December 2004

Music industry in the era of online delivery: Application of Differential pricing and flat rate pricing for songs with varying consumer valuations

Param Sidhu
University of Washington

Vishal Midha
University of North Carolina at Greensboro

Music industry in the era of online delivery: Application of Differential pricing and flat rate pricing for songs with varying consumer valuations

Param Vir Sidhu
University of Washington
psidhu@u.washington.edu

Vishal Midha
University of North Carolina- Greensboro
v_midha@uncg.edu

ABSTRACT

Online digital delivery allows the music companies to un-bundle their music albums and offer individual songs to the consumers. Consumers differ in their valuations of singles. A seller might now know the exact consumer valuations but there are resources available that would offer reliable information about consumer population. We develop a stylized model to investigate whether these song singles be offered at flat rate price or at differential price. Flat rate pricing, which is predominant in the online music industry, involves offering all songs at same price. Differential pricing involves pricing each song at consumers' valuation for that song. We compare these pricing decisions for a profit maximizing monopolist. We show that the differential pricing fares at least as good as the flat rate pricing in every scenario. Moreover, for songs with different consumer valuation distributions, we show that the monopolist is able to extract greater consumer surplus if he offers songs at differential pricing. We further show that the additional profits by differential pricing over flat rate pricing increase as the relative difference between the mean valuations of songs under consideration increase. These additional profits decrease as the relative variance of the valuations of the songs under consideration increase.

Keywords

Online music pricing, bundling, unbundling, differential pricing, flat rate pricing.

INTRODUCTION

Recording industry has frequently changed the way people get music, from tapes to CD's and then mini-discs. Today, in the digital era, consumers can get downloadable music files in various formats. Consumers can then keep these on their computers or burn CD's. For-pay music download sites have fledged in past couple of years. In collaboration with the recoding labels, real networks and AOL offered the first internet downloading service, music net, in 2001. Recently, real networks acquired rhapsody service, another for-pay music site, of Listen.com. Apple i-Tunes music store sold over one million songs in first week and about 25 million in the first eight months (Kesser 2003, Sequeria and Vacante 2003). Even retail giant Wal-mart has entered the business of selling music online. It is predicted that the $80 million digital market of today will grow to $1.6 billion in 2008 (Kesser 2003).

Traditionally the record labels have bundled the songs as albums. The only time the record labels have tried to sell song singles they have ended up offering minidisks containing few songs. Moreover, in the absence of online facility, it is economically unprofitable for labels to offer single songs. For instance, it will take one CD per song for each song to be offered individually. When offered as a bundle, the cost of this CD is spread over all the songs in the CD and hence is negligible per song. However, if there is only one song in the CD the cost will be a significant addition to the price of the song. This will make the price of song higher than valuations of several consumers.

With the advent of online downloading services, it is feasible to offer individual songs. All the major downloading services are offering songs at a flat rate price. Apple's i-tunes offers songs at 99 cents each for downloading (Sequeria and Vacante 2003). Wal-mart is offering songs at a cheaper flat rate of 88 cents (Kesser 2003). Rhapsody service is offering downloads at a further lower flat rate of 79 cents.

It also seems that the consumers prefer to buy single songs than albums (Green 2004, mehta 2003, News 2003, Ordonez 2003). About 50% of the songs sold at Apple i-tunes were sold as singles (Wilcox 2003). Even at services like KAZAA, Napster, Music match etc songs are downloaded as single rather than as part of albums (Dreier 2003).

Research on bundling information goods have shown that mixed bundling is the best strategy for selling information goods (Adams and Yellen 1976, Schmalensee 1984). Mixed bundling involves selling information goods both as singles as well as in a bundle. However record labels are objecting to selling of single songs along with albums (Wilcox 2003).

Mixed bundling literature investigates selling songs as singles at differential pricing alon with bundle. However the downloading services are offering these songs at flat rate. We investigate whether this flat rate pricing is an optimal pricing strategy compared to differential pricing.

Each song is different from the other one and has different appeal to consumers. When sold as an album the different valuation for the songs get balanced out. However when sold as singles the valuations remain intact. Hence flat rate pricing will not be able to accommodate for different valuations for single songs.

Consumers have different valuations for different songs in the album (Bhattacharjee, et al. 2003). And if the seller decided to sell at a flat rate then he will not be able to extract the maximum consumer surplus. For instance, consider an album with three songs. Bob rates song one high and is willing to pay $5 for this song. He is also willing to pay $2 and $1 for song two and three respectively. Bob is willing to spend a total of $8 on his music shopping. Seller can sell the whole album to Bob for $8 and extract the total surplus. Other option available to seller is to sell the songs as singles at a flat rate of $8/3. However if the seller offers songs at $8/3 each then Bob will buy only song one for which his valuation is higher than the price. Moreover if the seller decides to choose some other flat rate price even then he can make a profit of $5 at most. He makes this profit by choosing the flat rate price of $5 to extract the complete surplus for the highest valued song and zero for the other two songs. However if the seller offers songs at their valuations by Bob, he can make a profit of $8 by offering them at $5, $2 and $1.

For any seller to offer songs at differential pricing, he should be able to get a distribution of consumer valuations for each song. Various services are available that rank songs based on their popularity. Pop-chart ranking services have different ranking for single songs and complete albums. Complete album rankings are based on the over all collection of songs in the album. These rankings for individual songs are readily available from various forms of media. BBC offers songs ratings of top 40 songs for every week (BBCi 2004). MTV offers an updated rating of single songs every week (MTV 2004). There are numerous others sources to get the song rankings like CNN, Channel V, pop-chart programs on various radio channels and television channels.

However it would not be feasible to get the consumer valuations for all the songs in the album. Generally few songs in an album are hit and those drive the sales of the album (Shirky 2004). This implies that there are in general very few songs whose valuations are significantly higher than the valuations of other songs in the album. These high valuation songs usually find their way in one pop chart or the other. If the seller can price discriminate between these high and low valued songs than he can extract a greater portion of consumer surplus compared to that in flat rate option.

In the context of this article we define flat rate pricing as one single price at which all the song singles are offered. We further define differential pricing as the pricing strategy in which the offering price of each song single is decided based on its consumers' valuations.

In this paper we propose a model of pricing for a profit maximizing monopolist who offers single songs. We contend that the monopolist might now know the consumer valuations but there are resources available that would offer reliable information about consumer population. We recommend that he should offer songs at differential pricing when the consumers population differ in their valuation of songs.

LITERATURE REVIEW

This work involves analyzing pricing strategies for information goods. Pricing strategies for information goods differ from the pricing strategies for traditional goods. A traditional good is generally priced by adding a fixed mark up to the marginal cost of production. However the marginal cost of information goods is generally negligible but they have huge upfront cost. Hence an optimal strategy for pricing information goods is to price them at their consumer valuations (Varian 1995).

Generally quality differentiation has been suggested for information goods that can act as substitutes and bundling has been recommended for goods that can act as complements (Bakos and Brynjolfsson (1999, 2000), Varian 1995, Bhargava and Choudhary 2001, Ekelund 1970) . Song singles are not substitutes but they are already differentiated because they hold different values to consumer population.

Ekelund (1970) recommends differentiating information goods to increase profit. He suggests that the differentiated products sold then be sold at different prices to cater to different consumer segments. (Bhargava and Choudhary 2001) show that the seller's profit selling information goods increase by applying vertical differentiation and price discrimination. Our model considers song singles which are not substitutes for each other. Moreover song single are differentiated and hold different values individually.

Pricing strategies for selling information goods have primarily considered bundling them to maximize profits. Adams and Yellen (1976) analyzed the selling strategies for two goods using two-dimensional graphical framework. They considered pure component, pure bundling and mixed bundling (involves offering both bundles and components). They suggested that mixed bundling is always profitable to the other two selling strategies. Building on (Adams and Yellen 1976)'s work (Schmalensee 1984) analyzed the selling strategies with a Gaussian distribution. He confirmed (Adams and Yellen 1976)'s result that mixed bundling is always better than pure component or pure bundling strategies. Bundling has been preferred over pure component selling due to various reasons ranging from cost savings in production and transaction costs, complementarities in bundled goods and sorting consumers according to their valuations (Eppen and Hanson 1991). Bakos and Brynjolfsson (1999, 2000) investigated optimal bundling strategies for large number of information goods and show that selling a very large number of unrelated information goods as bundles is very profitable compared to selling them as singles. Investigating the software goods, Dewan and Freimer (2003) shows that adding third part goods in a bundle increases software producer's profit.

In the next section, we develop a model to compare two different pricing strategies for selling song singles. Flat rate pricing has been very widely adopted by downloading services. However we propose differential pricing as a better pricing strategy for selling song singles than flat rate pricing.

MODEL

We present a single period model where we compare flat rate pricing strategy with differential pricing strategy. We first derive results for optimal price and profit for flat-rate pricing and then for differential pricing. We then compare the difference between the profits from two strategies for various conditions.

Assumptions

Product

Product under consideration is a digital downloadable collection of n songs. These songs have same level of quality technically. Songs are offered as singles and not as an album. There is no second hand market for these songs. These songs are offered by a profit maximizing monopolist. We consider a monopolist to analyze the differences between the two pricing options in the purest form. Monopolist's decision problem is to decide a pricing structure so as to extract the maximum consumer surplus. It can offer the songs at a flat rate or can offer the songs at differentiated price. As with all information goods we assume that the songs have zero marginal cost, i.e. it costs noting to make copies of a song. We further assume the fixed cost per song to be zero.

To keep the calculation tractable we develop and solve the model for just two songs s1 and s2. Both the songs are only available as singles. We do not allow the songs to be sold as a bundle. We realize that in reality the songs are sold as bundles as well as singles but the focus of this research is to compare flat rate pricing of singles to differential pricing. Moreover even if we allow the songs to be sold as bundle along with singles our results will not change. It will only be the magnitude of results that will change[1].

Consumers

Consumers are heterogeneous in their valuations for songs. They are assumed to have either zero or positive valuation for each song. This implies that we allow for free disposal, i.e. the consumers can not have negative valuation for any song. We do not allow for any budget constraint. Consumers can buy both songs and at most one unit of any song. Consumer buys the song if his valuation exceeds the price of the song.

---

[1] Though Adams, W.J. and J.L. Yellen, "Commodity bundling and the burden of monopoly," *Quarterly Journal of Economics*, 90, (1976), 475-498. shows that mixed bundling (selling both bundles and singles) is the most profitable way of selling goods. They consider differential pricing for goods when sold as singles. However the option of selling the goods at flat-rate pricing is not considered.

Consumer valuations of the product

Monopolist believes that the consumer valuations for song s1 follow a uniform distribution[2] between interval (a1, b1) and zero elsewhere. Similarly consumer valuation for song s2 follows a uniform distribution between interval (a2, b2) and zero elsewhere. We further assume zero correlation between the valuations of two songs. This is a reasonable assumption because valuing one song higher does not increase or decrease the valuation of another song.

Distributions of consumer valuations for s1 and s2 are

$$f(p_1) = \begin{cases} \dfrac{1}{b_1 - a_1} & a_1 < p_1 < b_1 \\ 0 & elsewhere \end{cases} \text{ if}$$

$$f(p_2) = \begin{cases} \dfrac{1}{b_2 - a_2} & a_2 < p_2 < b_2 \\ 0 & elsewhere \end{cases} \text{ if}$$

In this setting we solve for perfect Bayesian equilibria, i.e. the monopolist's belief about the distribution of consumer valuations is the original distribution of consumer valuations.

SOLVING THE MODEL

Flat-Rate Pricing

Monopolist offers both the songs at a flat rate of p_f. Consumers buy the songs for which their valuations exceed p_f. Flat rate price is calculated as follows

$$\text{Fraction of consumers who would buy song 1 at a flat rate of pf} = \int_{p_f}^{b_1} f(p_1)dp_1 \qquad (1)$$

$$\text{Fraction of consumers who would buy song 2 at a flat rate of pf} = \int_{p_f}^{b_2} f(p_2)dp_2 \qquad (2)$$

Monopolist decides pf by maximizing his profit as follows =

$$\pi(p_f) = \max_{p_f}\left[p_f\left(\int_{p_f}^{b_1} f(p_1)dp_1 \right) + p_f\left(\int_{p_f}^{b_2} f(p_2)dp_2 \right) \right] \qquad (3)$$

here $\pi(p_f)$ represents the profit made by the monopolist at flat price p_f.

Solving equation 3 for p_f yields

$$p_f^* = \frac{(2b_2b_1 - a_2b_1 - a_1b_2)}{2(b_2 - a_2 + b_1 - a_1)} \qquad (4)$$

[2] We recognize the fact that there are other types of distributions that can predict the true consumer valuations better. Probably a normal distribution can be a better choice but it makes the calculations cumbersome without adding any new insights. We consider a uniform distribution to keep the calculations tractable. Moreover any other distribution can be converted into a uniform distribution.

Let us further define x1 and x2 as follows

$$x_1 = \begin{cases} p_f^* & a_1 < p_f^* < b_1 \\ a_1 & \text{if } a_1 > p_f^* \\ b_1 & b_1 < p_f^* \end{cases} \quad (5)$$

$$x_2 = \begin{cases} p_f^* & a_2 < p_f^* < b_2 \\ a_2 & \text{if } a_2 > p_f^* \\ b_2 & b_2 < p_f^* \end{cases} \quad (6)$$

Inserting this value in equation 3 yields

$$\pi(p_f) = \frac{(2b_2b_1 - a_2b_1 - a_1b_2)}{2(b_2 - a_2 + b_1 - a_1)}\left[\frac{b_1 - x_1}{b_1 - a_1} + \frac{b_2 - x_2}{b_2 - a_2}\right] \quad (7)$$

Differential Pricing

Monopolist offers the songs at their individual optimal prices. Let p_{d1} represents the optimal price for song s1 when the monopolist maximizes the profit from song 1. Similarly p_{d2} represents the optimal price for song s2.

Profit that the monopolist gets from sales of s1= $\max_{p_{d1}} p_{d1}\left(\int_{p_{d1}}^{b_1} f(p_1)dp_1\right)$ (8)

Solving equation 8 for pd1 gives

$$p_{d2}^* = \max\left(\frac{b_1}{2}, a_1\right) \quad (9)$$

Profit that the monopolist gets from sales of s2= $\max_{p_{d2}} p_{d2}\left(\int_{p_{d2}}^{b_2} f(p_2)dp_2\right)$ (10)

Solving equation 10 for pd1 gives

$$p_{d2}^* = \max\left(\frac{b_2}{2}, a_2\right) \quad (11)$$

The profit equation for the monopolist in the differential case becomes

$$\pi(p_d) = \left[p_{d1}^* \frac{b_1 - p_{d1}^*}{b_1 - a_1} + p_{d2}^* \frac{b_2 - p_{d2}^*}{b_2 - a_2}\right] \quad (12)$$

Profit difference between differential pricing and flat rate pricing is

$$\pi(p_{d-f}) = \pi(p_d) - \pi(p_f) \quad (13)$$

Results and Propositions

Now that we have set up the model, we analyze how these pricing strategies fare with relative changes in the distribution of consumer valuations for the two songs. Any distribution is characterized by its mean and variance. We analyze how these pricing options fare with changing means and variances. First we compare them for identical consumer valuation distributions for the two songs. Then we conduct numerical simulations to show how these pricing options fare for various means and variances of distributions.

Identical Distribution of Consumer Valuations for both Songs

By identical distribution we mean that the overall distributions of consumer valuations for s1 and s2 are identical. This would mean that consumers as a population do not differentiate between two songs. This implies that the means for s1 and s2 are same and the variances for the two distributions are also same (i.e. a1=a2=a, and b1=b2=b). For two songs to have identical distribution of consumer valuations, we do not need to have every consumer value both songs at same level. Instead we need that the consumers as a population rate s1 in the same way as s2. For example, in a population of 15 consumers, if only 10 consumers rate song 1 at $3 and the rest five rate it at $4, then we do not require that the same 10 consumers rate song 2 at $3 and the same five rate it at $4. But what we do require is that out of the whole population of consumers exactly any 10 consumers rate song 2 at $3 and the other five rate song 2 at $4.

Table 1 presents the results for optimal price and maximum profit made by adopting differential pricing and flat rate pricing for songs with identical distributions.

Comparison of Flat rate pricing and differential pricing for songs having identical consumer valuations[3]		
	Flat rate Pricing	**Differential pricing**
Optimal price	$p_f^* = \frac{2(b^2 - ab)}{4(b-a)} = \frac{b}{2}$	$p_{d1}^* = p_{d2}^* = \frac{b}{2}$
Profit	$\pi(p_f) = \frac{b}{2}\left[\frac{b}{b-a}\right]$	$\pi(p_d) = \frac{b}{2}\left[\frac{b}{b-a}\right]$

Table 1- Comparing the two pricing strategies.

As table 1 shows both flat rate pricing and differential pricing lead to same prices and profits for songs with identical distributions.

This leads to our first proposition:

PROPOSITION1: *Ceterus Paribus, flat-rate pricing and differential pricing lead to identical levels of maximum profits for songs with identical distributions of consumer valuations.*

Proposition 1 in equation form can be represented as

[3] Here we have presented the results assuming that b/2>=a. Even if b/2<a, the optimal prices ($p_f^* = p_{d1}^* = p_{d2}^* = a$) and the maximum profit ($\pi_f = \pi_d = 2a$) made will be identical for both options.

$$\pi\left(p_{d-f}\right)_{\left(\mu_{s2}=\mu_{s1} and \sigma_{s2}^2=\sigma_{s1}^2\right)}=0$$

This is an important proposition and helps us to understand the rationale behind the download services offering songs at flat rate. This proposition implies that if consumers rate two different songs identically then offering songs at a flat rate is as good as offering them on differential pricing. It seems that the downloading services have made this implicit assumption that the consumers rate all songs equally. This assumption though very strong, may be acceptable for a collection of songs of different genres. However, in a collection of songs of same genre, some will be valued higher than others. Downloading services should realize that consumers as a population value songs in every genre differently and should offer the songs at their valuations.

Different Consumer Valuation Distribution for Two songs

Now that we have seen how differential pricing fares compared to flat rate pricing for identical distribution of consumer valuations. We focus on how both pricing options fare against each other when the songs have different distributions. Any distribution is characterized by its mean and variance. We analyze how these pricing options fare with changing means and variances. We conduct numerical simulation and present the results in the form of a figure 1.

In general the downloading services are offering songs for a flat rate of 99 cents. Hence a reasonable assumption for the mean valuation of songs could be 1. In figure 1, we have considered mean valuation of s1 to be 1. We have then varied the mean valuation of s2 keeping the variance constant and same as that of s1. We plotted the results in figure 1.

We then increased the variance of s1 but kept the mean same. Keeping the same variance as that of s1 we varied the mean again for s2 and did the calculations and plotted the results in figure 1. we have conducted several calculations for different levels of variances and the results are shown in figure 1. The legend for table 1 is presented in tabular form in table 2.

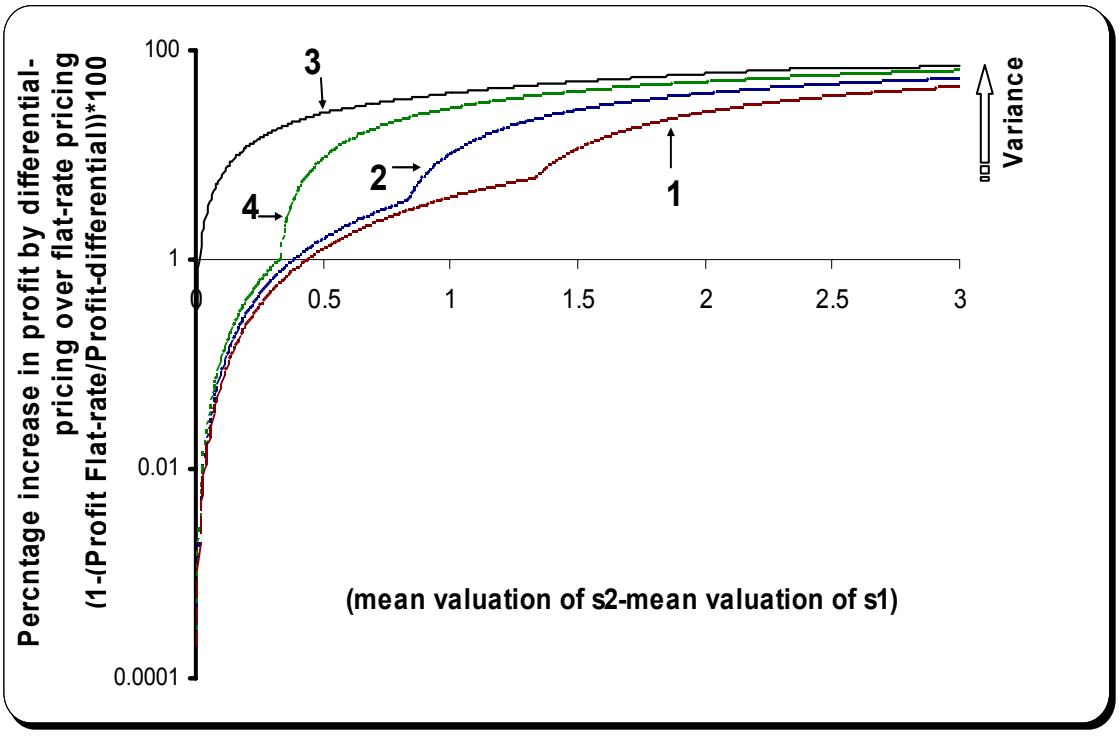

Figure 1: Comparison of differential pricing and flat-rate pricing for songs with different consumer valuation distributions[4].

(note: y axis is on logarithmic scale whereas x-axis is on regular scale)

[4] Here we have presented results for means valuation of s1 set as 1 as the basis. Plots with higher mean valuation for s1 are available from the author on request. The results of the plots with higher mean valuation of s1 are consistent with figure1.

Curve in figure 1	μ_{s1} mean of s1	σ^2_{s1} variance for s1	σ^2_{s2} variance for s2
1	1	0.3333	0.3333
2	1	0.1875	0.1875
3	1	0.08333	0.08333
4	1	0.020833	0.020833

Table 2: Legend for figure 1.

Figure 1 is the graphical representation of the model that we have built. It shows that for all values of mean and variance of s1 and s2 differential pricing is better than flat rate pricing. It shows that as the difference between the mean valuations of s1 and s2 increase the difference between the profits earned by differential pricing and flat rate pricing also increase. This difference between the profits further increases as the variance of the two songs increases. It leads us to our next three propositions.

PROPOSITION 2: Ceterus paribus, difference between the profits achieved in differential pricing and flat rate pricing is positively correlated to the difference between the mean valuations of the two songs for same constant variance.

Proposition 2 in equation for can be represented as

$$\pi\left(p_{d-f}\right)_{\left(\mu_{s2}\neq\mu_{s1} and \sigma^2_{s2}=\sigma^2_{s1}\right)} \alpha\left(\mu_{s2}-\mu_{s1}\right)$$

This is a very important implication of our model. It states that as the difference between the mean valuations of two songs increases differential pricing becomes a much better pricing strategy than flat rate pricing. The reasoning behind this proposition is that as the difference between the means increase, the lower value song will pull the flat rate price down and the higher value song will pull the flat rate price higher. In this tug of war the flat rate price will lie somewhere in between the optimal prices for the two songs. This will lead to loss of per consumer surplus from the higher valued song and the loss of consumers for the lower valued song. Popular songs are generally valued higher than the average songs. If the price is set between the values of these songs then the monopolist would not be able to extract full consumer surplus for the popular song and would not be able to serve to the optimal consumer segment for the average song. However, differential pricing, by its definition, allows the monopolist to set the prices for the songs at their individual optimal. Hence as the difference between their values increase the monopolist is better off by offering them at differential prices.

PROPOSITION 3: Ceterus paribus, for songs with same level of variance but different constant means, the difference between the profits achieved in differential pricing and flat rate pricing is negatively correlated to the common variance of the two songs.

Proposition 3 in equation form can be represented as

$$\pi\left(p_{d-f}\right)_{\left(\mu_{s2}\neq\mu_{s1} and \sigma^2_{s2}=\sigma^2_{s1}\right)} \alpha\left(\frac{1}{\sigma^2_{si}}\right) \qquad \text{i=1 or 2}$$

This is another important proposition. It states that as the consumer's differ a lot in their valuations of a song and the two songs differ in their means, differential pricing appears to be a better and better option compares to flat rate pricing. The rationale behind this proposition is that as the distribution of a song is spread out more the optimal price for that song decreases. However the flat rate pricing still lies in between the optimal price of the two songs. Hence the monopolist looses higher share of low value song consumers and also higher consumer surplus from high value song consumers.

PROPOSITION 4: Ceterus paribus, Differential pricing leads to higher maximum profits than that in flat rate pricing for songs with differing mean consumer valuations.

Proposition 4 in equation form can be represented as

$$\pi\left(p_{d-f}\right)_{(\mu_{s2}\neq\mu_{s1})} \succ 0$$

This proposition is very significant and has direct implications for the industry. It states that if the consumers as a population differ in their valuations of two songs then those songs should be offered at differential pricing. Since consumers do differ in their valuations of two songs hence to maximize its profit and to extract the maximum surplus possible the monopolist should offer the songs at differential prices.

DISCUSSION

This work analyzed the differential pricing and flat rate pricing for song singles. Our main results are

(1) Differential pricing is atleast as good as flat rate pricing for a monopolist.

(2) Difference between the profits earned in differential pricing and flat rate pricing increase as the mean valuations of two songs increase.

(3) Difference between the profits earned in differential pricing and flat rate pricing increase as the common variance of two songs increase.

First point clearly implies that downloading services should adopt differential pricing strategies for selling song singles. In differential pricing strategy, the monopolist will be able to cater to a larger market segment and also extract greater consumer surplus. We suggest that the record label's objection to selling of song singles can be removed by selling the singles at differential pricing.

Second point implies that as the consumers start differentiating between songs at a greater level the monopolist should be much better off by adopting differential pricing strategy. Generally few sings in an album are popular and those drive the sales of that album. If the monopolist is unbundling the album, he should price differentiate between the differing valued songs.

Third point implies that as the consumers starts differing a lot in their valuation of a song and as a population they valuations are spread over a larger range, flat rate pricing becomes worse compared to differential pricing.

All the three points are very interesting and significant as they highlight a subtle point that has been ignored by the downloading services while deciding the pricing strategy. Services should understand that the each song is different than other and has different appeal to consumers as a population. Downloading services should decide their pricing structure so as to maximize their surplus as well as cater to larger consumer segment.

This work has focused on just the flat rate pricing and differential pricing options for a monopolist. We did not allow for bundling of the songs. However it would be very difficult to acquire the consumer valuations for low valued songs and it would be beneficial to sell them in bundles. Future research can look at how to decide the bundling and the differential pricing strategies for these songs.

Advances in information technology are changing the way business would be done in music industry. New pricing strategies are bound to be adopted to make the markets work more efficiently. Differential pricing is just one of those options and the onus lies on the researchers to figure out and suggest other more efficient options.

REFERENCES

Adams, W.J. and Yellen, J.L. (2003) Commodity bundling and the burden of monopoly, *Quarterly Journal of Economics*, 90, 475-498.

Bakos, Y and Brynjolfsson, E. (1999) Bundling Information Goods: Pricing, Profits, and Efficiency, *Management Science*, 45, 12, 1613-1631.

Bakos, Y and Brynjolfsson, E. (2000) Bundling and Competition on the Internet, *Marketing science*, 19, 1, 63-83.

1. BBCi, (2004) Top of the pops, Feb 20, Available at: http://www.bbc.co.uk/totp/top40/index.shtml
2. Bhargava, H. and Choudhary, V. (2001) Information goods and vertical differentiation, *Journal of Management Information Systems*, 18, 2, 89-106.
3. Bhattacharjee, S., Gopal, R. and Sanders, L. (2003) Digital music and online sharing: software piracy 2.0?, *Communications of the ACM*, 46, 7, 107-111.
4. Dewan, R. and Freimer, M. (2003) Consumers Prefer Bundled Add-Ins, *Journal of Management Information Systems*, 20, 2, 99-111.
5. Dreier, T. (2003) Online music store: Are they music to your years? *PC magazine*, 22, December 09.
6. Ekelund, R.A. (1970) Price discrimination and product differentiation in economic theory: an early analysis, *Quarterly Journal of Economics*, 84, 268-278.
7. Eppen, G.D. and Hanson, W.A. (1991) Bundling New products, new markets, low risk, *Sloan management review*, 32, 4, 7-14.
8. Green, H. (2004) Downloads: The Next Generation; Music merchants are trying new ways to make an honest buck off the Internet, *Business Week*, 64, Feb 16.
9. Kesser, M. (2003) Apple blase about online music rivals, *USA today*, December 16.
10. Mehta, R. (2003) iTunes 5 - Napster 1: 1st week sales figures, *Mp3newswire*, Feb 16, Available at: http://www.mp3newswire.net/stories/2003/5to1.html
11. MTV (2004) Billboard Top 20 singles: Issues Date: 02.21, *MTV.com*, Feb 20, Available at: http://www.mtv.com/charts/charts_billboardsingles.jhtml
12. News, BBC (2003) US downloads beat CD sales, *BBC.com*, Available at: http://news.bbc.co.uk/2/hi/entertainment/3237021.stm
13. Ordonez, J. (2001) Music store seek the revival of CD Singles, *The Wall Street journal*, B.1.
14. Schmalensee, R.L. (1984) Gaussian demand and commodity bundling, *Journal of business*, 57, s211-s230.
15. Sequeria, N and Vacante, L. (2003) iTunes Music Store Sells over One Million Songs in First Week, Available at: http://www.apple.com/pr/library/2003/may/05musicstore.html
16. Shirky, C. (2004) Napster and the death of the album format, Available at: http://www.shirky.com/writings/napster_nyt.html
17. Varian, H. (1995) Pricing information goods, University of Michigan, June 15.
18. Wilcox, J. (2003) iTunes store: More than 1 million sold, Available at: http://news.com.com/2100-1027_3-999701.html

APPENDIX

Steps for reaching equation 4 from equation 3

$$\pi(p_f) = \max_{p_f}\left[p_f\left(\int_{p_f}^{b_1} f(p_1)dp_1\right) + p_f\left(\int_{p_f}^{b_2} f(p_2)dp_2\right)\right] \tag{3}$$

$$\pi(p_f) = \max_{p_f}\ p_f\left[\frac{b_1 - p_f}{b_1 - a_1} + \frac{b_2 - p_f}{b_2 - a_2}\right] \tag{3.1}$$

Taking derivative with respect to p_f

$$\frac{\partial\pi(p_f)}{\partial p_f} = \left[\frac{b_1 - 2p_f}{b_1 - a_1} + \frac{b_2 - 2p_f}{b_2 - a_2}\right] \tag{3.2}$$

Solving for p_f to get maximum profit

$$\frac{b_1 - 2p_f}{b_1 - a_1} = \frac{2p_f - b_2}{b_2 - a_2} \tag{3.3}$$

$$2p_f(b_2 - a_2 + b_1 - a_1) = (2b_2b_1 - a_2b_1 - a_1b_2) \tag{3.4}$$

$$p_f^* = \frac{(2b_2b_1 - a_2b_1 - a_1b_2)}{2(b_2 - a_2 + b_1 - a_1)} \tag{4}$$

Steps to reach equation 9 from equation 8

Profit for the monopolist from sales of s1 at differential pricing =

$$\max_{p_{d1}}\ p_{d1}\left(\int_{p_{d1}}^{b_1} f(p_1)dp_1\right) \tag{8}$$

$$= \max_{p_{d1}}\ p_{d1}\frac{b_1 - p_{d1}}{b_1 - a_1} \tag{8.1}$$

Differentiating wrt p_{d1} and equating to zero

$$= \frac{b_1 - 2p_{df}}{b_1 - a_1} = 0 \tag{8.2}$$

$$= p^{*}_{df} = \frac{b_1}{2} \tag{8.3}$$

However, if the consumers are distributed in a very small range and pdf becomes lower than the valuation of the lowest valuing consumer then the seller would be better off by offering the song at the value of the lowest valuing consumer.

Hence we get

$$p^{*}_{d2} = \max\left(\frac{b_1}{2}, a_1\right) \tag{9}$$

For getting to equation 11 from equation 10 follow the same steps were followed in reaching equation 9 from equation 8.