Targeted Consumer Information and Prices: The Private and Social Gains to Matching Consumers with Products

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Abstract

It is well known that product differentiation increases both prices and profits, other things equal. What is less well understood is how the distribution of consumer preferences affects firms' incentives to differentiate their products. This paper focuses on the incentive of firms to reveal truthful information about product attributes. Because consumers' preferences differ, the revelation of this information differentiates products. The profitability of inducing this differentiation is shown to

I. Introduction

Is one better off being part of a small group, or a large one? In some contexts, there are clear advantages to being part of a small group. For example, it has been estimated that wages for individuals in smaller age cohorts earn more when entering the job market than those in larger cohorts (see, e.g., Welch, 1979). In other circumstances, there are advantages to being part of a large group. Some cases in which being part of a large group is advantageous include the outcome of voting and the purchase of products for which there is significant R&D required to create the product, such as pharmaceuticals and automobiles. With the graying of the baby boom generation, it is not surprising that products such as the prescription hair loss treatment Propecia and night-vision windshields for automobiles have reached the market.

In these two examples, the existence of a large market for a product appears to justify the high R&D expenses undertaken by the producer. This paper highlights a second, perhaps subtler advantage to being a member of a large group. Suppose a producer can develop information that shows his brand of a product works well for a specific "targeted" subset of the population (e.g., the effectiveness of his drug for a specific age group), but poorly for another group. Such "matching" information may not increase his unit sales, but can be profitable because it differentiates his brand, leading to higher prices.[1]

Previous work, such as Anderson and Renault (*A&R*, 2000) and Meurer and Stahl (*M&S*, 1994), has shown that information of this type can increase prices. Because information revelation leads to higher prices, which induce a transfer from consumers to producers, information may be

[1]In contrast, Grossman and Shapiro (1984) show that information about the existence and prices of rival goods results in greater substitutability between products, and lower prices.

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group required for obtaining FDA approval to list an additional indication or patient population for a drug is independent of the size of the user population). However, a second reason is suggested by this analysis; information about the suitability of a drug for male patients has a more-than-proportionally larger effect on price than information about female patients.

Explicitly modeling the role of group size permits analysis of another issue relating to the profitability of information revelation. An assumption made in the previous literature is that information is symmetric; that is, when information revelation increases the willingness to pay for a group who learn the brand is well-suited to them, there is another group of *the same size* whose willingness to pay falls. There are, however, circumstances in which information can have an asymmetric effect, whereby the size of the group whose willingness to pay increases is different from that of the group for whom it falls as a result. For example, suppose clinical trials have revealed that drugs A and B are equally effective in treatingr.sTJ 0 Tcs6stancers Tw 231 t.t(s(]2(outa1.44 0 Td0.72 Tw 4a5iou

[3]In section V, I discuss the alternative interpretation that the information about the efficacy of drug for one group has no effect on the expected efficacy by patients in other groups.

remaining 80%.

[4] In the drug example, *product* corresponds to a class of drugs (e.g., H_2 antagonists for ulcers) and *brand* corresponds to a specific chemical (e.g., Tagamet or Zantac). Note that specific differences in the relative efficacy of drugs within a class for different individuals can sometimes be dramatic. For example, while the two leading anti-herpetics are roughly equally effective for most patients, only one is approved for use in immuno-compromised (e.g., HIV positive) individuals. One example of $,_{ij}$ is consumer j's valuation of the side effects of drug i.

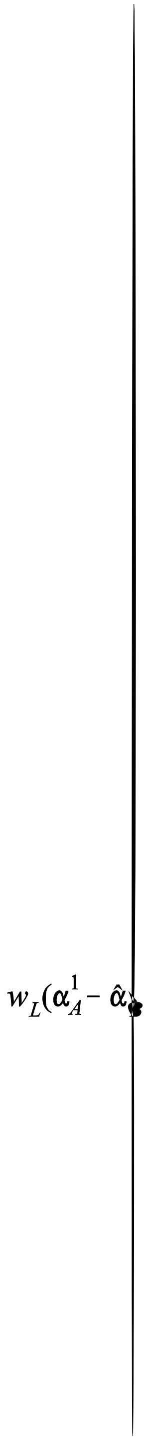
$$Q_A = \sum^{K}$$

[5]This use of the term *drastic* parallels the use in the R&D literature (see, e.g., Reinganum, 1988). In the R&D literature, drastic refers to a cost reduction due to innovation that is sufficiently large that the old technology is not a binding constraint on the seller of the innovation. Analogously, here drastic refers to information that leads to the rival brand no longer serving as a constraint when selling to the targeted group.

[6]The condition that $f(\bar{e}) = f(-\bar{e}) = 0$ implies that demand is continuously differentiable.

[7]In M&S, $,_{ij}$ = V for one product, and zero for the other, while the $,_{ij}$ are I.I.D. in the A&R model.

[8]In section V, I consider a different interpretation of information, where the average efficacy changes with the information. Specifically, section V considers what happens if $"_A^k$



remains equal to ^ for other groups, while "$_A^1$ > ^.

$$Q_A = \frac{1 -}{}$$

$$P_A^s = P_B^s = \frac{1}{2(1-2\ w_1)}$$

[9]Information costs are here modeled as if firm A knew "$_A^1$ and was calculating the profitability of publicizing that information. A more realistic interpretation (which is analytically similar) is that information costs include the manufacturer's cost of conducting the R&D to determine "$_A^1$ (multiplied by the probability he finds "$_A^1$ > ’^) plus the costs of publicizing that information.

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$k(\delta - 1)4$

[10]For some drugs, there may be some specialization between physicians and patients (i.e., pediatricians), so that it may be fairly inexpensive to target the relevant group.

[11]Perhaps in recognition of this effect, the FDA offers incentives for drug companies to perform clinical studies on children (who often represent a small share of patients).

Holding the average quality of a brand of a product fixed, information that reveals a superior match between that brand and consumers in a specific group necessarily reduces the suitability of that brand for some or all of the remaining population. In some circumstances, it is plausible that, contrary to the assumption of symmetry made in the previous section, this reduction in suitability occurs for a different-sized group than the group that experiences increased suitability.[12] As discussed in an earlier example, information that a drug is particularly suitable to patients under 20 years old could be interpreted as information that it is less suitable for all patients 20 and over.

This section explores the implications of such asymmetric information on prices and profits. I assume that the information has a positive effect on the suitability of a brand of a product for a targeted group representing less than one-half the population. I further assume that the cost of informing this group are the same whether the information is symmetric or asymmetric. Finally, I assume that the information has a negative effect on the remaining population that is uniform across all non-targeted groups.[13] That is, firm A's information is that α_A^1 is greater than $\bar{\alpha}$ and $\alpha_A^k = (\bar{\alpha} - w_1 \alpha_A^1)/(1-w_1) < \bar{\alpha}$ for all non-targeted groups, with $w_1 < ½$ and α_A^k non-drastic (although α_A^1 may be drastic). Not surprisingly, such information increases sales to the targeted group, and reduces sales to the other groups. As Proposition 3 shows, the second effect dominates and total sales fall.

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[12] A third possibility, which is discussed in section V, is that an increase in α_A^1 has no effect on the other α_A^k, in which case the information increases average quality.

[13] Of course, information could also be asymmetric if the group whose α_A fell comprises less than all of the remaining population. If the group whose α_A falls is actually smaller than the group for whom it rises, the analysis is similar, except that the effects on the two firms are reversed. That is, similar analysis to Proposition 3 shows that firm A's sales increase from revealing the information.

$$Q_A = \frac{1}{2} + \frac{(1-2}{\qquad}$$

[14] Holding $"_B{}^k$ = ^ for all k, $\partial P^*_B(P_A)/\partial "_A{}^1 > 0$ if w_1 is less ½. That is, the information shifts out B's best response function. However, the effect on $P^*_A(P_B)$ is ambiguous, so that the effect of information on prices is ambiguous. In fact, as Figure 5 below demonstrates, it is possible that information can lower P_A.

Proof: Follows same logic as Lemma 1. ,

The intuition behind these lemmas is that compared to the symmetric case, asymmetric information increases B's

Unfortunately, the relationship between the asymmetric and symmetric reaction curves in the drastic case depends on the values of the two parameters. For example, when $\alpha_A^1 - \hat{\alpha} = 1$, prices and profits are higher for both firms in the symmetric equilibrium than in the asymmetric one for all values of w_1. In fact, for certain values of w_1, firm A's profits with drastic asymmetric information can actually be lower than in the initial, "no information" equilibrium. The reason is that drastic asymmetric information increases a small group's valuation of brand A by a large amount, while reducing a large group's value of it by a small amount. Since the density function is lower when evaluated at higher values of $|\alpha_A^k - \alpha_B^k|$, large changes in information have proportionately smaller effects on sales than small changes.[15] Hence, firm A's sales fall, and even though its (absolute) demand elasticity falls as well, the net effect on A's profits could be negative. Figure 5 shows the relationship between $\alpha_A^1 - \hat{\alpha}$ and firm A's prices and profits for $w_1 = .1$. Note that in both the asymmetric and symmetric equilibria, both prices and profits are increasing in α_A^1 for $\alpha_A^1 - \hat{\alpha}$ non-drastic (i.e., less than 1). However, for $\alpha_A^1 - \hat{\alpha} > 1$, A's profits in the asymmetric case are decreasing in α_A^1, and eventually firm A's profits are below those in the no information equilibrium.

The direct implication of this analysis is that firm A may not have an incentive to disclose targeted information, even if the generation and dissemination of that information is costless. This contrasts with symmetric targeted information, which always increases revenue. While targeted information can be both socially and privately productive, previous literature has shown that the incentive to gather and disseminate this information may be excessive from a social perspective. The next section reexamines this result for asymmetric information.

[15] Of course, if the targeted group is sufficiently large, and the change induced by the information is sufficiently large, condition (6) is no longer satisfied, and firm A increases its profits by revealing the information, and then selling to group 1 only.

receives transfers from inframarginal consumers).

The representation of information in the model presented here is somewhat different from representations

	$[\int_{-1}^{0} (\alpha_A^1 - \hat{\alpha} + R)(1$	

clinical trials, so that a rational consumer should interpret an increase in the success rate of the drug for a group to which she does not belong as a decrease in the likelihood the drug will work for her.

An alternative interpretation of targeted information is the news that a product is more appropriate for the targeted group has no effect on the perceived value of that product to the remaining population. In this case, the targeted information has two effects on consumers. It increases the average quality of the product, while simultaneously increasing the extent of differences across groups in the market. This latter effect was dealt with in sections II and III, while the effects of increases in one firm's quality are well-established (see, e.g., Tirole, 1988 at 296/7). Hence, the implications of this alternative interpretation of targeted information on prices and outputs can be readily discerned using the intuition from these other models.

In particular, the effects on prices of firm A's targeted information depend on whether the information is drastic. Drastic information shifts A's reaction curve out, while it leaves B's unchanged (its first-order condition is simply multiplied by (1-w), leaving its optimal price unaffected). Hence, drastic information leads to higher prices for both firms. In contrast, non-drastic information leaves the demand for brand B from non-targeted groups unchanged, while reducing the targeted group's demand for it. Hence, non-drastic information shifts B's reaction curve in, while shifting A's out, so that the net effect on both prices is ambiguous. However, under the F(R) analyzed in sections III and IV, this information causes B's price to fall while A's rises.

While the model assumes that consumers know their own $,_{ij}$, I do not model how they learn their $,_{ij}$'s. The model most readily lends itself t

off. Since information is less likely to be produced for small groups, this implies that the information that does get produced will tend to harm members of small groups.

A second relevant aspect of information is whether it is symmetric. Asymmetric information generally leads to smaller price effects than symmetric information. In fact, asymmetric information may actually lower prices and revenues relative to the no information equilibrium, whereas symmetric information always raises prices and revenues. This implies that firms may choose not to differentiate themselves, contrary to what is sometimes called (e.g., Tirole,1988 at 267)) the "Principle of Maximum Differentiation." Finally, the information content of a message is an important determinant of its welfare consequences. Even though prices are non-decreasing in the information content of the message, the welfare effects are increasing in the information content over some range.

While this paper focuses on differentiation through information revelation, the results can also apply to changes in objective characteristics. For example, suppose there are two important features of a bicycle component; durability and weight, and different groups within the population value these features differently (recreational riders vs. commuters vs. racers). Consider the combination of durability and weight at which the utility of the median user in the population is-0.12 Tw 20c5 show that the profitability of the change will be a function of the size of the group to whom this variety appeals. That is, producing the variety preferred by a sub-population will be more profitable if the sub-population is large, even if the additional total costs are proportional to group size.

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Figure 1 - Symmetric Equilibrium Price as a Function of $\alpha_1 - \hat{\alpha}$

for w = .1, e_{ij} uniformly distributed on (0,1)

Figure 2 - P_A as a function of w_1 in symmetric and asymmetric equilibria

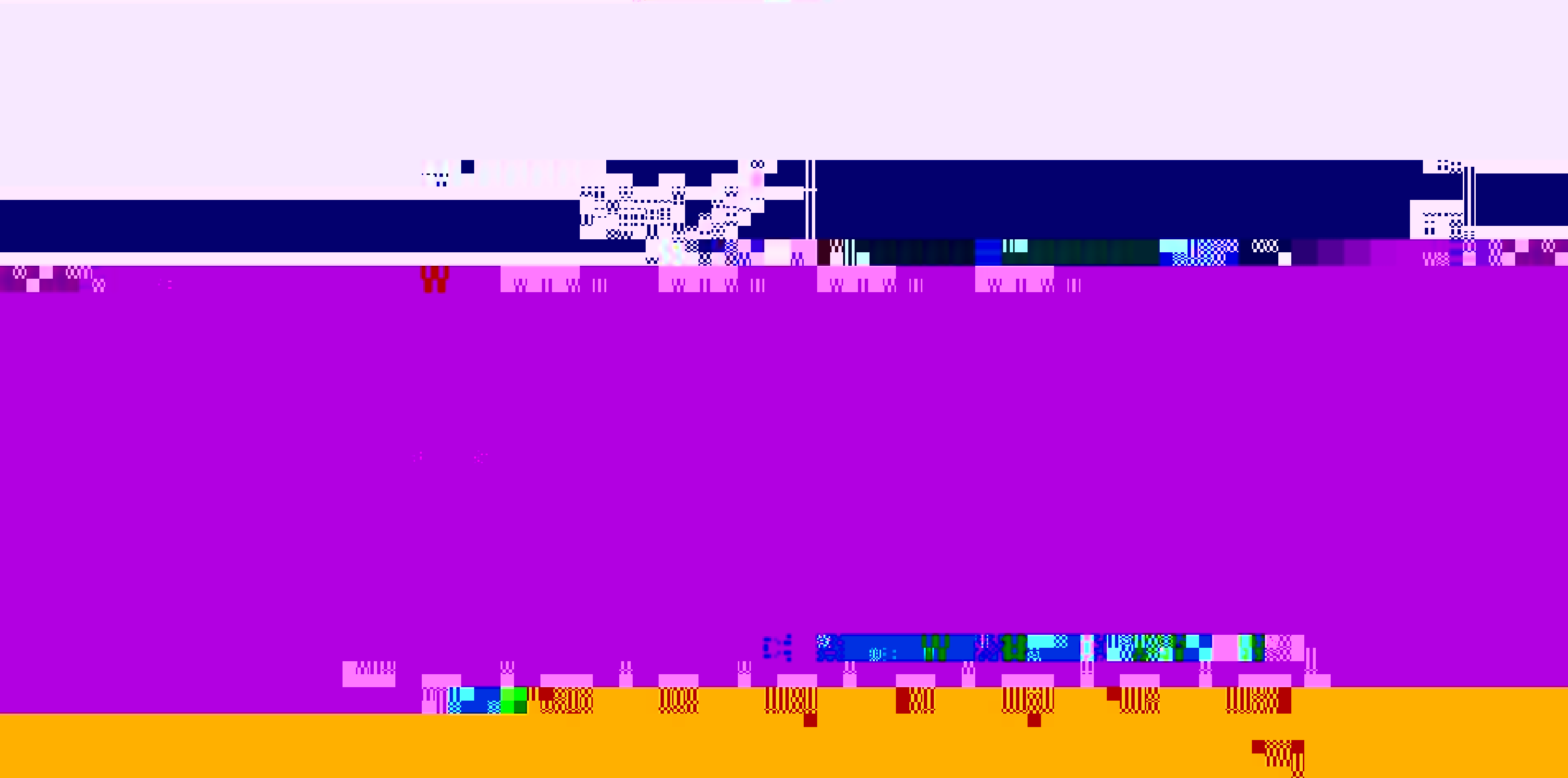

Figure 3 - Firm

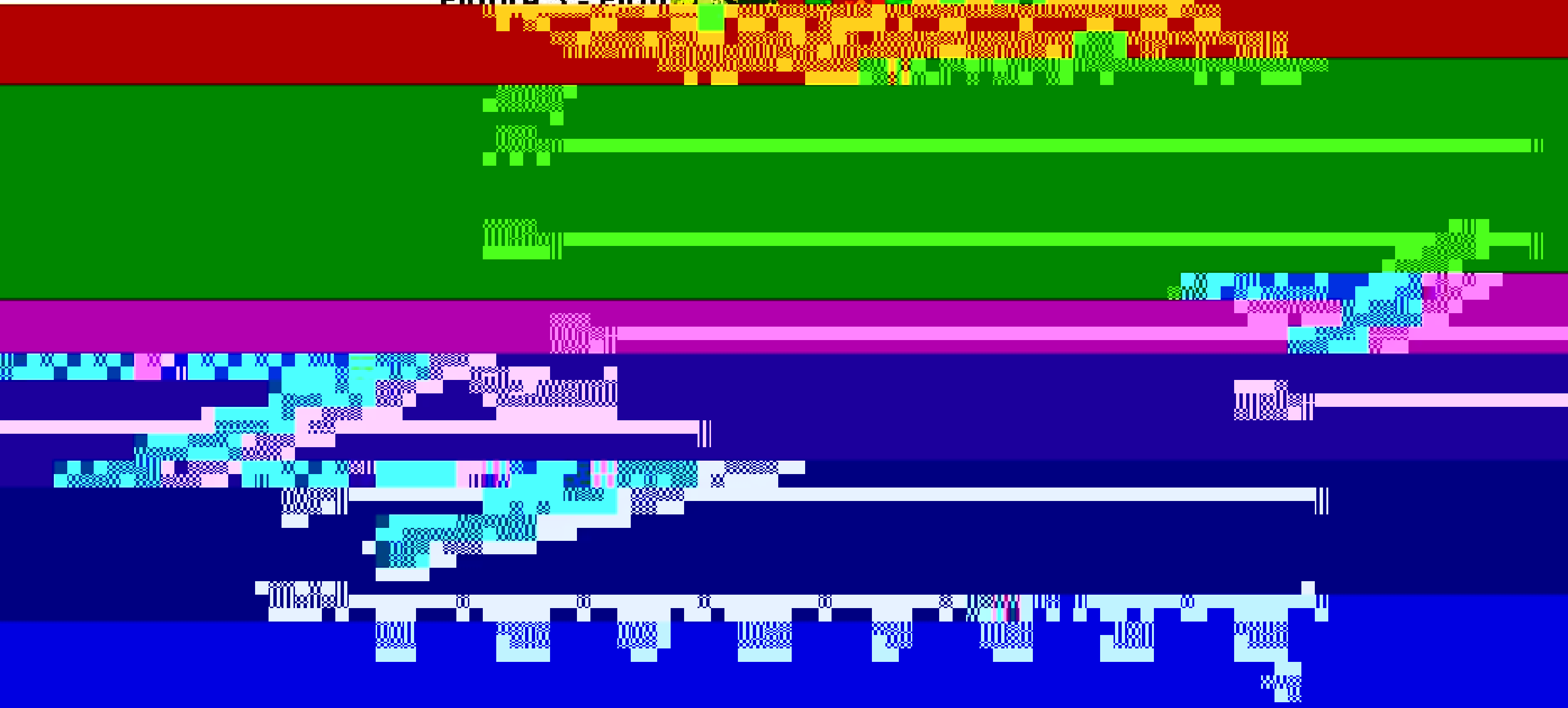

Figure 4 - Firm A's Profits and Prices in the
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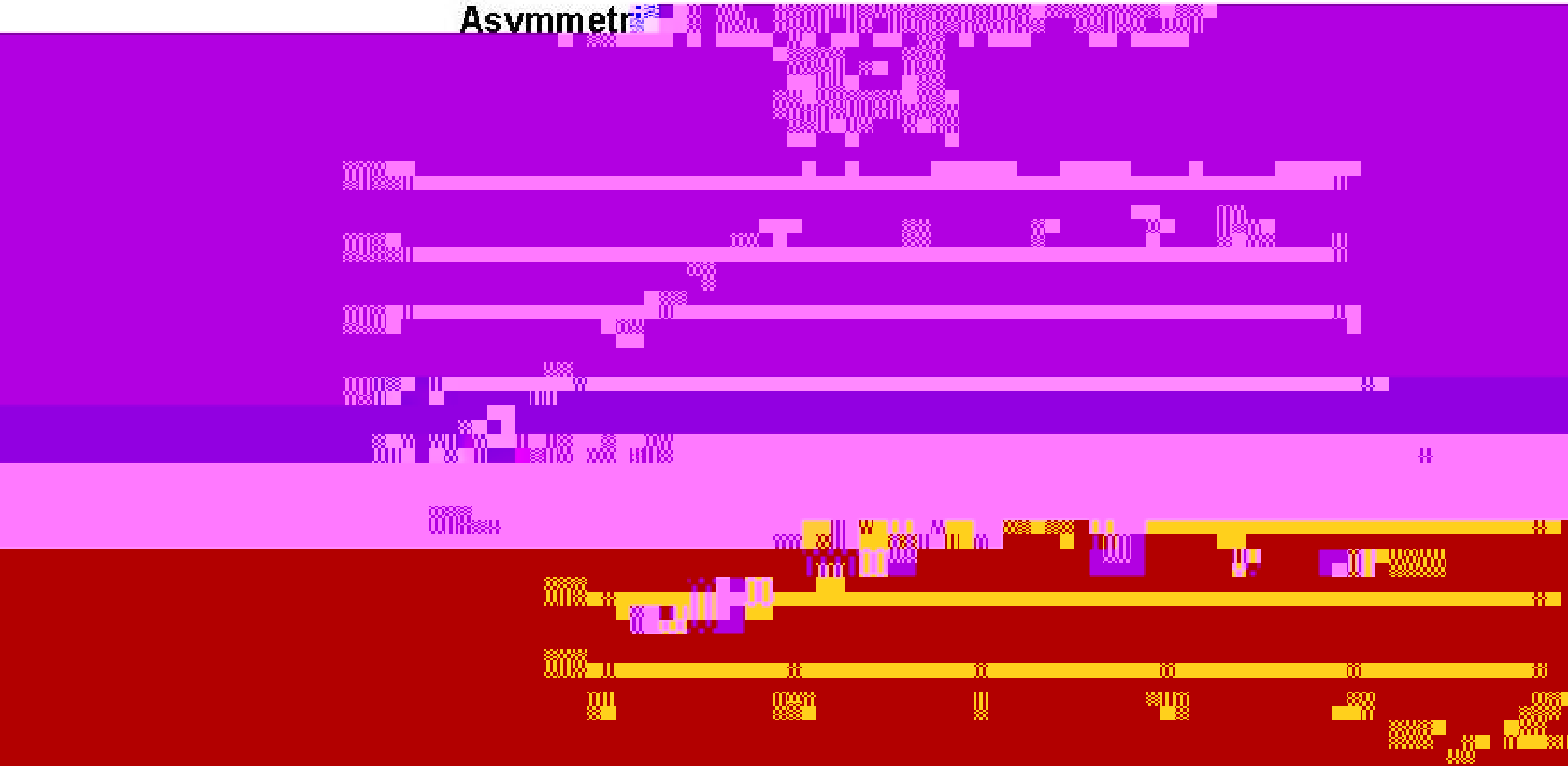

Figure 5 - Firm A's Prices and Profits