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When Price Discrimination Fails – A Principal Agent Problem with Social Influence

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Abstract

I develop a theoretical model of price discrimination under social influence. I find that social influence gives sellers the incentive to artificially create and maintain excess demand on the market. The rationing occurs mainly at the low end of the market, and sometimes results in full rationing of the low end. Furthermore, the incidence of price discrimination under social influence is much lower than in the absence of it. Social influence lowers the profitability of price discrimination and incentivizes sellers to reduce product variety and to only target the high end of the market, a fact that is consistent with many empirical observations.

Keywords: Price Discrimination; Social Influence; Excess Demand.

JEL Classification Numbers: D4, L15, M31.

1 Introduction

In a seminal paper, Becker (1991) noted that many firms allow excess demand to persist on the market without adjusting prices or quantities, and justified this behavior using social influence as the main driving factor. If someone's demand is positively correlated with the demand of others, then this kind of social interaction can explain the under-pricing observed in many industries.

Under-pricing and persistent excess demand are commonly observed in the entertainment industry. Popular sporting events, Broadway theater, and music concerts are often times under-priced. The same is true for certain popular electronic products such as the Nintendo Wii console, or the Iphone and other Apple products. When markets are under supplied, secondary markets emerge where speculators can generate extra profits from reselling these goods in high demand. Speculative markets are extremely common in the entertainment industry where attending a popular event, often times cannot be achieved through traditional box office ticket purchases, but only through secondary market transactions that come at a steep price. Such speculative markets are slowly encompassing other industries and dramatically expanding, with the emergence and development of online marketplaces such as *Ebay* and *Craigslist*.

The popular gaming console Nintendo Wii has been under-supplied for almost three years since its launching in 2006. The Wii used to be extremely hard to find in stores and it sold for the same price of about 250 dollars, while resellers were able to generate significant profits on secondary markets. It was a common thing to see consoles auctioned on *Ebay* for up to 450 dollars. Nintendo is in fact well known for employing this kind of strategies. Peter Main, one of Nintendo's vice presidents of marketing, was convinced that scarcity sustains demand. He started employing a successful marketing strategy of both stimulating the demand and rationing the supply, in order to keep consumers' interest high[1]. Mr. Main was once reported stating that "with demand projected at 43 million units, ideally we would like to produce 40 million"[2].

Another common observation is that on such markets that are persistently under-supplied, producers do not price discriminate very much. Apple is a company that is famous for offering very little product variety and mainly targeting the high end of the market. In six years since

[1] The Games Played for Nintendo's Sales - NY Times 1989

[2] Adweek's Marketing Week 1989

the original introduction of the iPhone, it is for the first time that Apple decided to offer a lower quality version of their flagship product by launching the iPhone 5c in September 2013. Also in the entertainment industry, price discrimination can be employed very easily by employing a practice that is commonly referred to as "scaling the house" – pricing the better seats in the house higher, and progressively reducing the price for lower quality seats. The location of the seat provides the quality differentiation needed for successfully price discriminating. However, in spite of this easiness of implementation and in spite of many scientific studies [3] that argued the profitability of employing such a strategy, price discrimination is surprisingly underused for live entertainment. A survey conducted in 2003 found that 43% of all live events were uniformly priced. Moreover, even among those who use non-uniform pricing, the degree of price discrimination seems to be sub-optimal, with only two or three different price levels. This fact led many to conclude that promoters simply do not price optimally and the resulting secondary markets only take advantage of this sub-optimal pricing strategy.

We argue that maintaining excess demand and a reduced level of price discrimination can be optimal when social influence is present. We do not aim at explaining how social influence works or through which channels. In fact, social influence can work through multiple channels and affect consumers in different ways, but the fundamental result is the same – consumers change their preferences. Whether we talk about Becker (1991) type social interactions, or bandwagon and snob effects, or information and signaling effects such as in Stock and Balachander (2005), or even complementarities effects such as in Hendricks and Sorensen (2009), the final market outcome will present consumers with a higher preference for the good involved. We are interested to see the effects of this kind of social influence on markets. We develop a principal agent model that includes social influence and study the effect that social influence has on the incentives to price discriminate. We find that, when compared to a benchmark case where no externalities are present, social influence induces the seller to artificially create and maintain a certain level of excess demand by rationing some customers. This is the same effect that Becker (1991) tried to explain. We also find that rationing is more profitable at the low end of the market, and it can go as high as full rationing of the low end. Social influence also reduces the profitability and incidence of price discrimination, and for some cases where social influence is very strong, sellers

[3] Huntington (1993), Rosen and Rosenfield (1997), Leslie (2004), Courty and Pagliero (2012)

will only serve the high end of the market and use uniform pricing. This is consistent with many empirical observations that product differentiation and price discrimination is low on markets with high incidence of social influence.

2 Benchmark Model

This section presents a standard price discrimination model without social externalities. I will use this model as a benchmark, to analyze the qualitative implications that social influence has on price discriminatory strategies. The model is a simple principal agent problem with the principal producing two slightly differentiated versions of the same base product and selling them to two different types of customers, without being able to distinguish between individual types. The seller has to devise an incentive compatible mechanism in order to successfully price discriminate.

To formalize, there is one seller who can produce and sell two slightly different qualities of the same base product to a market of N consumers. One can think of front and back seats at a concert, or different memory capacity for cellphones, etc. For simplicity, we assume no production costs for either one of the two possible qualities. The seller knows that there are two types of customers on the demand side, but cannot distinguish between them. The central assumption of the model is that customers do not know ex ante the exact quality and usefulness of the product, but have different beliefs about it.[4] Some customers truly believe the seller is offering a good product, and they value the two different quality versions accordingly. We will refer to these customers as being high type customers. The high type customers have valuations V_H, and V_L for the high quality, and respectively low quality version of the product. On the other hand, there are low type customers who do not believe the product is that good or useful. Low type customers do not differentiate between the two versions of the product.[5] Their valuation is V_0 no matter what version they buy. We assume $V_0 < V_L < V_H$. Let the proportion of high type consumers on the market be denoted by ϕ. Without being able to tell who is a high type customers and who is a low type customer, the seller must choose a pricing scheme to maximize his profits. In essence, the seller will have to choose between serving the entire market using an incentive compatible price discrimination

[4] This assumption is not needed in the benchmark model, but in the model with social influence it represents the channel through which social influence works.

[5] The assumption is not crucial for the qualitative implications of the model, but is used for simplifying the argument.

mechanism, or offering a single price and just serving the high types.

Serving only the high types, implies that the seller will offer only the high quality version, set the price $P = V_H$, and sell to the entire high end of the market. There are ϕN high end customers, therefore the seller's profits, if he chooses to use this strategy, will be:

$$\pi_{NX1} = \phi N V_H$$

Alternatively, the seller might design a price discrimination strategy and serve the entire market. The seller will offer both quality versions, with the high quality designed for the high type customers, and the low quality designed for the low type customers. The seller will have to optimally choose a pair of prices, P_H and P_L, that are both incentive compatible and individually rational for the two groups of consumers. The seller has to solve the following mechanism design problem:

$$\max_{P_H, P_L} \pi_{NX2} = \phi N P_H + (1-\phi) N P_L$$

$$\begin{aligned} \text{subject to: } & (IR_H) : V_H - P_H \geq 0 \\ & (IR_L) : V_0 - P_L \geq 0 \\ & (IC_H) : V_H - P_H \geq V_L - P_L \\ & (IC_L) : V_0 - P_L \geq V_0 - P_H \end{aligned}$$

The individual rationality constraints, IR_H and IR_L, simply require that each customer gets positive utility if he buys the product version designed for his type. The incentive compatibility constraints, IC_H and IC_L, require that each customer gets higher utility from buying the version designed for his type than from buying the version designed for the opposite type.

To solve the problem, first note that the incentive compatibility constraint for the low type (IC_L) never binds since P_L will always be lower than P_H. With this constraint removed, the seller can now increase P_L up to the point where the IR_L constraint binds. This is consistent with profit maximization as it increases profits from the low types, and, at the same time, makes the low quality version more unattractive for the high types, thus reducing the informational rents the seller has to pay to high type customers. Therefore, the optimal price the seller has to choose for the low quality version is $P_L = V_0$. The next step for the seller is to increase P_H as much as he can, without violating the IC_H constraint. A violation of this constraint would prompt the high type customers to buy the low quality version instead, thus destroying the price discriminatory mechanism. Making the IC_H constraint to bind results in the seller setting $P_H = V_H - V_L + V_0$. At this price, the IR_H constraint is satisfied without binding. In essence, the seller is extracting all consumer surplus from the low end of the market, while leaving some surplus to the high end in order to incentivize them to buy the version designed for them. Summarizing, the optimal incentive compatible pair of prices is:

$$\begin{cases} P_L = V_0 \\ P_H = V_H - V_L - V_0 \end{cases}$$

The informational rents that the seller has to pay to each high type customer will equal to $V_L - V_0$, while the seller's total profit will be:

$$\pi_{NX2} = \phi N(V_H - V_L + V_0) + (1-\phi)NV_0 = NV_0 + \phi N(V_H - V_L)$$

The next logical question to ask is when will the seller find it profitable to offer both qualities and serve the entire market, and when will he find it profitable to only serve the high end of the market. Comparing the two profits, the seller will only serve the high type customers if:

$$\pi_{NX1} > \pi_{NX2} \Leftrightarrow \phi NV_H > NV_0 + \phi N(V_H - V_L) \Leftrightarrow \phi V_L > V_0 \Leftrightarrow \phi > \frac{V_0}{V_L}$$

Concluding, the optimal strategy for the seller in the benchmark model is:

$$\begin{cases} \text{if } \phi > \frac{V_0}{V_L}, \text{ offer only the high quality version and charge } P = V_H \\ \text{if } \phi \leq \frac{V_0}{V_L}, \text{ offer both qualities and charge } P_L = V_0, \text{ and } P_H = V_H - V_L + V_0 \end{cases}$$

It is interesting to compare the results of this base model with the results that emerge when we include social influence as a driving force. One especially interesting question to ask is how does social influence affect the profitability and incidence of price discrimination? As discussed earlier, one of the most puzzling questions that emerges from studying ticket pricing strategies for popular music concerts is why don't promoters make more use of price discrimination? Another question that we will address is which sellers should we expect to use price discrimination more often? Studying social influence in a price discrimination framework will provide some answers.

3 A Model with Social Influence

In this section, we enhance our benchmark framework by including social influence to the mix. If some customers are not ex ante convinced of the usefulness or overall quality of the product, they might alter their beliefs if they notice the product is extremely popular. In that sense, shortages on the market act as a form of advertising by providing quality signals to uninformed customers. Becker (1991) explains social externalities as something specific to those markets dealing with social goods, that are consumed in groups and therefore, people prefer attending more popular events because they might derive utility not only from the concert itself, but also from socializing. While this explanation is perfectly possible for music concerts, sporting events, or popular restaurants, explanations based on quality signaling can be applied to virtually any product, whether people consume it in groups or alone. Peer effects arguably exist is some shape or another virtually on every market. Another departure from the original model is that I use the excess demand itself, and not aggregate demand, as a driving force for social externalities. This can be motivated by people deriving utility from competing for goods and snob effects, but even more naturally, excess demand is a measure of popularity which is easily observed by individual customers. A customer might find it impossible to quantify the total aggregate demand for a particular product, but a line in front of a store is an easy to see quality signal that can influence his perception immediately. We can see this strategy employed frequently by stores during special sales events, or by trendy nightclub managers who constantly maintain a line outside, whether the club is crowded or not.

We model social externalities by allowing a portion of the low type customers to change their beliefs and become high types. Under these forces, the seller might find it profitable to create excess demand on the market and allow these externalities to work. In industries such as professional basketball or baseball, where a club has a a game every 2 or 3 days, these externalities work naturally from game to game. In durable goods industries, such as electronic products, sellers have to be more creative. A popular strategy that is being used nowadays before virtually any product launch, is to offer so called *pre-sale* periods during which only a limited number of units is made available to the public. We will allow this kind of strategy in our model and assume that, after the pre-sale period, the remaining low type customers are influenced by the level of excess demand observed during this period and will become high types with a probability that depends on the level of excess demand.

To formalize, the seller first commits to a pricing scheme. Just as in the benchmark model, the seller can choose to serve only the high end of the market and set a single price for only the high quality product, or he can choose to serve the entire market and price discriminate accordingly. Note that the social influence does not change the incentive compatibility constraints, nor does it provide new incentives to customers. Therefore, the optimal prices the seller will set will be exactly the same as before: the seller will set $P = V_H$ if only serving the high types, and will set $P_L = V_0$ and $P_H = V_H - V_L + V_0$ if serving both types.

After committing to the pricing scheme, the seller will offer a pre-sale period by making available some quantities of the product. We denote by Q_L the quantity made available of the low quality product, and by Q_H the quantity made available of the high quality product. The producer will ration some customers by setting $Q_L \leq (1-\phi)N$, and $Q_H \leq \phi N$. We denote the resulting excess demand by $x = N - Q_H - Q_L$. Naturally, if a one price commitment has been made, the only rationing will be possible in the high end segment, and the resulting excess demand will simply be $x = \phi N - Q_H$.

Based on the realized excess demand, with some probability $p(x)$, each remaining low type customer will update his belief about the product and become high type. We assume the probability function to be of the form $p(x) = \alpha f(x)$, where α is a parameter measuring the sensitivity to social influence, and $f(x)$ is a single-peaked function which reaches its maximum value of one at some x^* and is increasing for $x < x^*$ and decreasing for $x > x^*$. We also require $f(x) = 0$ if no excess demand is created or if the entire market is being rationed. The parameter α speaks of how likely it is for a particular seller to be impacted by social influence. Consider for instance, that some sellers have established a history of quality and reliability, and therefore are less likely to be affected by social influence. On the other hand, relatively new sellers, or sellers who introduce revolutionary products with no previous public exposure, are more likely to face uninformed customers who are more likely to be influenced by any sort of advertising strategy. The probability function $f(x)$ simply states that the probability that a low type customer is influenced by the observed excess demand is increasing in x for relatively small values of x, and decreasing if the excess demand becomes too big. In other words, for limited values, the larger the excess demand, the more people believe that the product is good. However, if excess demand becomes too big, people start getting angry or start feeling deceit. As mentioned earlier, we denote by x^* the level of excess demand that maximizes the function $f(x)$. Naturally, $f(x^*) = 1$ and $p(x^*) = \alpha$. After the excess demand is realized during the pre-sale period and the social externalities affect the market shares of customers, the seller produces as much as needed to clear the market.

3.1 One Price Commitment

We now analyze the optimal choice of the seller in the sub-game corresponding to a one price commitment strategy. If the seller commits to only serving the high end of the marker, he will set the price $P = V_H$, offer a quantity of Q_H during the pre-sale period, realize an excess demand of $x = \phi N - Q_H$, and generate the following profit:

$$\pi_{X1} = Q_H V_H + x V_H + p(x)(1-\phi)NV_H$$

The seller will have to optimally choose the level of excess demand by choosing how much to supply during the pre-sale period. The seller's problem can be written as:

$$\max_{Q_H} \pi_{X1} = V_H[\phi N + p(x)(1-\phi)N]$$

Taking the appropriate derivative, we obtain the marginal effect of changing Q_H:

$$\frac{\partial \pi_{X1}}{\partial Q_H} = (1-\phi)NV_H \frac{\partial p(x)}{\partial x}\frac{\partial x}{\partial Q_H} = -\frac{\partial p(x)}{\partial x}(1-\phi)NV_H$$

which is negative for $x < x^*$ and positive for $x > x^*$. This means that, as long as the level of excess demand is smaller than x^*, the seller can increase his profits by lowering Q_H. The maximum level of profits is reached when Q_H is chosen in such as way as to generate an excess demand exactly equal to x^*. Of course at this level of excess demand, $p(x^*) = \alpha$ and the seller's profit will be:

$$\pi_{X1} = NV_H[\phi + \alpha(1-\phi)]$$

3.2 Two Prices Commitment

We now turn to the more interesting case of price discriminating under social influence. If the seller chooses to serve the entire market, he will offer both qualities and set the incentive compatible prices $P_L = V_0$ and $P_H = V_H - V_L + V_0$. The seller will also choose quantities Q_L and Q_H to offer during the pre-sale period, which will induce an excess demand of $x = N - Q_H - Q_L$. After the pre-sale period, the residual demands in the two different market segments will be $x_L = (1-\phi)N - Q_L$

and $x_H = \phi N - Q_H$. The seller's profit when using two prices will be:

$$\pi_{X2} = Q_H P_H + Q_L P_L + x_H P_H + x_L p(x) P_H + x_L[1 - p(x)]P_L$$

which can be rewritten as:

$$\pi_{X2} = P_H[\phi N + p(x)x_L] + P_L[Q_L + (1 - p(x))x_L]$$

The seller can collect P_H from all the initial high types plus the transfers due to the externality, and P_L from the initial low types served during the pre-sale period plus the leftover low types after the externality takes effect. As before, it is in the seller's interest to generate excess demand and increase the number of transfers from the low type group to the high type group. The seller can achieve the same excess demand by rationing either the low types or the high types. In order to see in which group rationing is more profitable, we analyze the marginal effects of changing Q_H, and Q_L respectively:

$$\frac{\partial \pi_{X2}}{\partial Q_H} = (P_H - P_L)[(1 - \phi)N - Q_L]\frac{\partial p(x)}{\partial x}\frac{\partial x}{\partial Q_H}$$

$$\frac{\partial \pi_{X2}}{\partial Q_L} = (P_H - P_L)[(1 - \phi)N - Q_L]\frac{\partial p(x)}{\partial x}\frac{\partial x}{\partial Q_L} - p(x)(P_H - P_L)$$

Since $\frac{\partial x}{\partial Q_H} = \frac{\partial x}{\partial Q_L} = -1$, we can draw a number of conclusions from analyzing these marginal effects. The first, and most important conclusion is that rationing the low end by lowering Q_L is always more profitable than rationing the high end and lowering Q_H. Secondly, lowering Q_H is only profitable if the resulting excess demand is $x \leq x^*$, while lowering Q_L can also be profitable for some levels of excess demand $x > x^*$. For later purposes, we denote by $\tilde{x}$ the level of excess demand where further lowering Q_L becomes unprofitable. Intuitively, lowering Q_H simply affects profits by increasing x and the value of the externality function $p(x)$. This benefits stop once we reach x^* and the maximum value of the externality function. On the other hand, lowering Q_L has a double effect: it increases the excess demand and the value of the externality function in a similar fashion, and also it increases the size of the low end market available for this externality to affect. This is why it is always better for the seller to first ration the low end, and this is also why the seller will sometimes ration the low end even past the optimal threshold where the externality function in maximized, an extent to which he will never ration the high end. Of course, the seller can never ration more than the original market share, and therefore, depending on these initial market shares, a few distinct cases emerge.

First, let's assume that there are not enough low type customers on the market to reach the top of the externality function by only rationing the low types. That is to say, assume $1-\phi < \frac{x^*}{N}$. In this case, the seller will fully ration the low types by setting $Q_L = 0$, then continue to ration the high types until he reaches the desired level of excess demand $x = x^*$. In this case, the externality function will be $p(x^*) = \alpha$. The seller's profit in this case will be:

$$\pi^*_{X2} = NV_0 + N(V_H - V_L)[\phi + \alpha(1-\phi)]$$

Now, let's consider the case where there are enough low type customers to reach the top of the function $p(x)$ without needing to ration the high types at all. In this case, the entire excess demand will be created by rationing the low types, since it is never optimal to ration the high types past the point where $x = x^*$. There are however, two separate scenarios here. Remember that, given enough low type customers, one should lower Q_L until he reaches the point $\tilde{x}$, where it is no longer profitable to do so. We know that $1-\phi > \frac{x^*}{N}$, so there are enough low types to ration and reach x^*, but we don't know whether there are enough low type customers to reach $\tilde{x}$, since $\tilde{x} > x^*$. If there are enough low type customers, $1-\phi \geq \frac{\tilde{x}}{N}$, then the seller will set $x = \tilde{x}$ and obtain the following profits:

$$\tilde{\pi}_{X2} = NV_0 + (V_H - V_L)[\phi N + p(\tilde{x})[(1-\phi)N - Q_L]]$$

If however, there are not enough low types and $\frac{x^*}{N} < 1-\phi < \frac{\tilde{x}}{N}$, then the seller will do his best and fully ration the low types by setting $Q_L = 0$. In this case the excess demand realized will be some $\hat{x}$, with $x^* < \hat{x} < \tilde{x}$, and the seller's profit will be:

$$\hat{\pi}_{X2} = NV_0 + N(V_H - V_L)[\phi + p(\hat{x})(1-\phi)]$$

Note that $x^* < \hat{x} < \tilde{x} < N$ and, since the function $p(x)$ is decreasing in this region, we will have $\alpha > p(\hat{x}) > p(\tilde{x}) > 0$. It is easy to see that the presence of social externalities increases profits and creates excess demand on the market no matter what scenario we consider. For further insights, especially to see the effects of social externalities on the decision to price discriminate, we now have to analyze, case by case, the seller's optimal strategy regarding which market segments to serve, and compare the results with those found in the benchmark model.

3.3 Profit Comparisons

In order to see whether the seller will decide to use price discrimination, or just serve the high end of the market, we need to compare the profits obtained under a one price commitment with the profits obtained from offering two versions of the product and price discriminating accordingly. Summarizing the previous results, the seller will obtain the following profits:

$$\begin{cases} \pi_{X1} = NV_H[\phi + \alpha(1-\phi)], \text{ if the seller uses a one price commitment strategy} \\ \pi^*_{X2} = NV_0 + N(V_H - V_L)[\phi + \alpha(1-\phi)], \text{ if the seller price discriminates and } 1-\phi \leq \frac{x^*}{N} \\ \tilde{\pi}_{X2} = NV_0 + (V_H - V_L)[\phi N + p(\tilde{x})[(1-\phi)N - Q_L]], \text{ if the seller price discriminates and } 1-\phi \geq \frac{\tilde{x}}{N} \\ \hat{\pi}_{X2} = NV_0 + N(V_H - V_L)[\phi + p(\hat{x})(1-\phi)], \text{ if the seller price discriminates and } \frac{x^*}{N} < 1-\phi < \frac{\tilde{x}}{N} \end{cases}$$

First, assume the first case, where $1-\phi \leq \frac{x^*}{N}$. Under this case, the seller will decide to only serve the high type customers if:

$$\begin{aligned} &\pi_{X1} > \pi^*_{X2} \\ \Leftrightarrow\ &NV_H[\phi + \alpha(1-\phi)] > NV_0 + N(V_H - V_L)[\phi + \alpha(1-\phi)] \\ \Leftrightarrow\ &NV_L[\phi + \alpha(1-\phi)] > NV_0 \\ \Leftrightarrow\ &\phi + \alpha(1-\phi) > \frac{V_0}{V_L} \end{aligned}$$

Note that, in the benchmark case, the condition for serving the high types only was $\phi > \frac{V_0}{V_L}$. Since $0 \leq \alpha \leq 1$, we have $\phi \leq \phi + \alpha(1-\phi) \leq 1$. Comparing the benchmark case with the externality case we conclude that for certain values of the parameters, social influence reduces the incidence of price discrimination. More specifically, if $\phi < \frac{V_0}{V_L} < \phi + \alpha(1-\phi)$, the seller would find it optimal to price discriminate if there were no externalities present, but only serves the high type customers under social influence.

Considering the second case, when $1-\phi \geq \frac{\tilde{x}}{N}$, the seller will only offer the product to the high type customers if:

$$\begin{aligned} &\pi_{X1} > \tilde{\pi}_{X2} \\ \Leftrightarrow\ &NV_H[\phi + \alpha(1-\phi)] > NV_0 + (V_H - V_L)[\phi N + p(\tilde{x})[(1-\phi)N - Q_L]] \end{aligned}$$

which, after adding and subtracting the term $\alpha(1-\phi)NV_L$ from the right hand side, and rearranging becomes:

$$(V_H - V_L)[\alpha(1-\phi) - p(\tilde{x})(1-\phi) + \frac{p(\tilde{x})Q_L}{N}] + V_L[\phi + \alpha(1-\phi)] > V_0$$

Let $\tilde{\varepsilon} = \frac{V_H - V_L}{V_L}[(1-\phi)(\alpha - p(\tilde{x})) + \frac{p(\tilde{x})Q_L}{N}]$. Note that $\tilde{\varepsilon} > 0$, since $\alpha > p(\tilde{x})$. We can rewrite the above condition as:

$$\phi + \alpha(1-\phi) + \tilde{\varepsilon} > \frac{V_0}{V_L}$$

Again, compared with the benchmark case, there is wedge between ϕ and $\phi + \alpha(1-\phi) + \tilde{\varepsilon}$ where the seller does not find it optimal to price discriminate anymore when social externalities are present. This wedge is even more pronounced that the one from the previous scenario due to the addition of $\tilde{\varepsilon}$, and also due to the fact that $1-\phi$, the proportion of low type customers, is higher in this scenario. Even more so, under certain values of the parameters, the addition of the $\tilde{\varepsilon}$ term might raise the whole lefthand side of the inequality above 1, and in that case, the seller will always find uniform pricing preferable to price discriminating.

Finally, considering the third possible case, when $\frac{x^*}{N} < 1-\phi < \frac{\tilde{x}}{N}$, the seller will choose to only serve the high end of the market if:

$$\pi_{X1} > \hat{\pi}_{X2}$$

$$\Leftrightarrow NV_H[\phi + \alpha(1-\phi)] > NV_0 + N(V_H - V_L)[\phi + p(\hat{x})(1-\phi)]$$

Adding and subtracting $\alpha(1-\phi)V_L$ on the righthand side, yields after rearranging:

$$(V_H - V_L)[\alpha(1-\phi) - p(\hat{x})(1-\phi)] > V_0 - \phi V_L - \alpha(1-\phi)V_L$$

Let $\hat{\varepsilon} = \frac{V_H - V_L}{V_L}[(1-\phi)(\alpha - p(\hat{x})]$. The above condition becomes:

$$\phi + \alpha(1-\phi) + \hat{\varepsilon} > \frac{V_0}{V_L}$$

which just as before, compared with the benchmark model, creates the same situation where the seller does not find it profitable anymore to offer both qualities and price discriminate under social influence. Moreover, for a large enough $\hat{\varepsilon}$, the seller will always use uniform pricing and price discrimination will be completely eliminated. Figure 1 presents a graphical representation of the analysis regarding the incidence of price discrimination in the benchmark case versus the social influence case for the first scenario. One can observe the wedge created by the social externality, between ϕ and $\phi+\alpha(1-\phi)$. In this region, the seller would serve both market segments and price discriminate in the absence of social influence, but will only serve the high end of the market when social externalities exist.

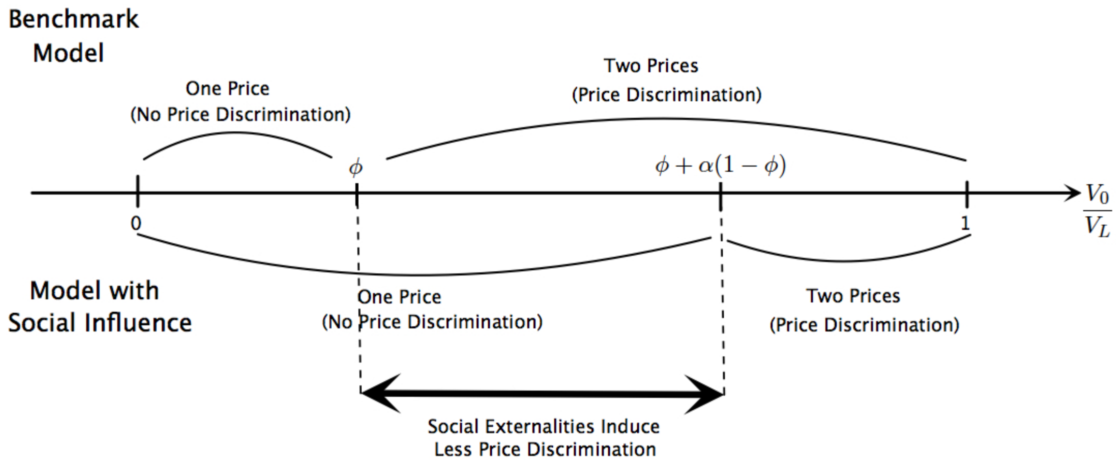

Figure 1: The Incidence of Price Discrimination

Note also that if the social influence becomes maximal, that is if $\alpha = 1$, price discrimination is completely eliminated since $\frac{V_0}{V_L} \leq 1$. The analysis for the other two cases, where the level of excess demand is $\tilde{x}$ or $\hat{x}$ is analogous, with the only difference that the point $\phi+\alpha(1-\phi)$ gets moved further to the right by the additional terms $\tilde{\varepsilon}$, or respectively $\hat{\varepsilon}$. This additions increase the wedge further, and even more so, price discrimination can be completely eliminated even for smaller values of α, as long as $\tilde{\varepsilon}$ or $\hat{\varepsilon}$ are high enough. It is also easy to observe from the graph that, for given ϕ and given customer valuations, sellers with larger sensitivity to social influence price discriminate less. This is consistent with the empirical observations that cult products firms do not usually offer a lot of product differentiation or variety and at the same time they usually target the high end of the market. Apple only offers two versions of a cell-phone, and both of them are smart-phones, while its main competitor Samsung offers phones that cover the entire market spectrum, offering many types of smart-phones and also basic phones. The same kind of empirical findings can be found in the entertainment industry, where less experienced and less successful bands price discriminate less. Less experienced and successful bands have more uninformed customers and their customers are more likely to be influenced by social interactions in forming their beliefs regarding the quality of the shows.

4 Robustness and Empirical Support

We have presented a very simple model with two types of consumers and social influence that acts in a way that increases consumers preferences for a certain product. All the functional forms used in modeling social influence and any other assumptions were designed for the sake of simplicity and to be able to show clearly certain intermediate results. The main results of this model are however beautifully simple: at any time social influence affects consumers preferences in an upward fashion, the profitability of price discrimination is reduced. This is fully robust to any other functional form assumption or even when we consider a continuum of types. The result hinges on a simple comparative static of second degree price discrimination models: price discrimination becomes less profitable the more high type consumers there are. If social influence shifts any consumers from the low to the high end, the profitability of price discrimination is reduced. In the continuum of types case, shifting the distribution of types essentially raises the cutoff point below which consumers do not get served.

To provide empirical support, we assemble a small but suggestive sample of 45 popular music concerts. We collect pricing data from Ticketmaster, which is the largest box office system in the United States. There is evident variation in the levels of price discrimination used on these markets. Some concerts are uniformly priced, some others offer various degrees of price differences. We analyze the promoters' price discrimination decision by regressing the number of different price levels used on various artist and location characteristics. Since concerts are definitely social goods that are consumed in groups the fit perfectly the Becker type social influence. At the same time there are arguably other types of social influence present, such as informational issues. It is virtually impossible to quantify the sensitivity to social influence for different artists, but we should expect more famous and experienced artists to have consumers that are less sensitive to social pressure. The more information there is about an artist, the more should we expect consumers to form individual opinions and preferences. At the other extreme however, when an artist is not as well known, consumers often rely on social pressure to form preferences and hence for these artists we should expect higher sensitivity to social influence. The estimation results are presented in the following table:

The variable **Debut Album** represents the year of the debut album and is hence a proxy for experience and how well known an artist is. The variable **Success** is a proxy for sales success of an artist as given by gold, platinum, and multi-platinum records. It also points to how well

Table 1: Price Discrimination Regression – Dependent Variable: Price Levels

Variable	Coefficient	(St. Error)
Debut Album	-0.12**	(0.02)
Success	0.06**	(0.01)
Albums	-0.27**	(0.04)
Last Album	-0.30*	(0.17)
Population	-6.43e-08*	(2.99e-08)
Income	-0.000054**	(0.000015)
Weekend	0.21	(0.16)
const	849.26**	(318.01)

*-significant at 5% level; **-significant at 1% level; $R^2 = 0.8187$

known an artist is. As mentioned earlier we argue that better known artists have consumers that are less sensitive to social influence and according to the model they should price discriminate more. This is exactly the pattern observed in the data. At the same time, success and experience aside, artists with a higher number of recorded albums or with newer recorded albums should experience higher sensitivity to social influence and should therefore price discriminate less since, relatively speaking, information is limited for more recent albums. Once again, these patterns are present in the data. The variable **Albums** represents the total number of recorded albums, and the variable **Last Album** represents the year of the last studio album and hence a measure of how recent the album is. Moving on to the market specific characteristics we see that price discrimination is used less on larger markets and on richer markets. Larger and richer markets are arguably more sensitive to social influence as there are more people that can create fashions and fads and also richer consumers with lower price elasticities are generally more likely to base their preferences on fads and fashion. Both these effects are therefore supporting the idea that when social influence is stronger, sellers price discriminate less. While some of the observed effects might have alternative explanations, the fact that no single effect contradicts the theory is highly suggestive that social influence plays a critical role in determining the optimal decision to price discriminate for a monopolist. Similar stories can be found on other markets as well. Consider cult product markets or certain trendy electronic products versus mainstream products. We can easily observe that cult or fashionable products, or products that are recently introduced on the market are generally offered in limited variability and price discrimination is limited in these cases. For instance Apple only offers smartphones geared towards high valuation consumers, while their main competitor Samsung offers a wide range of phones from smartphones to basic phones. This is in full agreement with the theory.

5 Conclusions

We have studied the effects of social influence on the seller's incentives to maintain excess demand and to price discriminate. Social influence increases total profits by inducing some low type customers to revise their beliefs regarding the overall quality of a product. Under social influence, sellers have incentives to create and maintain excess demand during pre-sale periods or from sale to sale in the case of frequent, repeated sales. This excess demand can be achieved by rationing some of the customers. It is always in the seller's best interest to ration the low end of the market first. Also, we showed that, when compared to a benchmark case with no externalities, having social influence reduces the profitability and incidence of price discrimination. The incidence of price discrimination is negatively correlated with the sensitivity to social influence. For sufficiently high sensitivity to social influence, price discrimination is completely eliminated. This findings are consistent with the empirical observations that we observe for certain cult products and live entertainment events.

In light of these findings, we urge the audience to re-evaluate the claim that secondary markets emerge as a result of some sub-optimal pricing or marketing strategy. In the presence of excess demand there are gains to be made from arbitraging goods from lower valuation consumers to higher valuation ones and speculators achieve that. However, maintaining excess demand and not fully price discriminating can be profit maximizing strategies on those markets that are affected by social influence. The presence of social influence is certainly not the only plausible explanation for why firms might want to ration the market, but it is the one thing that can explain both persistent excess demand and a low incidence of price discrimination.

The authors acknowledge the fact that the channels and mechanisms through which social influence affects consumers beliefs and valuations need to be studied more carefully. The results of this paper should therefore not viewed as general or applicable to every market. They are merely suggestive of the effects that one should expect on markets characterized by this type of social influence. We believe that many markets posses such uninformed or impressionable consumers who are affected by social elements in revising their beliefs and valuations, and we believe this phenomenon should be given more attention by researchers.

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