Chapter One

Introduction

Products are often described as a bunch of characteristics: location, availability, quality, consumers’ information about its existence, and so on. Each consumer has a ranking of his own over the mix of such characteristics. Depending on the preferences of the consumers, the product space is either horizontally differentiated or vertically differentiated. In a horizontally differentiated product space, consumers differ about their preference ordering when goods are offered at the same price. On the other hand, in a vertically differentiated product space, consumers agree on the preference ranking of the product characteristics. An important aspect of vertical product differentiation is the quality of the product. If two goods of varying qualities are offered at the same price, then all consumers will agree to choose the one of higher quality.

Let us consider the example of laptop computers. Different companies provide laptops, which come in different shapes and sizes, and the products are roughly distinguishable by their technical specifications, like the type of the processor, installed memory, size of the hard drive, etc. A typical buyer of such laptops comes to the market with a fairly good idea about what the technical specifications actually mean. For example, he knows that a laptop with Core 2 Duo processor is more powerful than the one with Celeron processor. It is quite possible that if the prices of these two types of laptops were the same, then all buyers would prefer the first type of laptop to the second type. In this case, we say that the two types of products are vertically differentiated. Consider now the case of laptops with Core 2 Duo processors. Since, laptops have features other than processing speed, preference rankings may vary across consumers over different laptops even though they have the same processor. In that case, we say that these laptops are horizontally differentiated products.
The quality of a product can have several dimensions – the durability of the product, its reliability, safety, comfort, etc. So, it is not easy to define quality. Sometimes quality can be pinned down in terms of the technical specifications provided by the firms to the consumers before purchase. These specifications provide a reasonably good idea of the performance of the product. For example, when a consumer decides to purchase a car, he is given a list of technical specifications, like its engine capacity, fuel consumption, size, etc. Sometimes even when the technical specifications are given, the signal it provides of the actual performance is noisy. One has to experience the good before actually getting an exact idea about the performance.

The question that arises now is: how do we extend the standard models of imperfect competition to incorporate this distinction between technical specifications and performance? In the simplest case, that of a monopolist who faces identical consumers, the extension is trivial. Compute the maximum profit at each technical specification level, and then pick the level at which this is highest. Extending the scenario to incorporate the possibility that the firm may have two distinct types of consumers, who differ in that one type (high type) of consumer is willing to pay more per unit at each specification level than the other (low type), leads to unanticipated complications, even if we assume that consumers belonging to each group are homogeneous, and arbitrage is not possible. Since arbitrage is not possible by assumption, clearly the firm can profitably price discriminate across consumer types. For each technical specification level, one can find the maximum profit that the firm can earn and pick the level that maximizes its overall profit. The question is: is this the best that the firm can do? What prevents it from offering different price-quality combinations to different types of consumers if that yields higher profits? The standard model of monopolistic quality discrimination deals with this, and related questions [Mussa and Rosen (1978), Cooper (1984), etc.]. We shall have more to say on this in subsequent sections.

The standard models of vertical product differentiation do not distinguish between the...
“quality” of the product, given in terms of the technical specifications and other characteristics of the product, and the actual performance of the product. Our potential consumer of the laptops observes the configurations provided by the firm and forms an idea about different aspects of the quality of the product, like its speed, efficiency, durability, etc. In this sense, in the standard models, quality of the product is observable to the consumers before purchase. However, it may be noted that even when the technical specifications provided to the consumers offer a fairly good idea about the quality of the product, it is almost impossible to get an exact idea about how the product is going to perform before one uses it. In other words, one has to ‘experience’ the product to get an exact idea about the quality. Thus, in not distinguishing between a priori observable features and actual performance, the standard model implicitly presumes that quality specifications, etc. provide a degenerate signal of performance. However, though the technical specifications provide only a noisy signal about the performance of such products, the products may well be vertically differentiated as long as every consumer prefers one commodity to the other. In all the three chapters that follow, we have considered experience goods model.

In what follows, we use the term technical specifications and quality interchangeably as is done in the literature on quality choice. In the literature, there is usually no difference between quality and performance as quality, or technical specification, provides an exact signal of performance. As our concern is with experience goods, technical specifications and performance are no longer synonymous. In this dissertation, quality, or synonymously, technical specifications, provide a noisy signal of actual performance.

In a vertically differentiated model, firms often face consumers who are not homogeneous in nature. Though everybody agrees on the preference ranking, individual valuation about the product differs. In order to serve the entire group of such heterogeneous consumers, the firms often produce different varieties of the same basic product. The varieties differ in the levels of sophistication of their technical features. Again, the markets in these models are not always competitive in nature because of the
presence of asymmetric information: buyers, who are heterogeneous in nature, can observe the quality of the product offered to them, but the firms cannot distinguish among the buyers before the actual sale (Mussa and Rosen (1978), Cooper (1984), etc.). This is actually an adverse selection problem that arises when one party possesses better information that is not available to the other party. The questions that are often raised in the literature in this context are: what would be the optimal price-quality bundles offered by the firms to the consumers who are heterogeneous in nature? Second, do the firms distort the quality levels relative to the Social Planner who has full information? And third, whether a separating menu will be provided, where different types of consumers are offered different price-quality bundles, or is a pooling menu, where all the consumers are provided uniform price-quality bundles irrespective of their types, more desirable?

A monopolist who faces heterogeneous consumers with different tastes often adopts a policy of discrimination in order to appropriate potential consumer surplus. If the firm knows each consumer’s taste then it can capture the entire consumer surplus by charging a price equal to the consumer’s reservation price for the product. In other words, the firm achieves perfect (first degree) discrimination. In case of incomplete information about individual preference, the firm may still be able to extract part of the consumer surplus. In the unit-demand vertical differentiation model, the firms know that some consumers are willing to pay a higher price than others for products of the same quality. If the firm could somehow identify the preference of the consumers then it would be able to charge a high price to a consumer with a high willingness to pay for his good, and a low price to a consumer with a low willingness to pay. However, it is meaningless to ask a consumer about his own preference because the consumer will always have a strong incentive to claim that he has a low willingness to pay so that he will be charged a lower price. Therefore, the firm uses another device, namely, the self-selection device. In order to discriminate between consumers, the firm provides a menu of price-quality bundles to choose from. In doing so, it must ensure that the bundle that is targeted to a particular consumer is not chosen by another consumer. This is the ‘self-selection’ or ‘incentive compatibility’ constraint that makes perfect price discrimination impossible. It may be
noted here that in the presence of imperfect information, perfect price discrimination is not possible. The price discrimination that is practiced in this case is known as second-degree price discrimination.

1.1. Monopolistic Quality Discrimination: The Standard Model

Let us explain the standard story of monopolistic quality discrimination with the help of Figure 1.1.

Consumer Surplus

![Figure 1.1: Consumer surplus at various levels of quality when \( P_{HL}^{max} > P_{LH}^{max} \)](image)

Suppose, the monopolist produces two fixed levels of qualities: \( Q_L \) and \( Q_H \) where \( Q_H > Q_L \), and there are two types of consumers – high type and low type, as discussed earlier. Let the maximum price that the low type consumers are willing to pay be \( P_{LH}^{max} \) and \( P_{HL}^{max} \) when they are offered \( Q_L \) and \( Q_H \) respectively. Similarly, assume that the high type consumers are willing to pay a maximum price of \( P_{LH}^{max} \) and \( P_{HH}^{max} \) when they are offered \( Q_L \) and \( Q_H \) respectively. Let the area ‘a’ denote the value attached to one unit of the commodity whose quality level is \( Q_L \) of a low type consumer and the area ‘g + b’
denote the same for high type consumers. Similarly, let us assume that the valuation of one unit of commodity, of low type and high type consumers are the area ‘d’ and area ‘e + f’ respectively when each of them consumes one unit of commodity of quality \( Q_H \). Let the cost of producing one unit of commodity of quality \( Q_L \) be \( C_L \) and that of producing one unit of commodity of quality \( Q_H \) be \( C_H \) where \( C_H > C_L \). We next consider the following cases:

1.1.1. The Monopolist has full information and can discriminate on the basis of both price and quality

Let us first assume that the monopolist has full information about individual buyer’s preferences and given the fixed levels of qualities \( Q_H > Q_L \), he discriminates on the basis of price only, i.e., he offers same quality to both types but at different prices. For simplicity, assume that there are two potential consumers: one of the high type (with high willingness to pay) and the other of the low type (with low willingness to pay). Then, we can think of the following two possibilities:

i) The monopolist offers \( Q_L \) at price \( P_{LL}^{\text{max}} \) to low type consumers and the price set for high type consumers is \( P_{LH}^{\text{max}} \) for providing same level of quality. The profit of the monopolist is \((a + b + g – 2C_L)\).

ii) \( Q_H \) is offered to low type and high type consumers at price \( P_{HL}^{\text{max}} \) and \( P_{HH}^{\text{max}} \) respectively. The profit in this case is \((d + e + f – 2C_H)\).

With full information, the monopolist knows the level of maximum prices that the consumers are willing to pay at different quality levels and hence is able to extract the entire consumer surplus from them. Between the two possibilities, the monopolist opts for the second one and produces \( Q_H \) if \((d + e + f – 2C_H) > (a + b + g – 2C_L)\). Otherwise, it produces \( Q_L \). If now the market allows quality discrimination as well, then we can think of a third possibility:
iii) The monopolist provides $Q_L$ to low type consumers at price $P_{LL}^{\text{max}}$ and $Q_H$ to high type consumers at price $P_{HH}^{\text{max}}$. The profit of the firm in this case is $(a + e + f - C_L - C_H)$.

In all the three strategies, mentioned above, there is full market coverage and the producer chooses that strategy for which the profit level is maximized.

1.1.2. The Monopolist has full information but can discriminate on the basis of only quality

We now assume that the monopolist still has full information about the market, but can discriminate among the consumers on the basis of quality only. Quality discrimination without price discrimination means that he can offer different qualities to different consumer types, but cannot charge different prices for the same quality to different consumer types. Since, the firm cannot use price discrimination, we can think of the following possibilities:

iv) The monopolist offers a pooling menu $(P_{HH}^{\text{max}}, Q_H)$. Since, $P_{HH}^{\text{max}}$ exceeds the maximum price that the low type consumers are willing to pay for the quality type $Q_H$, they do not buy. Only the high type consumers purchase and so it is a case of uncovered market where the low type consumers are kept out of the market. The profit of the monopolist is $(e + f - C_H)$.

v) The monopolist offers a pooling menu $(P_{HL}^{\text{max}}, Q_H)$. Here, the market is fully covered. He extracts the entire consumer surplus from the low type consumers though the high type consumers enjoy a positive surplus (area ‘$f$’ of Figure 1.1) and the profit of the producer is $(d + e - 2C_H)$.

vi) The monopolist offers a pooling menu $(P_{LH}^{\text{max}}, Q_H)$. The low type consumers purchase $Q_H$ provided $P_{HL}^{\text{max}} > P_{LH}^{\text{max}}$ and the surplus enjoyed by the low type
and high type consumers are denoted by area l and (f + i) respectively (Figure 1.1). The profit of the firm is \(((d - l) + (e - i) - 2C_H)\) if both the consumers buy. If \(P_{LH}^{\text{max}} > P_{HL}^{\text{max}}\) then only the high type consumers buy and let their surplus be denoted by the area \((f - m)\) (Figure 1.1.a). The profit of the firm in this case is \((e + m - C_H)\).

vii) The monopolist offers a pooling menu \((P_{LL}^{\text{max}}, Q_H)\). Let the surplus enjoyed by the low type and high type consumers be denoted by area \((l + j)\) and \((f + i + k)\) respectively (Figure 1.1). He serves the entire market and makes a profit of the amount \(((d - l - j) + (e - i - k) - 2C_H)\).

viii) The monopolist offers a pooling menu \((P_{LL}^{\text{max}}, Q_L)\). Both type of consumers buy the product and the monopolist makes a profit of the amount \((a + b - 2C_L)\).

ix) The monopolist offers a pooling menu \((P_{LH}^{\text{max}}, Q_L)\). Since, \(P_{LH}^{\text{max}}\) exceeds the maximum price that the low type consumers are willing to pay for the quality type \(Q_L\), they do not buy. Only the high type consumers purchase, and so it is an uncovered market, where the low type consumers are kept out of the market. The profit of the monopolist is \((b + g - C_L)\).

x) The monopolist offers a pooling menu \((P_{HL}^{\text{max}}, Q_L)\). The low type consumers will never purchase and the high type one will purchase it, provided \(P_{HL}^{\text{max}} < P_{LH}^{\text{max}}\). Let \(P_{HL}^{\text{max}} < P_{LH}^{\text{max}}\) and the surplus enjoyed by the high type consumers be denoted by area ‘h’ (Figure 1.1.a). Then the profit of the monopolist is \((b + g - h - C_L)\) where, as in the previous cases, the area \((b + g)\) denotes the value attached to one unit of commodity of quality \(Q_L\) for high type consumers.

It may be noted that the monopolist will never offer a pooling menu \((P_{HH}^{\text{max}}, Q_L)\) because neither of the consumers will purchase the product of quality \(Q_L\) at a price of
$P_{HH}^{max}$. In possibilities (iv) to (x), the monopolist offers a uniform price-quality bundle to both consumers and so does not really discriminate between the consumers on the basis of quality. Let us now look at another possibility where the firm serves the entire market, and actually provides a separating menu to different groups of consumers.

Consumer Surplus

![Diagram](Figure 1.1.a: Consumer surplus at various levels of quality when $P_{HL}^{max} < P_{LH}^{max}$)

xi) The firm offers different price-quality combinations to different types of consumers: it offers $(P_{LL}^{max}, Q_L)$ to low type consumers and $(P_{HH}^{max}, Q_H)$ to high type consumers and the profit of the firm is $(a + e + f - C_H - C_L)$.

In the discussion above, we assumed that there are two fixed levels of qualities, $Q_H > Q_L$. Let us now assume that the firm can pick the quality level of the product it offers for sale, and choose appropriate prices for each quality. Recall that the firm cannot discriminate in prices. Thus it has two alternative strategies available to it. First, the firm selects distinct quality levels for each type of consumers and charge different prices for them. Second, it
chooses a single quality level and charge the same price to both types of consumers. In
the first case, the problem reduces to:

$$\max_{(q_1, q_2)} \left[ u_1(q_1) - c(q_1) \right] + \left[ u_2(q_2) - c(q_2) \right]$$

where $u_1(q_1)$ and $u_2(q_2)$ denote the total willingness to pay for quality $q_i$, $i = 1, 2$ of the
low type and the high type consumers respectively. We assume that $u_2(q) > u_1(q)$ and
$u_2'(q) > u_1'(q)$. The per unit cost for quality level $q$ is denoted by $c(q)$ with $c'(q) > 0$ and
$c''(q) > 0$. Assuming that an interior maximum exists, the optimal value of $q_i$, $i = 1, 2$, is

$$q_i^* = \arg\max_{q_i} \left[ u_i(q_i) - c(q_i) \right] \quad (1.1)$$

The monopolist offers $(p_i^*, q_i^*)$ to consumers of type $i$, where $p_i^* = u_i(q_i^*)$. In Figure 1.1,
this translates to choosing $Q_L$ to $\max[a(Q_L) - c(Q_L)]$ and $Q_H$ to $\max [(e+f)(Q_H) - c(Q_H)]$.
The total profit of the firm is $\left[ u_1(q_1^*) - c(q_1^*) \right] + \left[ u_2(q_2^*) - c(q_2^*) \right]$.

In the second case, where the firm offers a pooling menu, either both types buy or one
type does not. Clearly, the price will be set to extract the fullest amount from the
consumer with the lower willingness to pay and allow the other types to retain a positive
consumer surplus (a case of covered market). Or, it will be set to extract the entire surplus
from the consumers who are willing to pay more and price out the other type (a case of
uncovered market). In either case, the quality level, $q$, will be set to maximize per unit
profit from the type whose entire consumer surplus is being extracted. In the former case
(covered market), since, $u_2(q) > u_1(q)$, the maximum price that can be charged is $u_1(q)$. Hence, the problem of the firm is to:

$$\max_{q} 2[u_1(q) - c(q)]$$

Let $\arg\max_{q} 2[u_1(q) - c(q)] = q^*$ \quad (1.2)
Notice from equations (1.1) and (1.2) that $q^* = q_1^*$. 

So, the total profit of the firm is $2[u_1(q_1^*) - c(q_1^*)] = 2[p_1^* - c(q_1^*)]$. 

In the latter case, when the market is not covered, the price that is charged by the firm for each quality is $u_2(q) = u_2(q_2)$. Since, $u_2(q) > u_1(q) \forall q$, it follows that at the optimal $q$, price exceeds $u_1(q)$. The optimal problem of the firm is to:

$$\max_{q} [u_2(q) - c(q)]$$

Let $\arg\max\limits_{q} [u_2(q) - c(q)] = q^{**}$  \hspace{1cm} (1.3)

From equations (1.1) and (1.3) we get $q^{**} = q_2^*$. 

The total profit in this case is $[u_2(q_2^*) - c(q_2^*)] = [p_2^* - c(q_2^*)]$. 

We compare the profit levels of the firm in the three cases and our conjecture is that, with full information about the individual consumer’s preferences, the firm provides distinct price-quality combinations to different types of consumers. The next two propositions assert the validity of this conjecture.

**Proposition 1.1:** $[u_1(q_1^*) - c(q_1^*)] + [u_2(q_2^*) - c(q_2^*)] > 2[u_1(q_1^*) - c(q_1^*)]$

**Proof:** Suppose, this is not true. Then 

$$[u_1(q_1^*) - c(q_1^*)] + [u_2(q_2^*) - c(q_2^*)] \leq 2[u_1(q_1^*) - c(q_1^*)]$$

i.e., $[u_2(q_2^*) - c(q_2^*)] \leq [u_1(q_1^*) - c(q_1^*)]$ 

i.e., $[u_2(q_2^*) - c(q_2^*)] \leq [u_2(q_1^*) - c(q_1^*)]$ [since, $u_2(q_1^*) > u_1(q_1^*)$] 

which contradicts the assumption that $q_2^*$ maximizes $[u_2(q_2) - c(q_2)]$ and hence, the result follows. □
**Proposition 1.2:** \([u_1(q_1^*) - c(q_1^*)] + [u_2(q_2^*) - c(q_2^*)] > [u_2(q_2^*) - c(q_2^*)]\) if and only if \([u_1(q_1^*) - c(q_1^*)] > 0\).

**Proof:** Trivial. \(\square\)

So, under full information, the firm obtains higher profit by offering different price-quality bundles to different consumer types provided \([u_1(q_1^*) - c(q_1^*)] > 0\). If \([u_1(q_1^*) - c(q_1^*)] < 0\) then clearly the firm would not produce quality level \(q_1^*\).

In Figure 1.2, the points \(A^* = (p_2^*, q_2^*)\) and \(B^* = (p_1^*, q_1^*)\) represent the optimal price-quality combinations under full information. Note that, profit maximization under full information requires the firm to extract the entire consumer surplus for each type of consumer, so \(p_i^* = u_i(q_i^*), i = 1, 2\).
1.1.3. The monopolist does not have full information – Types of the consumers are not known to him

Let us now assume that the monopolist does not have full information about the preferences of individual consumers. He knows that there are two types of consumers in the market but cannot identify the “type” of individual consumers. As discussed earlier, the monopolist, in such case, provides a menu of price-quality bundles and allows the consumers to self select. What would be the optimal menu of price-quality bundles for each consumer type? To begin with, let us assume that the monopolist offers the full information level of price-quality bundles $A^*, B^*$ of Figure 1.2 to the consumers. The low type consumer definitely chooses $B^*$ which gives him zero consumer surplus. The high type consumer, however, pretends to be a low type one and also chooses $B^*$ instead of $A^*$, the bundle actually meant for him. This gives him a net positive surplus whereas, the consumption of $A^*$ gives him zero consumer surplus. Hence, though the monopolist is able to extract full consumer surplus from the low type consumer, it fails to do so from the high end. In order to induce the high type consumer to reveal his true type, the monopolist must reduce the price from the level of $p_2^*$ to $p_2$ so that the high type consumer enjoys exactly the same amount of surplus that he would have enjoyed, had he chosen the price-quality bundle $B^*$. In other words,

$$u_2(q_2^*) - p_2 = u_2(q_1^*) - p_1^*$$

i.e.,

$$p_2 = u_2(q_2^*) - u_2(q_1^*) + p_1^*$$

The total profit of the monopolist who offers $(p_1^*, q_1^*)$ to low type consumers and $(p_2^*, q_2^*)$ to high type consumers is:

$$\pi = [u_1(q_1^*) - c(q_1^*)] + [u_2(q_2^*) - u_2(q_1^*) + p_1^* - c(q_2^*)]$$

$$= [u_1(q_1^*) - c(q_1^*)] + [u_2(q_2^*) - u_2(q_1^*) + u_1(q_1^*) - c(q_2^*)], \text{ since } p_1^* = u_1(q_1^*)$$
Differentiating $\pi$ with respect to $q_1$ we get:

$$\frac{\partial \pi}{\partial q_1} = [u_1'(q_1^*) - c'(q_1^*)] + [u_1'(q_1^*) - u_2'(q_1^*)]$$

$$= [u_1'(q_1^*) - u_2'(q_1^*)] < 0,$$

since $u_1'(q_1^*) - c'(q_1^*) = 0$ and $u_2'(q_1^*) > u_1'(q_1^*)$

Hence, the monopolist can increase his profit by reducing the quality offered to the low type consumer from the level of $q_1^*$. For example, if the monopolist lowers the quality level at the lower end to $q_1^M$ then the price-quality bundle $(p_1^M, q_1^M)$ becomes less attractive to the high type consumer as the surplus he gets here is less compared to the level of $B^*$. This allows the monopolist to raise the price of quality $q_2^*$ from $p_2$ to $p_2^M$. In other words, the reduction of price at the upper end, from the level of $p_2^*$, which is required to prevent arbitrage, is also less. To find the optimal policy of the monopolist let us consider his optimal problem:

$$\max_{q_1, q_2} \pi(q_1, q_2) = [u_1(q_1) - c(q_1)] + [u_2(q_2) - u_2(q_1) + u_1(q_1) - c(q_2)]$$

The first order conditions for an interior maximum are:

$$\frac{\partial \pi}{\partial q_1} = [u_1'(q_1) - c'(q_1)] + [u_1'(q_1) - u_2'(q_1)] = 0 \quad (1.4)$$

and $$\frac{\partial \pi}{\partial q_2} = [u_2'(q_2) - c'(q_2)] = 0 \quad (1.5)$$

Conditions (1.4) and (1.5) reveal that the optimal policy of the monopolist is to provide socially optimal level of quality at the high end and sub-optimal level of quality at the lower end. This is the standard Mussa and Rosen (1978) story of monopolistic quality discrimination.\textsuperscript{1} In their analysis, the extent to which quality is reduced at the lower end

\textsuperscript{1} While Mussa and Rosen (1978) have assumed that there is a continuum of consumer types, we have assumed that there are only two distinct types of consumers.
depends on the number of low type consumers. If the number is large, the reduction in quality is small, but, if they are not large, then it may not pay the monopolist to serve them at all. The discussion above presumes that a separating menu is optimal and derives the properties of this menu.

1.2. Extensions and Applications

Like Mussa and Rosen (1978), Cooper (1984) also analyses the allocative distortion that arises in problems of self-selection and shows that the discriminating monopolist enlarges the quality spectrum by providing a socially optimal quality at the high end and a sub-optimal quality at the low end. While Cooper (1984) restricted himself to separating equilibria, where agents of different types receive different price-quality bundles, Mussa and Rosen (1978) show that under certain circumstances, a pooling contract is optimal. According to them, the monopolist generally equates marginal revenue, which is associated with an increment of quality sold to consumers of a particular type, to marginal cost to determine the equilibrium level of quality. But the marginal revenue need not be monotonically increasing function of the consumer’s taste parameter. In fact, it may be a decreasing function for a particular range and the monopolist may not equate marginal revenue and marginal cost in this range. The optimal policy in this case is to assign the same quality to a bunch of consumers and, hence, pooling equilibrium occurs. These are the canonical results of the theory of monopolistic quality discrimination.

The literature shows that one can get results that are different from the standard ones if one deviates a little bit from the standard assumptions made in these models of monopolistic quality discrimination (Srinagesh and Bradburd (1989), Kim and Kim (1996)). The standard models assume that consumers with higher total utility also enjoy higher marginal utility of quality. Srinagesh and Bradburd (1989), on the contrary, have assumed that an inverse relationship exists between each consumer groups’ total and
marginal utility of quality\(^2\). They have shown that in a separating equilibrium, under second-degree discrimination, the consumer group that derives the lower total utility experiences quality distortion. Their results also demonstrate that it is the consumer groups’ relative marginal valuation of quality that determines which group purchases the higher quality good, and that it is possible to have a separating solution in which the high quality good is purchased by the consumer type that obtains the lower total utility of quality. In fact, in their analysis, quality distortion takes the form of quality enhancement, rather than quality degradation, when the low total utility consumers purchase the high quality goods.

Kim and Kim (1996) show that the welfare distortion does not necessarily occur to the group of consumers with low preferences, as found in the standard literature, if some technical spillover effect is introduced in the standard model of quality discrimination by a monopolist seller. While Mussa and Rosen (1978), Cooper (1984), etc. have assumed that the unit cost of production depends on the level of the quality of the product and not on the quality of other products, Kim and Kim (1996) found enough empirical evidence from the economy of Korea to assume that the cost of production of the low end quality falls as the quality of the high end product increases. The knowledge and the expertise obtained from the production of technically sophisticated high end products are used successfully in the production of relatively lower quality products in the form of reduced costs. Unlike the standard results, Kim and Kim (1996) show that quality distortion may occur to any level of quality offered to the consumers. In fact, it is the rate of reduction of the marginal cost from spillover effect that determines the direction of distortion. Another important finding of Kim and Kim (1996) is that higher marginal willingness to pay does not necessarily imply higher quality. They show that if it is socially optimal to provide a higher quality to low type consumers, then the monopolist may offer a pooling menu.

\(^2\) They considered the example of a household production function to show the inverse relationship between consumer groups’ total utility and marginal utility.
The models described so far have all taken the technical specifications of a product and its performance to be synonymous. Chapters Two and Three of the thesis have introduced the possibility that that the quality of the product, which is defined in terms of the given technical specifications, and the performance may actually differ. Consumers can only observe the technical specifications and are unable to identify the exact performance level of the product \textit{a priori}. They can form \textit{a priori} beliefs about the level of performance of the good based on the given information about the technical quality of the product. In that sense, the goods considered in the models of these chapters are ‘experience’ goods. The distinction made between quality specifications and actual performance allows us to raise certain questions: what happens if the quality specification choice at one end affects prospective buyers’ beliefs about the likely performance of the product positioned at the other end of the spectrum? In these models, the technical specifications of the product at a particular end act as a bearer of information to the prospective buyers of the product at the other end.

Selling experience good to a one-time consumer often gives strong incentives to a firm to cut quality to the lowest possible level. Since, the buyers do not have any information about the quality of the product at the time of purchase, both the good quality products and the bad quality products would be sold at the same price and so only bad quality products would come into the market for sale. The classic paper by Akerlof (1970) considers the example of a used car market – the cars are either of high quality (peaches) or low quality (lemons), and the quality does not change over time. In the simplest version of the story, each buyer buys only a single unit of the product. Since, there are no credible means of signalling their product quality, the good sellers cannot distinguish themselves from the sellers of low quality products. Hence, only ‘lemons’ will be sold in the used car market. This problem is aggravated once we introduce the possibility that the quantity demanded varies inversely with price and positively with the average quality in the market. If the average quality supplied in the market is increasing in prices, then the average demand may have a positive slope for some levels of prices. In this case, the
market may not have any intersection between demand and supply and, hence, the market may not exist.

As an extension of Akerlof’s story, Chiang and Masson (1988) show how the ‘lemons’ effect emerges in international trade in presence of imperfect information. They found from the experience of Taiwan that the output and export of these small newly industrialized countries concentrate on low quality, low price items and the firms of such countries have little incentive to improve their quality levels because of the free riding problem. They have considered a model where the industry of a ‘small’ country is assumed to produce only for a world market. The customers in the world market do not have perfect information about each product’s quality and cannot detect individual firm’s quality. However, it is assumed that they can correctly perceive the average quality of the country’s products and use it as a proxy for judging the quality of each firm in the industry. Chiang and Masson (1988) assume that the small country, producing for a world market, faces a given world price function which varies positively with the perceived average quality level. The market is competitive and so price equals marginal cost at equilibrium. Their principal result is that, as the number of firms in the economy increases, the average quality falls.

1.3. Quality Signalling, Brand Stretching and Reputation Bonding

The literature shows that there are several means by which a firm can credibly convey information about the quality of a product to a buyer. Wernerfelt (1988), Choi (1998), Tadelis (1999) and Cabral (2000) have used brand names as bearers of information in their studies of vertical differentiation models. In Tadelis (1999), each product is sold under a different name and these names can be traded. The name of a firm is uniquely associated with its characteristics and past performance. Once a firm is established, it is recognized by its name – the intangible asset of a firm. So, selling a firm’s name amounts to selling its reputation. The model looks at the equilibrium in the market for names and studies the reputational effects that characterise such markets. He assumes that the
transactions carried out in the market for names are hidden from the potential clients and the agents can change their names secretly. In an overlapping generation model, where agents live for two periods and clients live for one period, and can observe firm’s track records for assessment of their types, the paper shows that names must be actively traded in all equilibria. Also, it shows that at every equilibrium, both the good type as well as the bad type of agents must buy names.

Wernerfelt (1988), Choi (1998) and Cabral (2000) focus on the firm’s decision to brand stretch, given fixed qualities and show how the brand extension allows the established brand names to provide a stock of information about the new product’s quality. Brand stretching or brand extension is a marketing practice that uses an established brand name in one category to introduce products in other categories. This practice has been widely used by firms to introduce new experience good in the market. For example, Sony uses its established brand names in audio and audio-visual equipments like television sets to market digital cameras. Toshiba attaches its established brand name to market laptop computers. Tata, known as a producer of steel, motor vehicles and other engineering products, uses its brand name to sell common salt.

In Wernerfelt (1988), a multi-product firm uses the reputation of the brand name of an established product as a bond for quality when it introduces a new experience good in the market. In this model, a firm produces a good in the first period. If the product turns out to be good, then the associated brand name develops a reputation for quality. In the second period the firm introduces a new product. The firm knows the quality of this product, though its buyers do not. It can sell the new product under a new brand name or use the old brand name. If it uses a new brand name, customers, as in Akerlof’s model, have no a priori idea of the quality of the product. If it uses the old brand name, then the firm is signalling that it is a good product. Why is such a signal believable? This leads to the third period where the firm sells its first product again. Wernerfelt (1988) assumes that if the product introduced in the second period is bad, then, this leads to a fall in the demand for the original product in the third period. In that sense, brand stretching is like a
bond: the firm stakes its reputation and hence its profit in the third period to provide a credible signal of its product quality in the second period. The principal result obtained by Wernerfelt (1988) is that the firm will brand stretch only if it knows that its product quality is good.

Choi (1998) is an extension of Wernerfelt’s three periods model to an infinite horizon model where the multi-product monopolist has the option to develop a new product in each period. In this paper, the monopolist is assumed to have an established product whose quality is known to be high to the consumers. The quality of the newly developed product can be either high or low, and the firm decides whether or not to extend the brand name of its established product to the new one. In case of brand stretching, the consumers believe that the new product is also of high quality, provided all the previous products with same brand name were of high quality. The firm uses two kinds of signalling – brand extension, which is free and price signalling which has a cost. In the first period, the monopolist chooses a price. Consumers observe the price, form beliefs about the quality of the product and make purchase decision. A high quality producer, in order to signal its quality, distorts price away from the full information monopoly price. With brand extension, the price distortion required to signal the quality of the product is less. There is trigger strategy belief in the sense that brand extension to a bad product implies loss of reputation forever and the consumers ignore any signalling value of brand extension and respond only to price signalling in the future. Both Wernerfelt (1988) and Choi (1998) use firm’s future profits from the established product(s) as a bond. However, while Wernerfelt’s model uses feedback reputation on the established product as bond, Choi’s paper makes use of brand reputation for future products as a bond.

Cabral (2000) develops a model, which is similar in structure as that of Wernerfelt (1988) with the difference that Cabral (2000), like Choi (1998), has assumed that brand stretching does not affect the cost. He also considers an overlapping generation model where firms live for three periods and sells the base product at the beginning and at the end, and brings the new product in the intermediate period. However, Cabral’s paper is
different from the rest as he distinguishes between product quality, which is privately observed, and product performance, which is observed by the consumers and is positively related to the level of quality. Here brand stretching influences the consumers’ willingness to pay for the new product. While the firm uses its reputation from the old product to profit from the sale of the new product, some risks are always there in case the new product turns out to be a bad one. Cabral (2000) studies the tradeoff between the two. Similar to Wernerfelt (1988), Cabral (2000) shows that given the past performance, firms stretch if and only if quality is sufficiently high.

The reputation mechanism used for brand extension in the models of Wernerfelt (1988), Choi (1998) and Cabral (2000) is very similar to the one in Klein and Leffler (1981) and Shapiro (1983). Both of these models assume that there is a single product monopolist who chooses quality in each period. Once the firm cuts the quality of the product, its reputation is lost and so is its reputation rent. Thus the reputation mechanism in Klein-Leffler-Shapiro model is intra product. The former models, in contrast, consider a multi-product firm for which quality of each product is exogenously given and unalterable. Hence, the decision for the firm is inter product. However, it may be noted that the models of Klein and Leffler (1981) and Shapiro (1983) are basically models of reputation building. There is no signalling in the sense that there is no burning of money or posting of bonds in these models.

There are several other papers in the literature where firms have adopted various other means like, price, advertisement, warranty etc. to signal the quality of the product. Milgrom and Roberts (1986) formulated a model based on repeat sales mechanism where both price and advertising are used simultaneously in equilibrium to signal the quality of a newly introduced experience good. While Wolinsky (1983), Bagwell and Riordan (1991) discuss the potential for high prices to signal high quality, Chu and Chu (1994) show how selling through a reputable retailer signals quality.
1.4. Research Questions

We introduce a difference between technical specifications of a product and its performance. In the standard models of quality differentiation, observable technical specifications provide a noise free signal of performance and, hence, are clubbed together under a single name (quality). In experience goods, by definition, such specification has no meaning as buyers do not have an exact idea of the performance they can expect from the product \textit{a priori}. At best, they can form beliefs about performance from information provided by the seller and in multi-period models, from their own past experience and that of others. Introduction of the possibility of product differentiation in models with experience goods thus requires us to move away from this standard formulation and introduce a distinction between the observable indicators of quality – what we call the product’s technical specifications – and actual performance. We assume that technical specifications provide a noisy signal of the performance that can be expected from the product, and this is captured in terms of probability distribution over the range of possible performance levels parameterized by the observable levels of technical specifications, as in Cabral (2000). Higher levels of technical specifications generate higher performance expectations captured by FSD shifts of the probability distribution on performance.

As we show in Chapter Two, this by itself does not qualitatively alter the standard Mussa and Rosen (1978) result that the monopolist provides the socially optimal quality level to the upper end consumers and a less than socially optimal quality level to the lower end consumers. In our models (Chapters Two and Three), we extend the Mussa and Rosen (1978) framework in an additional direction: technical specifications of product not only provide noisy signals of actual performance that can be expected from it \textit{ex post}, but have spillover effects on consumer’s perception about the performance that can be expected from the other products offered by the seller. For instance, an automobile manufacturer who produces very low end cars may find it difficult to convince the customers that its higher end cars will be as good as those produced by other manufacturers whose low end products are more technically sophisticated than their own. Conversely, a firm that
produces technically sophisticated cars may find that customers purchasing its lower end products believe that these will perform better than similar cars produced by firms who do not produce technically sophisticated products.

In this sense, technical specifications are not only bearers of information about the performance of the product, but also about the performance that can be expected from other products offered by the firm. Our models, therefore, bear some resemblance with the brand stretching models where the reputation of an established brand is used to affect consumer’s perceptions about a new product. In these models, the essential question was: what prevents a seller from using its established brand umbrella from selling new product that it knows is bad? Their resolution lies in the “bond” feature of reputation: attempts to pass off bad products as good products by using the brand reputation umbrella have sufficiently high future adverse impacts to dissuade firms from taking such a course.

In our models, firms a priori do not have any more information than consumers. Hence, the possibility of sending false signals about quality does not exist. Our question is different. Since the technical specifications at one end of product spectrum affects not only this product but also that of the other products, and these beliefs are positively related to the announced level of technical specifications, will the Mussa and Rosen (1978) result still hold? Our models are thus, extension of Mussa and Rosen type literature to the case of experience goods.

All the signalling models discussed above, talk about perception because reputation is nothing but a perception. When consumers cannot observe product quality ex ante, reputation corresponds to consumer’s prior beliefs about quality. In our case, the improvement of quality at a particular end causes a shift in the perception of quality at the other end. In chapter Two, the quality of the product at the lower end signals quality for the upper end product. Chapter Three shows how the perception about the quality of the

---

3 All the brand-stretching models assume that the firms know the quality of the new product, though potential consumers do not have any idea about it before purchase.
product at the lower end changes when there is a change in the quality of the product at the higher end. It seems apparently that the two chapters are similar, but it may be noted that the chapters are not symmetric. To highlight the asymmetries of the two problems we have put them in separate chapters.

In Chapter Four, we have again constructed a single period model involving an experience good. However, we deviated from the monopolistic market structure of the previous two chapters and have, instead, considered the possibility that more than two firms may exist in the market. Also, it is assumed that the consumers are identical in nature. This does not necessarily mean that the choice of quality of the firms would also be identical. They may produce either a good quality product or a bad quality product. There is information asymmetry in the market from the buyers’ side. They do not share the private information of the firm about the product quality, though they have the knowledge about the distribution of quality across firms. In this model, firms simultaneously choose the quality of the product in the first stage and the price in the second stage. We show that an increase in competition in the market does not necessarily lead to a secular shift from a high quality output norm to a low quality output standard as found in Chiang and Masson (1988). Change in the number of firms must be quite significant to change the equilibrium strategy profile: a small increase in the number of firms leaves the quality standard unchanged.