is the self-marketing effect of the legal content in the market. It promotes a general demand. That is, a person may like the artist's music by listening to a legal CD or legally purchased mp3s owned by someone else and decide to obtain the album. Whether he/she obtains it legally or illegally depends on the circumstances. Note that at best, the effect only increases the monthly demand by 90. On the other hand, marketing effect of illegal content is assumed stronger considering that other than exposing other people (e.g. friends, family, etc.) to the downloaded music and urging them to buy the album, the downloader may also decide to buy as well. The effect is formulated as in Figure 4.4.

200.00	
Marketing effect of illegal content	
0.000	
0.000	5000.00

Number of Contents Available For...	Marketing effect of illegal content
0.000	0.000
500.00	1.000
1000.00	7.000
1500.00	17.83
2000.00	35.00
2500.00	65.00
3000.00	120.00
3500.00	170.00
4000.00	192.00
4500.00	198.00
5000.00	200.00

Number_of_Contents_Available_For_Sharing   Data Points: 11
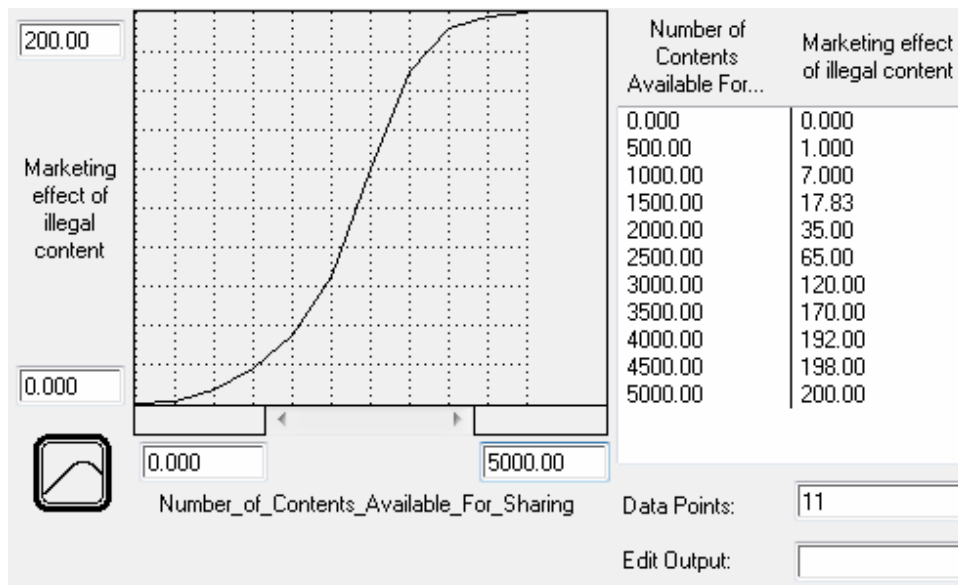
Edit Output:

Figure 4.4. Marketing effect of illegal content as a graphical function.

Observe that at best, the shared content can increase the monthly demand by 200.

4.4. Legal and illegal fractions of demand

Demand is divided into two parts: legal demand and illegal demand. This is formulated by defining fractions.

Legal activities are further divided into two parts, namely, the CD sales fraction and online sales fraction. For convenience, call these fractions subfractions. The subfractions add up to one. Legal fraction is given in equation 4.2.

$$legal\_fract = (legal\_fract)*(CD\_subfraction) + (legal\_fract)*(online\_subfract)$$

$$(4.2)$$

and

$$online\_subfract = 1 - CD\_subfract. \qquad (4.3)$$

We denote the products $(legal\_fract)*(CD\_subfract)$ and $(legal\_fract)*(online\_subfract)$ as *fract_CD_sales* and *fract_online*, respectively. Both of them are set to 0.5 initially. This means that legal buyers are divided equally among those who buy the CD and those who make an online purchase.

Illegal fraction and legal fraction also add up to one.

$$legal\_fract + illegal\_fract = 1$$

The fractions are used to calculate the amount of purchases and also the number of downloads. These are the inflows to the related stocks. Their sum is equal to total demand. The general formulation used for the inflows "CD sales", "Online album sales", and "P2P downloads" is given in equation 4.4.

$$in\_flow = fraction*demand \qquad (4.4)$$

The second inflow of "Number of Contents Available For Sharing" is "Ripping rate" and is formulated in a different way. It is the multiplication of a constant fraction with the total number of legal content. We assume that in a given month, a certain fraction of the purchased albums is ripped and becomes available for share.

4.5. Diversion from legal purchases to illegal sharing

Legal fraction of demand is initially at its normal value of 1. Since at first, no illegal content is available, all of the demand is met by legal purchases. The legal fraction of demand is affected by the number of illegal content in the market. That is, the more illegal content present in the market, the more it will be appealing for new people to download the album rather than buying it. This effect is formulated using the graphical function given in Figure 4.5.
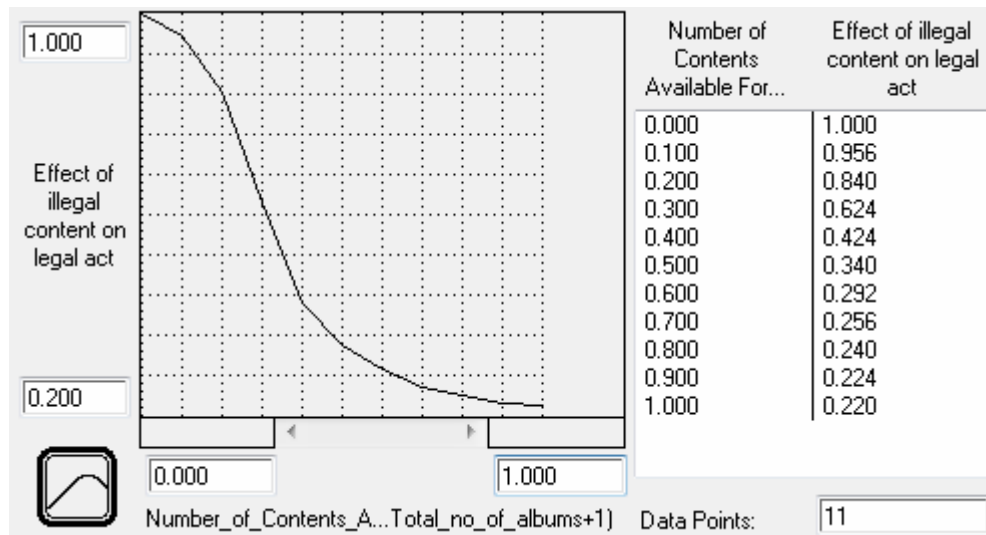
Figure 4.5. Diverting effect of illegal content on legal buyers as a function of
Number_of_Contents_Available_For_Sharing/Total_no_of_albums.

One can see that as the number of illegal copies of the album dominates the number of legal copies in the market, legal fraction of demand will drop significantly. Equation 4.5 gives this direct relationship between this effect and the legal fraction of demand.

$$legal\_fract\_of\_demand = 1 * Effect\_of\_illegal\_content\_on\_legal\_act \qquad (4.5)$$

At first, the illegal fraction of demand is zero. It could become positive only when legal fraction of demand falls below one. This could only happen when the diverting effect kicks in (i.e. effect of illegal content on legal activities becomes less than one). This starts with ripping of legal copies.

4.6. Effect of CD availability in retail stores on CD sales

As the album stocks in retail stores start to deplete, people will not be able to find the album and since they are committed to buying the album, they will purchase it over the internet. Also if no CD is produced, we expect no CD sales. To model these, we formulated CD subfraction as in equation 4.6.

$$CD\_subfraction = IF(No\_of\_CDs\_produced=0)THEN(0)ELSE(0.5*Availability\_effect)$$
$$(4.6)$$

Availability effect is formulated as a graphical function as given in figure 4.6.

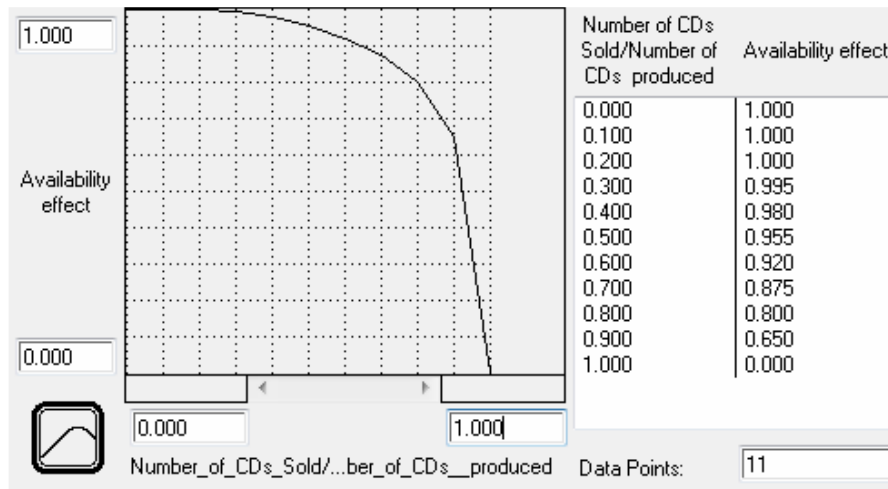| Number of CDs Sold/Number of CDs produced	Availability effect
0.000	1.000
0.100	1.000
0.200	1.000
0.300	0.995
0.400	0.980
0.500	0.955
0.600	0.920
0.700	0.875
0.800	0.800
0.900	0.650
1.000	0.000

Figure 4.6. Availability effect of CDs in stores as a graphical function.

As the number of CDs sold approaches the initial amount of produced CDs, this effect kicks in and as a result, legal buyers are diverted to purchase the album over the internet.

4.7. Effect of file availability on download rates

This effect is similar to the previous effect. We assumed that if the number of content available for sharing is low, the download speeds are low since the files are not available for share. Hence, the P2P downloads are negatively affected by it.

No of contents available for sharing/(50)	Effect of contents on downloads
0.000	0.000
0.100	0.260
0.200	0.430
0.300	0.625
0.400	0.770
0.500	0.875
0.600	0.940
0.700	0.970
0.800	1.000
0.900	1.000
1.000	1.000
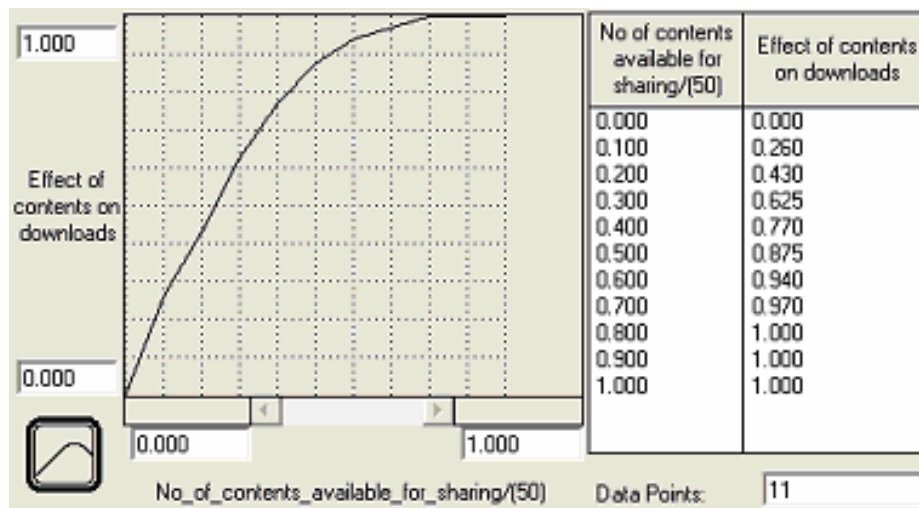
Figure 4.7. Effect of file availability on download rates as a graphical function

When there is no content available for sharing, practically no sharing can occur. As in the availability in the retail stores, the more the number of contents available, the faster the people access to the contents and they are shared faster. We assumed that after 50 files

are available for sharing, the download rate cannot get any faster. Hence, it reaches its maximum value.

4.8. Company's Cash Balance

We are assuming an initial fixed cost of CD production including duplication and distribution costs. This is calculated by multiplying a unit cost with the number of CDs produced. There is also a recording cost. We also assume that the company allocates 5000 YTL for marketing expenditures. However, it may choose to spend only a fraction of this amount or even, not to spend anything. The company initially starts at a negative balance which increases with revenues from CD sales and online album sales. Company's cash balance is given in equation 4.7. In this case, the company had decided to spend 2500 YTL on marketing which means the Marketing Budget has an initial value of 2500YTL.

balance = Revenue_from_CD_sales+Revenue_from__online_sales+Marketing_budget-(Recording_cost+inital_cost_of_CD_production)+2500

(4.7)

5. MODEL VERIFICATION AND VALIDATION

We applied two indirect structure tests to assess the validity of the model. These are extreme condition test and behavior sensitivity test. We also conducted a statistical significance test to assess the value of further estimation efforts on some variables that involve uncertainty.

5.1. Extreme Condition Tests

As an extreme case, assume that there are no P2P downloads and no ripping. We expect all demand to be met by legal sales. It turns out, after a simulation run under these circumstances, that legal sales equal demand for the album at all times.

In another extreme condition, initial legal demand is met by CD sales only. Legal buyers would continue to purchase CDs until retail stocks deplete and then, they would start to purchase the album online. As expected, all production volume is sold out by the end of the time horizon. Since CD price is higher than the online price, the company obtains higher cash balance than in the base case.

One final extreme condition test is when no online album sale is ever possible. That is, the company only gains money from CDs sold. As expected, this caused some loss in legal demand and thus some loss in revenues.

These tests helped strengthen our confidence in the structure of the model. Nevertheless, in the next subsection, we explain an analysis we carried out in order to investigate further the validity of the model.

5.2. Behavior Sensitivity Test

In this part, the parameters which were subjectively assessed are tested to determine how much the model is sensitive to them. Thus, we investigate the added value of more accurate estimations of these parameters. The parameters to be tested are *marketing effect of legal content*, *marketing effect of illegal content*, *effect of illegal content on legal act*, and *effect of marketing on demand*. These are formulated as graphical functions. In sensitivity runs, we alter the graphical functions so that strengths of effects change. We try to change the attained extreme values of the graphical functions. In Table 5.1, the final values, as attained by the graphical functions in the sensitivity runs, are given.

Table 5.1. Levels of the final values of the parameters for the sensitivity runs.

FACTOR	Low	High
Marketing effect of legal content	50	90
Marketing effect of illegal content	100	200
Effect of illegal content on legal act	0.22	0.62
Effect of marketing on demand	110	150

For example, recall the marketing effect of legal content given in Figure 4.3. We modify it so that the maximum it could attain becomes 50. The modified function is given in Figure 5.1.
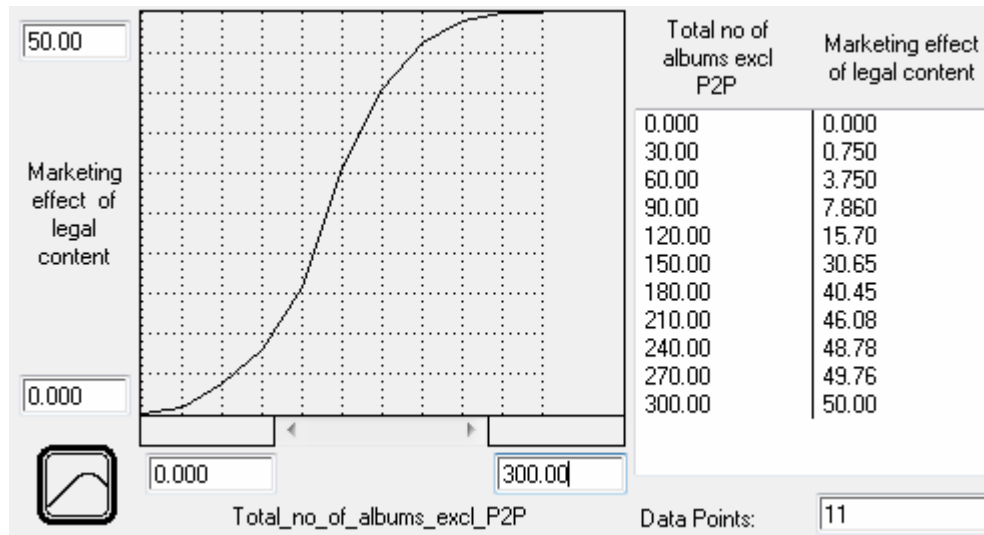

Figure 5.1. The modified *Marketing effect of legal content* to be used in the sensitivity analysis.

As the output variable, we focus on *legal demand* since this has relevance to the company's profits. We focus on the change in behavior pattern rather than a point by point comparison. In Figure 5.2 we give the sensitivity result for *Marketing effect of legal content*. The extreme value of the factor attains the values given in the first row of Table 5.1.
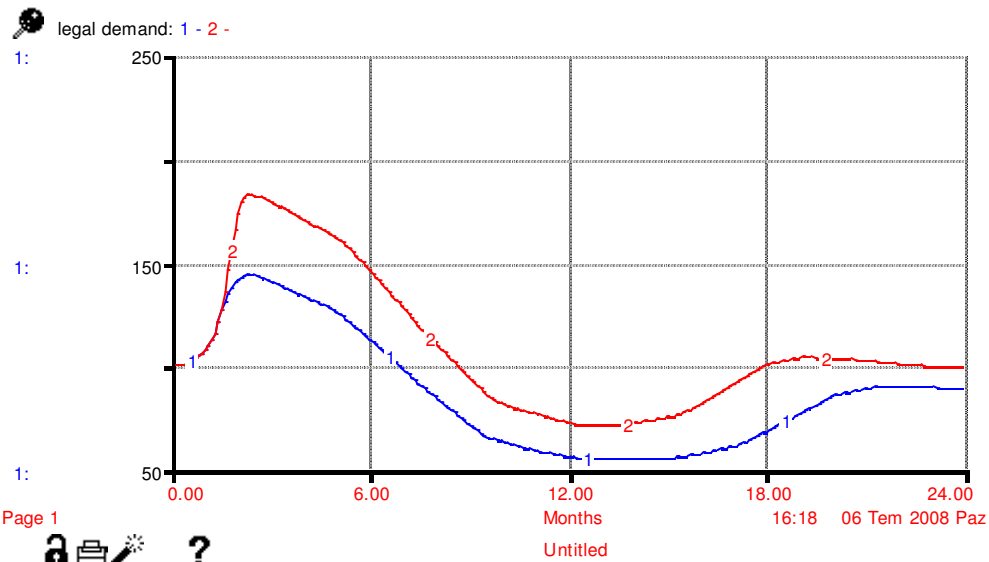
Figure 5.2. Behavioral sensitivity of *legal demand* w.r.t *Marketing effect of legal content*. 1: Low; 2: High

As the maximum value for *Marketing effect of legal content* drops from 90 to 50, *legal demand* shifts downwards without a change in behavior pattern.

In Figure 5.3 we give the sensitivity result for marketing effect of illegal content. The extreme value of the factor attains the values given in the second row of Table 5.1.
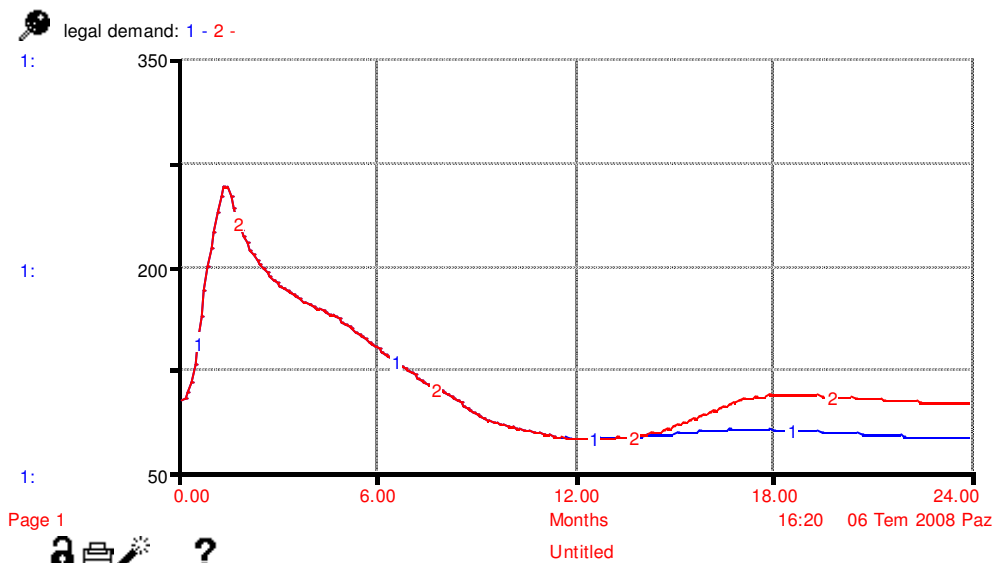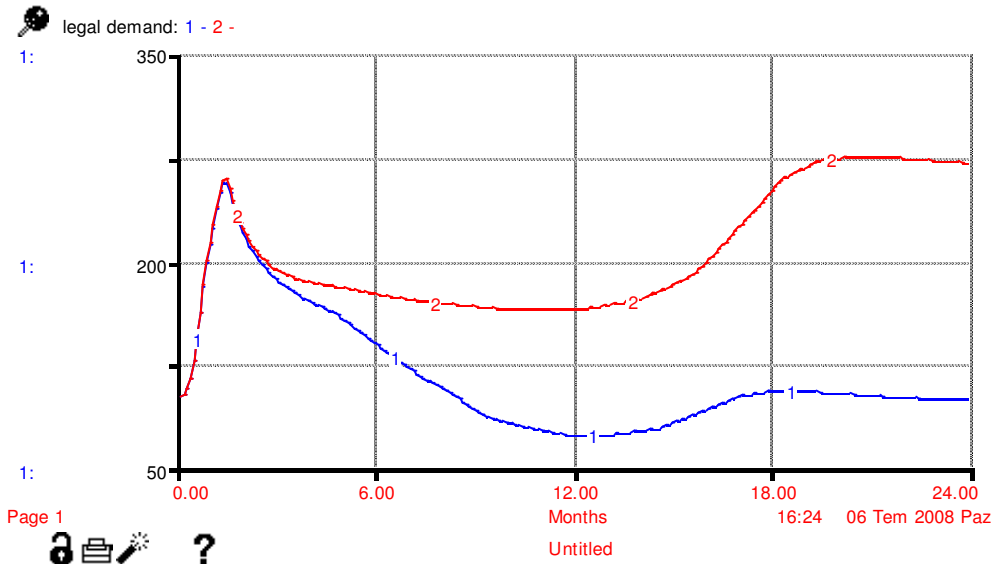

Figure 5.3. Behavioral sensitivity of *legal demand* w.r.t *Marketing effect of illegal content*. 1: Low; 2: High

Comparing the two curves in Figure 5.3, we see that the decrease in the maximum value of *Marketing effect of illegal content* affects the system after approximately 15 months as the number of illegal content begins to dominate the market. When the marketing effect is more, we observe a slight increase in legal demand after the 15th month. In comparison, when the effect is low, demand stays constant.

In Figure 5.4 we give the sensitivity result for *Effect of illegal content on legal act*. The extreme value of the factor attains the values given in the third row of Table 5.1.

Figure 5.4. Behavioral sensitivity of *legal demand* w.r.t *Effect of illegal content on legal act*. 1: Low; 2: High

When the minimum value of *Effect of illegal content on legal act* is decreased, we observe a decrease in *legal demand* since the appeal of free sharing is more. Although the two curves start to diverge around the third month, the patterns of behavior are similar, except that the decline in legal sales is more evident when the diverting effect is higher (i.e. free sharing is more appealing). In Figure 5.5, we give the sensitivity result for *Effect of marketing on demand*. The extreme value of the factor attains the values given in the fourth row of Table 5.1.
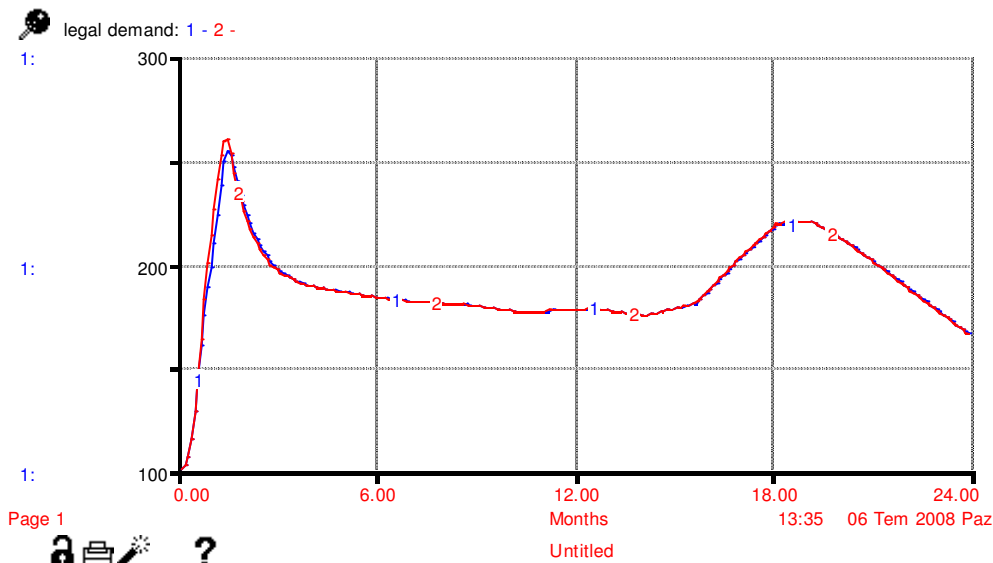
Figure 5.5. Behavioral sensitivity of *legal demand* w.r.t *Effect of marketing on demand*. 1: Low; 2: High

As can be seen, no significant change in behavior is observed due to a change in *Effect of marketing on demand*.

5.3 Statistical Significance Test

To help our investigation of the impact of uncertainty in the factors in Table 5.1, we also conducted a statistical significance test. Since the major output variable of the model is the company's cash balance, we used this as our response variable. We chose 3 levels for each factor. Low and high levels are as given in Table 5.1 and the third level is the center value. We chose an experimental design known as the Box-Behnken design which is a three level design that contains fewer runs than a full 3 level factorial design. The ANOVA results showed that all of the effects are significant except *Effect of marketing on demand* which means that precise estimation of this effect is not necessary. However, it would require an extensive survey to obtain more realistic estimates of the significant parameters, namely the marketing effects of legal and illegal content, and the diverting effect of illegal content. Such a research would contribute to the quality of our study. Finally, this analysis shows that, as expected, the company is best off when all parameters are at their high levels.

6. ANALYSIS OF THE MODEL

In this section, we give simulation results. We begin with a base model in which the parameters and functional relationships are as presented in the preceding sections and also given in Appendix. The following table gives the initial values of the stocks and some other key variables in the model.

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Table 6.1. Initial values of the stocks and some key parameters

Stock	Initial value
Marketing budget	2500
Number of CDs sold	0
Number of albums sold online	0
Number of contents available for sharing	0
Other variables	**Value**
Initial demand	100
Stated demand	200
Number of CDs produced	1200

The number of CDs produced is chosen considering the initial monthly demand of 100 and multiplying it with the time horizon of 24 months, then halving it since initially legal buyers are divided equally as CD buyers and online buyers. In Figure 6.1 we give the simulation results for *CD sales*, *Online sales* and *P2P downloads*. Recall that these are the inflows to the three major stocks and their sum gives *Demand for the album*. We also give results for *Demand for the album* and *legal demand* in Figure 6.2.
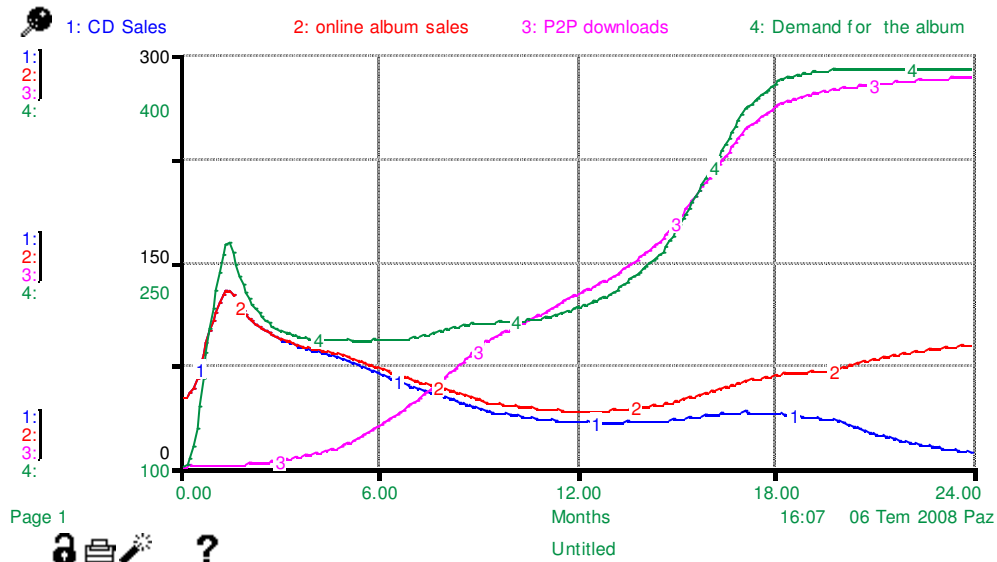

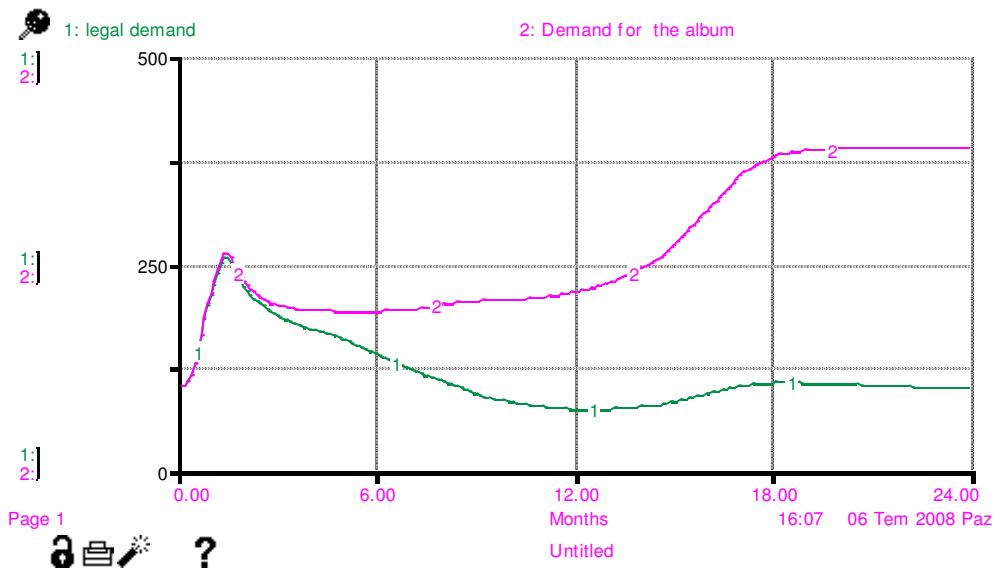Figure 6.1. Results for the major flows in the base run. Scaling for *Demand for the album* is different.

Figure 6.2. Total demand and its legal portion

In Figure 6.3 we give the results for *Marketing effect of legal content*, *Marketing effect of illegal content*, *Effect of illegal content on legal act*, and *Effect of marketing on demand* since these effects govern the behavior of the flows.
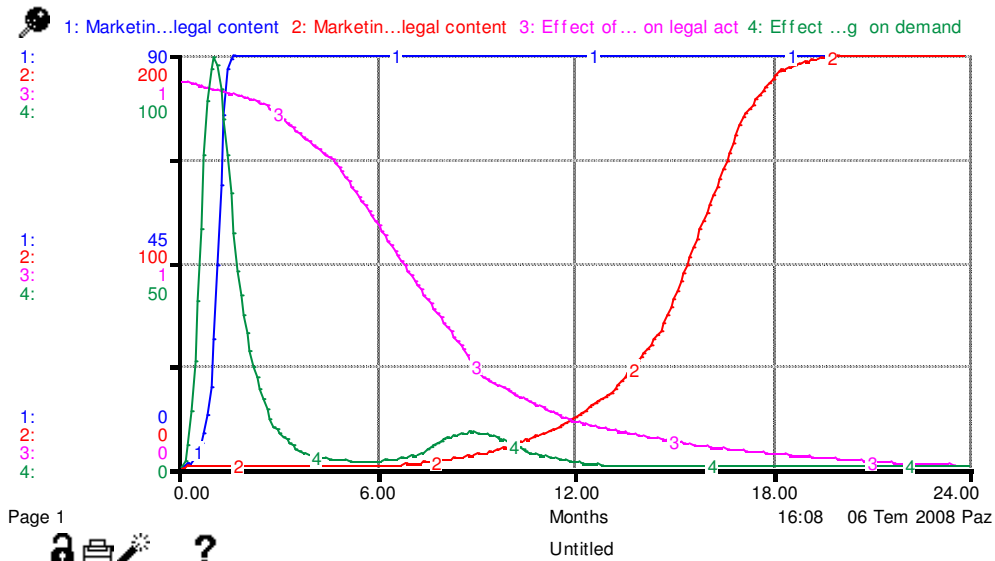

Figure 6.3. Behavior of major effects in the base run.

Observing Figure 6.1, we see that initially demand is fully met by legal products. With the effect of marketing, the demand raises from its initial value sharply. Since there is no illegal activity at the beginning, legal sales (CD sales, online album sales) increase with demand. When the demand goal is exceeded, the company cuts its marketing expenditures and thus the demand falls. The dynamics of the company's marketing budget can be seen in Figure 6.4 together with the cash balance. Around the sixth month, the demand declines

below the goal urging the company to re-incur marketing expenditures as can be seen from this figure.
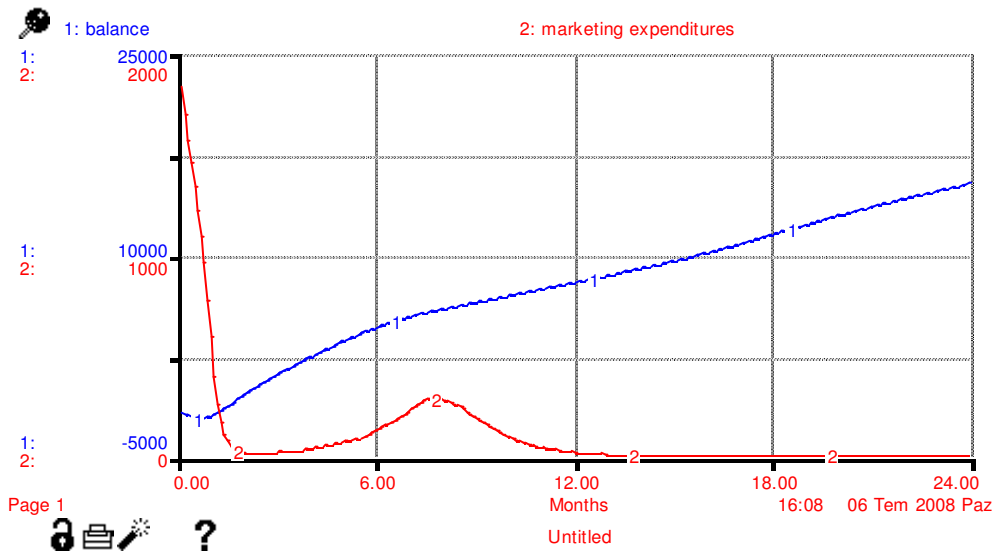

Figure 6.4. Cash balance and marketing budget in the base run

Figure 6.1 also shows that as shared content starts to increase around the third month, the self-marketing effect increases the demand especially after the 12th month. However, this increase is not accompanied by an increase in sales because more people download the album instead of purchasing it since this way of obtaining the album becomes more appealing. We verify from Figure 6.2 the divergence of legal demand from total demand due to *Effect of illegal content on legal act* shown by pink color in Figure 6.3.

Finally in Figure 6.1, we see that as the retail stores deplete CD stocks around the 18th month, online sales increase to meet legal demand. When the market saturates, the constant (yet slight) decrease in legal sales prevails. This can be seen by observing Figure 6.2 downstream (after the 18th month).

The company's cash position at the end of the time horizon is 15,350 YTL.

7. SCENARIO ANALYSIS

7.1. Ineffective Marketing

In this scenario, self-marketing effect is not as effective as in the base case. At most, the self-marketing effect of legal content is assumed to be 50 (it was 90 in the base case), self marketing effect of illegal content is assumed to be 100 (it was 200 in the base case), and effect of marketing on demand is 110 (it was 150 in the base case). A simulation run under these assumptions yields a cash balance of 11,150 YTL at the end of two years. This is approximately 15 % less than the balance in the base case.

7.2. No Internet Connection

One of the main questions of interest to the dynamics of music industry is: What if there was no file sharing? This means that all demand is met by legal activities. This also means that, on the other hand, sales will not benefit from the self marketing effect of illegal content. A simulation run without file sharing yields the following dynamics for the key variables.
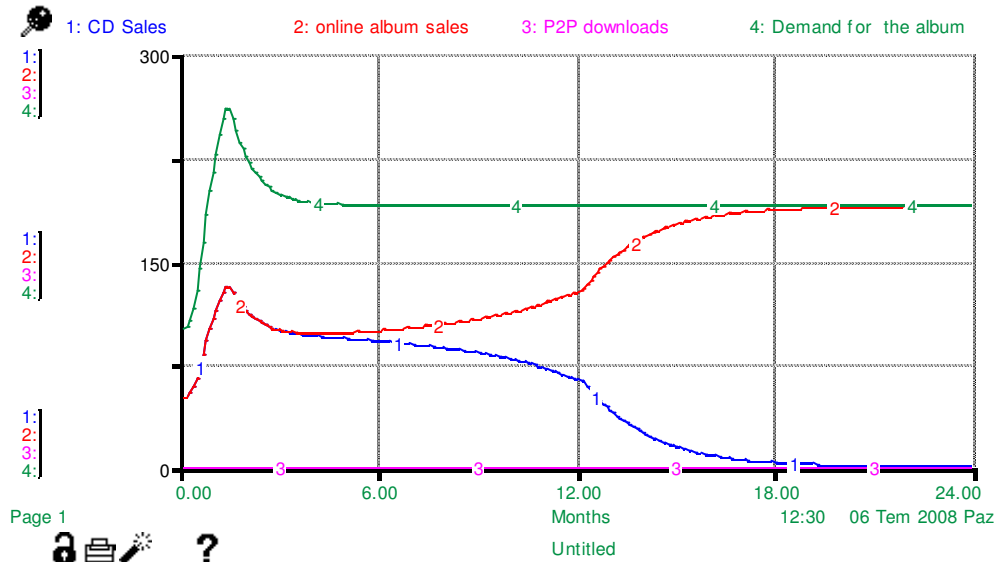

Figure 6.5. Results for the major flows when no file sharing is possible.

Observe that CD sales and online sales sum up to total demand at all times. The company ends up with a cash balance of 25,300 YTL under this scenario. This is significantly higher than the balance in the base case (i.e. 15,350 YTL). Hence, under these circumstances, the company would be better off if there were no P2P sharing.

7.3. Low Diverting Effect

In the previous scenario, the company could not benefit from the profound marketing effect of shared content. In this scenario, we assume that the appeal of free sharing is less due to the music industry's efforts to suppress file sharing (e.g. with the help of campaigns, lawsuits, etc.). We assume that the lowest value attainable by *Effect of illegal content on legal act* is 0.62 (This value was 0.22 in the base case). All remaining parameters are assumed to be at their base values. We get the following results.
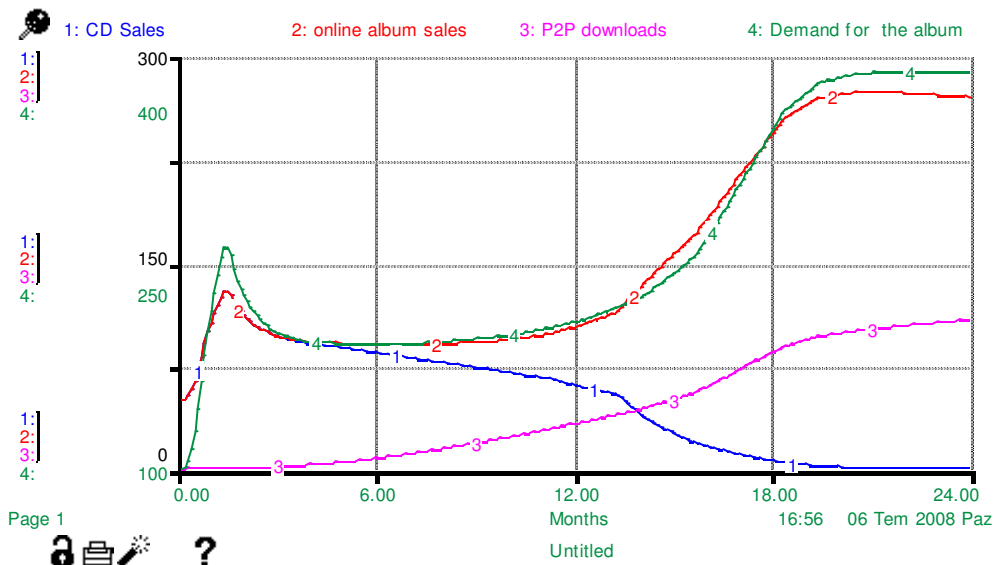
Figure 6.6. Results for the major flows when file sharing is less appealing.

Observe that while legal sales volume is increased (especially online sales), there is less downloading. However, total demand is still high. In Figure 6.7, we see that a big portion of total demand is legal.
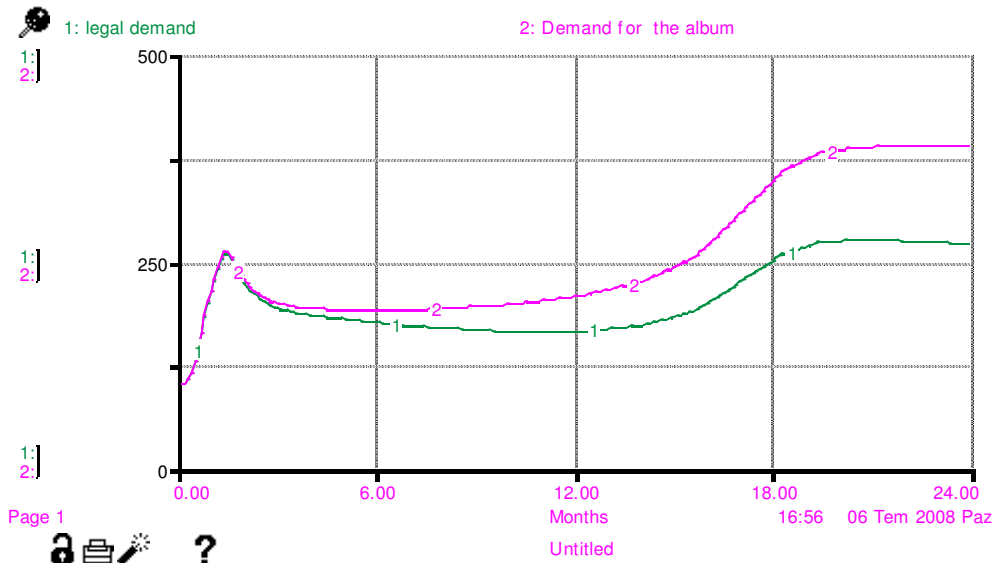

Figure 6.7. Legal demand when file sharing is less appealing.

The company ends up with a cash balance of 26,800 YTL under this scenario which is approximately 5 % more than no file sharing scenario. We conclude that the company may actually benefit (although not very much) from illegal sharing under certain circumstances. This scenario reveals the complexity and the counter-intuitive nature of the market which the record company faces.

8. POLICY ANALYSIS

A small company in the music industry has control over the number of CDs produced, marketing budget and how to spend the marketing budget. In our policy analysis runs, the effect formulations are in their base forms which are given in preceding sections and also in the Appendix.

In our base analysis of the model, the number of CDs produced was 1200 and 1162 of them were sold by the end of 24 months. That is, the company ended up with leftovers. This is a sunk cost. Deciding on the number of CDs to produce is merely a question of balance between leftovers and lost customers. It turns out that 1150 is a near optimum. Extreme case of no CD production is not profitable under the given circumstances since any CD sold is more profitable than an online album sale. Hence, in any case, the company is better off producing a nonzero number of CDs. Note that this apparent optimum of 1150 CDs is only true under the base circumstances.

Marketing budget is another tool that the company could use to change its final cash balance. Under the base spending policy and circumstances, it turns out that the company has the highest final cash position if it does not do any marketing at all and keep the money. However, if the company were obliged to do marketing, then one better policy is to keep the demand goal high or to be responsive to a difference between the demand goal and current demand. Then the company is able to generate sales early when majority of the demand is met by legal ways because file sharing is not as fast and common. It turns out that even with this policy, the company is still better off keeping the marketing budget. Note that these are true only under the given circumstances and are bound to change if effect formulations are changed. A sensible prediction would be that marketing would become important if *Normal marketing expenditure* decreases, or in other words, the impact of marketing on demand increases.

9. CONCLUSIONS

In our model, we tried to represent the life cycle of an album which was assumed to have a good potential to be successful. Illegal activities and possible consequences were tried to be captured. Results showed that illegal activities have substantial effects on demand and the record company's revenues. Although marketing effect of illegal content increases the demand, it also steals the larger portion of it, thus making the company suffer from lost sales. Our scenario analyses proved that the company is harmed from illegal activities when the illegal content's effect of diverting legal buyers is stronger than its self-marketing effect. However, the situation is opposite when the diverting effect is weaker. When this is the case, the company benefits from file sharing.

In further studies, the model can be extended to contain the price and demand dynamics. Accordingly, the price could become an endogenous variable and possibly a policy variable for the company. One other extension could be to include the effect of obsolescence of the album due to time. When this is included, it would be possible to study the dynamics of sales and file sharing in a longer time horizon.

REFERENCES

Blackburn, David. 2004. On-line Piracy and Recorded Music Sales. Unpublished Manuscript, Harvard University.

Clark, Don. 2000. Steps by music industry to halt Internet piracy may be futile. *Wall Street Journal Interactive Edition*, September 19.

Gopal, Ram D., Sudip Bhattacharjee and G. Lawrence Sanders. 2006. Do Artists Benefit From Online Music Sharing? *The Journal of Business* 79 (4): 1503-1534.

Liebowitz, Stanley J. 2004. Will MP3 Downloads Annihilate the Record Industry? The Evidence so Far. *Advances in the Study of Entrepreneurship, Innovation, and Economic Growth* 15: 229-260

Liebowitz, Stanley J. 2005a. Research Note: Testing File-Sharing's Impact on Music Album Sales in Cities. *Management Science*, forthcoming

Liebowitz, Stanley J. 2005b. Pitfalls in Measuring the Impact of File-sharing. *CESifo Economic Studies* 51 (23): 439-477.

Rob, Rafael and Joel Waldfogel. 2004. Piracy on the High C's: Music Downloading, Sales Displacement, and Social Welfare in a Sample of College Students. *Journal of Law and Economics* 49 (1): 29-62

Tomikawa, H. 2003. A system dynamics analysis for the complementary integration of online contents distribution businesses and electronic payment businesses, M.S. Thesis, Massachusetts Institute of Technology.

APPENDIX. Mathematical equations of the model

Marketing_budget(t) = Marketing_budget(t - dt) + (- marketing_expenditures) * dt
INIT Marketing_budget = 2500
OUTFLOWS:
marketing_expenditures =
Marketing_budget*Effect_of_demand_goal_on_marketing_exp*Normal_marketing_exp_fract
Number_of_Albums__Sold_Online(t) = Number_of_Albums__Sold_Online(t - dt) +
(online_album_sales) * dt
INIT Number_of_Albums__Sold_Online = 0
INFLOWS:
online_album_sales = fract_online*Demand_for__the_album
Number_of_CDs_Sold(t) = Number_of_CDs_Sold(t - dt) + (CD_Sales) * dt
INIT Number_of_CDs_Sold = 0
INFLOWS:
CD_Sales = fract_CD_sales*Demand_for__the_album
Number_of_Contents_Available_For_Sharing(t) = Number_of_Contents_Available_For_Sharing(t
- dt) + (ripping_rate + P2P_downloads) * dt
INIT Number_of_Contents_Available_For_Sharing = 0
INFLOWS:
ripping_rate = ripping_fract*Total_no_of_albums_excl_P2P
P2P_downloads =
illegal_fract_of_demand*Effect_of_contents_on_downloads*Demand_for__the_album*0.5
Realized_Marketing(t) = Realized_Marketing(t - dt) + (realization_rate) * dt
INIT Realized_Marketing = 0
INFLOWS:
realization_rate = (marketing_expenditures-Realized_Marketing)/Adj_time2
Traditional_Demand(t) = Traditional_Demand(t - dt) + (adjustment) * dt
INIT Traditional_Demand = Initial_demand
INFLOWS:
adjustment = (legal_demand-Traditional_Demand)/adj_time
adj_time = 1
Adj_time2 = 2
balance = Revenue_from_CD_sales+Revenue_from__online_sales+Marketing_budget-
(Recording_cost+inital_cost_of_CD_production)+2500
cd_cost = 4
CD_Price = 10
CD_subfraction = IF(Number_of_CDs__produced=0)THEN(0)ELSE(0.5*Availability_effect)
Demand_for__the_album =
Initial_demand+Marketing_effect_of_illegal_content+Marketing_effect__of_legal_content+Effect_
of_marketing__on_demand
Demand_goal = Stated_demand*0.7+Traditional_Demand*0.3
fract_CD_sales = legal_fract_of_demand*CD_subfraction
fract_online = legal_fract_of_demand*online__subfraction
illegal_fract_of_demand = (1-legal_fract_of_demand)
inital_cost_of_CD_production = cd_cost*Number_of_CDs__produced
Initial_demand = 100
legal_demand = online_album_sales+CD_Sales

legal_fract_of_demand = Effect_of_illegal_content_on_legal_act
Normal_marketing_exp_fract = 0.5
Normal__expenditure = 500
Number_of_CDs__produced = 1200
Online_album_price = 5
online__subfraction = 1-CD_subfraction
Recording_cost = 2000
Revenue_from_CD_sales = Number_of_CDs_Sold*CD_Price
Revenue_from__online_sales = Online_album_price*Number_of_Albums__Sold_Online
ripping_fract = 0.1
Stated_demand = 200
Total_marketing_effect =
Marketing_effect_of_illegal_content*Marketing_effect__of_legal_content
Total_no_of_albums =
Total_no_of_albums_excl_P2P+Number_of_Contents_Available_For_Sharing
Total_no_of_albums_excl_P2P = Number_of_Albums__Sold_Online+Number_of_CDs_Sold
Availability_effect = GRAPH(Number_of_CDs_Sold/Number_of_CDs__produced)
(0.00, 1.00), (0.1, 1.00), (0.2, 1.00), (0.3, 0.995), (0.4, 0.98), (0.5, 0.955), (0.6, 0.92), (0.7, 0.875),
(0.8, 0.8), (0.9, 0.65), (1, 0.00)
Effect_of_contents_on_downloads =
GRAPH(Number_of_Contents_Available_For_Sharing/(Total_no_of_albums+1))
(0.00, 0.00), (0.1, 0.52), (0.2, 0.86), (0.3, 1.25), (0.4, 1.54), (0.5, 1.75), (0.6, 1.88), (0.7, 1.94), (0.8,
2.00), (0.9, 2.00), (1, 2.00)
Effect_of_demand_goal_on_marketing_exp = GRAPH(Demand_goal/(Traditional_Demand+1))
(0.8, 0.00), (0.92, 0.0075), (1.04, 0.05), (1.16, 0.188), (1.28, 0.48), (1.40, 0.975), (1.52, 1.30), (1.64,
1.45), (1.76, 1.49), (1.88, 1.50), (2.00, 1.50)
Effect_of_illegal_content_on_legal_act =
GRAPH(Number_of_Contents_Available_For_Sharing/(Total_no_of_albums+1))
(0.00, 1.00), (0.1, 0.991), (0.2, 0.97), (0.3, 0.934), (0.4, 0.85), (0.5, 0.628), (0.6, 0.424), (0.7, 0.324),
(0.8, 0.256), (0.9, 0.232), (1, 0.22)
Effect_of_marketing__on_demand = GRAPH(Realized_Marketing/(Normal__expenditure))
(0.00, 0.00), (0.15, 0.55), (0.3, 3.23), (0.45, 9.90), (0.6, 24.8), (0.75, 45.7), (0.9, 84.0), (1.05, 122),
(1.20, 142), (1.35, 149), (1.50, 150)
Marketing_effect_of_illegal_content = GRAPH(Number_of_Contents_Available_For_Sharing)
(0.00, 0.00), (500, 1.00), (1000, 7.00), (1500, 17.8), (2000, 35.0), (2500, 65.0), (3000, 120), (3500,
170), (4000, 192), (4500, 198), (5000, 200)
Marketing_effect__of_legal_content = GRAPH(Total_no_of_albums_excl_P2P)
(0.00, 0.00), (30.0, 0.75), (60.0, 3.75), (90.0, 7.86), (120, 15.7), (150, 30.6), (180, 54.9), (210, 74.7),
(240, 86.9), (270, 89.5), (300, 90.0)