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HOW TO DEAL WITH UNPROFITABLE CUSTOMERS?

A SALESFORCE COMPENSATION PERSPECTIVE

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Abstract

How to deal with unprofitable customers? A salesforce compensation perspective

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We show that prices and incentives recommended by the salesforce literature when targeting a profitable segment can attract unprofitable customers, particularly when salespeople have high productivity and low risk (i.e., risk aversion times uncertainty). Therefore, when customers are unidentifiable, unprofitable customers may also enter the market creating an adverse selection problem for the salespeople. By solving the moral hazard and adverse selection problems simultaneously, we show that firms can prevent the entry of unprofitable customers by "screening". Although, screening generally requires a higher price to dissuade unprofitable customers, when firms hire salespeople, however, it requires lowering of both selling effort and the price. It also leads to a "sales trap" restricting the sales to the profitable segment to a fixed level. Screening, therefore, lowers firm profits obtained from the profitable customers. When salespeople are highly productive and risk tolerant, this drop in profit can be so high that "accommodating" unprofitable customers becomes the preferred strategy. Furthermore, the adverse selection problem intensifies and accommodation becomes more preferable when there is no moral hazard between firm and the salesperson. Behavior of unprofitable customers, therefore, must be an important consideration when targeting high-value customers and designing salesforce compensation.

Keywords: Salesforce compensation, target markets, adverse selection, screening, pooling, principal-agent models, agency theory

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1 Introduction

Standard texts in marketing (e.g., Kotler and Keller 2006) recommend that firms optimize their marketing-mix by aiming prices, advertising and sales incentives at targeted customers. Accordingly, the literature on salesforce compensation has focused on optimizing sales commission and price towards a profitable segment. It does not, however, recognize that the price and selling effort optimal for profitable customers could in fact attract unprofitable customers. It is not obvious how firms should deal with these unprofitable customers. Consequently, the prices and sales commissions derived in the literature may need to be re-examined when unprofitable customers could also enter the market.

It appears, however, that this problem can be solved simply by facilitating salespeople to 'spot and serve' only the targeted customers utilizing recent advances in information technology. For example, Best Buy asks its salespeople to use quick interviews to "pigeonhole" shoppers to focus on the higher income "angel" customers and ignore the "devils" (McWilliams 2004). "Dumping" unprofitable customers, however, risks developing a notoriety (Mittal et al 2008) as evidenced from a survey across industries such as IT, manufacturing, health care, finance, and professional services. For example, Sprint Nextel drew adverse publicity when it terminated contracts with many "high-cost" customers in June 2007 (Srivastava 2007). Moreover, the effectiveness of dumping relies on the salespeople's ability and willingness to distinguish between a genuine target customer and an unprofitable one, particularly when the latter is pretending to be a target customer only to receive the service effort. Worse still, profitable customers mistakenly treated as unprofitable customers may be disaffected for a long time, leading to loss of sales. Similarly, servicing unprofitable customers by mistake can also consume salespeople's time and firm resources. In other words, instructing salespeople to 'spot and serve' target customers is less likely to be the optimal strategy in many situations.

Moreover, in practice some sales occur invariably to customers outside the target segment (Urban and Star 1991) because of the difficulty to accurately target customers. In fact, with the increasing emphasis on customer service, a growing problem in today's marketplace is the influx of unprofitable customers drawn by the higher levels of service intended for high-value customers. For example, customers are attracted to automobile dealers whose salespeople offer test-drives, or wineries who offer free wine-tasting. Financial loans and mortgages, too, are often sold to customers who end up being costly to the firm (Cao and Gruca 2005). A

Harvard Business case documents how the problem of unwanted customers recently posed a threat to the brand image of Starbucks (Moon and Quelch 2006).

We therefore extend the salesforce compensation literature by allowing entry of unprofitable customers when solving for optimal prices and sales commissions. By modeling a customer's purchase decision, we introduce an adverse selection problem faced by salespeople into the traditional moral hazard problem, to capture the tension between optimizing the marketing-mix towards profitable customers and triggering demand from the unprofitable ones. The literature, which assumes all customers as profitable when resolving the moral hazard problem, suggests that optimal incentives are "high-powered" (i.e., both price and incentives will be high) when the salesperson's productivity is high and risk aversion times half of variance of the uncertainty (hereafter referred as "risk") is low. By linking sales incentives, price and targeting, our model leads to several specific contributions to the literature as detailed below.

First, we demonstrate that entry of low-value customers is more likely when the salesperson productivity is higher and the risk is lower. Under these conditions, the increase in value resulting from higher selling effort more than offsets decrease in value due to the higher price aimed at target customers. The firm's problem with the low-value customers is that their spending level is so low that the cost of serving them outweighs the benefits. Entry of these "unprofitable" customers, therefore, reduces the productivity of salespeople and in turn, the profitability of firms. In many industries, where selling involves a substantial outlay of resources (e.g., test drives in the auto industry, and free wine-tasting offered in wineries) to attract affluent buyers, the entry of thrifty customers, if undetected, can lead to significantly lower than expected profits.

Accordingly, the second contribution of our research is the characterization of a screening strategy that makes the effort-price combination unattractive to unprofitable customers. Although a firm normally can be expected to charge a higher price and lower selling effort to make the product unattractive to the unprofitable customers, we surprisingly find that screening requires reduction in both the selling effort and the markup. Accordingly, we show, contrary to the literature, that the price and incentives are not high-powered when the productivity and the risk tolerance of the salesperson is high. In addition, a screening strategy constrains the expected sales to profitable customers to stay fixed at a lower level, irrespective of the salesperson's productivity and risk tolerance. Consequently, the drop in profits from profitable customers can be significant when the salesperson's productivity risk tolerance are high.

In fact, the third contribution of our paper is that when the salesperson's productivity is very high and the risk is very low, the firm is better-off accommodating unprofitable customers than screening. Such a strategy allows the firm to "unshackle" the true potential of the salesperson by inducing her to exert higher effort than screening and to serve everyone in the market. The higher effort allows the firm to charge a higher markup and to unlock the "sales trap" under screening. Notwithstanding this increase in effort, the markup and sales volume under accommodation are still lower than those predicted in the literature.

An interesting contribution of our paper is that the adverse selection problem intensifies and the accommodation solution gains more ground in the absence of moral hazard. In other words, when salespeople's efforts are observable, the entry of unprofitable customers can be a bigger problem and accommodation is more likely the optimal response. Entry and accommodation of unprofitable customers, therefore, is more likely when the effort can be interpreted as investment in point of sale advertising or in-store display (e.g., in Starbucks) meant to attract high-value customers or when it can be monitored.

An accommodation strategy allows the firm to trade-off higher profits earned from profitable customers with the loss incurred by selling to unprofitable customers. Focusing narrowly on the "unprofitability" of some customers, therefore, can mislead firms to a screening strategy which can be more costly than accommodation. In contrast, taking a wider perspective allows the firms to reap indirect profits of accommodating 'unprofitable customers' as well as be ethical. In fact, we find that the selling effort and markup under accommodation can be significantly higher than screening, when there is a higher proportion of high-value customers in the market. We, therefore, caution against the practice of 'finding and firing' low-value customers.

The rest of the paper is organized as follows. Section 2 provides a brief literature review. Section 3 presents a model of salesforce compensation offered by a firm to a salesperson whose selling effort is unobservable, in a market consisting of two known types of customers (only moral hazard). Section 4 examines the decisions when customer types and selling efforts are both unobservable (both moral hazard and adverse selection). Section 5 analyzes the decisions when customer types are not observable but the selling effort is (only an adverse selection). Section 6 examines the effects of multiple customers under each type, and the ratio of quality to marginal costs of production on our results. Finally, we conclude the paper highlighting the implications of our results for managers and future research. The following section provides a brief review of the relevant literature.

2 Literature Review

Marketing literature on salesforce compensation starting with Basu et al (1985) derives the optimal salesforce compensation plan using a principal agent model where the firm (the principal) cannot observe the effort of an effort- and risk-averse salesperson (the agent).[1] Studies focus on a profitable customer segment to resolve the moral hazard problem through incentives. They show that when the salesperson's productivity is high and the risk is low, the optimal incentives are "high-powered", i.e., the level of selling effort, product price and sales volume will all be very high. As salesforce performance often interacts with other marketing mix variables (Gatignon and Hanssens 1987), the question of price-delegation to salesforce has also been studied in the literature (Mishra and Prasad 2004 and 2005). For example, delegating the pricing decision to the salesforce is not optimal when salespeople have incentives to substitute selling effort with price discounting (Joseph 2001) or the intensity of competition between firms is low (Bhardwaj 2001). We extend this literature to study the interaction between salesforce compensation and the behavior of different types of customers present in a market which is of topical interest.

In many markets, distinct groups of customers are regarded as unprofitable (Cao and Gruca 2005) and therefore not targeted. Due to recent developments in information technology, salespeople are being asked to target only customers belonging to strategic target segments (e.g., Zoltners et al 2001) although incentives necessary for such "precision selling" have not been investigated. In general, firms often face a trade-off between accurately defining target segments and identifying a consumer as belonging to that segment (Gal-Or et al 2006). Although investment in CRM technology has been increasing, the capability to accurately identify whether new customers belong to the target segment remains questionable (Cao and Gruca 2005, Rigby et al 2002). In the pharmaceutical industry, for example, such investments did not have a significant impact on performance (Ahearne et al 2008). If customers can only be targeted imperfectly, firms target only their loyal customers (Chen et al 2001, Chen and Iyer 2002, and Iyer et al 2005).

[1] See Coughlan 1993 for a review.

Higher accuracy of identification notwithstanding, errors in classification may jeopardize a firm's reputation due to customer disaffection since many "gripe sites" have emerged on the Internet (Krishnamurthy and Kucuk 2008). Refusing service to unprofitable customers can also exacerbate the ethical concerns about excluding the disadvantaged sections of the population (Prahalad 2006). Moreover, concerns about consumer privacy are increasingly restricting the scope of such practices (Goldfarb and Tucker 2011) since customers are unwilling to provide personal information to firms intending to personalize their offerings (Murthi and Sarkar 2003). We examine firm strategies to deal with unprofitable customers who may enter the market undetected by salespeople.

Recent literature on the need to discover and deal with unprofitable customers has focused on firm strategies that reveal the true cost of serving customers. For example, Shin et al 2012 examine price discrimination based on the past purchase behavior of customers. They show that, when the difference in costs to serve the two types of customers is large, the firm chooses not to serve some of both high and low cost customers in the market using a customer cost-based pricing strategy. Use a similar approach, Subramanian et al (2011) find that high cost customers exert a positive externality by reducing the competitor's inducement to poach on them. Our research complements this stream of literature by studying the problem in the salesforce context where the "unprofitability" of some customers arise not from higher firm costs to serve them, but from their low reservation value that is not revealed to the firm.

Research on problems involving both moral hazard and adverse selection (e.g., Bolton and Dewatripont 2005, and Lal and Staelin 1986) has examined situations where the firm is unable to observe the agent's type that determines the latter's productivity. For example, salespeople may have or acquire private information about a market condition which has an impact on the revenues of the firm (Chu and Sappington 2009 and Chen 2005). Similarly, Inderst and Ottaviani (2009) show that transparency of sales incentives or separation of the tasks (prospecting and advising) among two agents can reduce "misselling", i.e., deliberately selling unsuitable products to customers. In their model, the salespeople have a private signal about the suitability of a product for a customer who relies on the advice from the salesperson regarding the suitability. The adverse selection problem faced by the salesperson which is a phenomenon peculiar to the sales context, however, has not been analyzed. We analyze whether a salesperson (agent) facing adverse selection of customers influences the nature of the compensation contract offered by the firm (principal) facing moral hazard. We show that the adverse selection caused by the presence of thrifty customers restricts the firm's compensation contract under moral hazard with salespeople.

The following sections present the model and key findings.

3 A Model of Moral Hazard without Adverse Selection: Unobservable Selling Effort and Known Customer Types

Customer profitability analysis has revealed that sales from some customers can be unprofitable to the firm. Consequently, standard texts in management and marketing have been advising firms to target only profitable customers. Accordingly, we introduce buying decisions of two types of customers and targeting decision of the firm into the extant moral hazard model of salesforce compensation and analyze its implications for salesforce management.

3.1 Customer Decisions

We assume that a customer decides to purchase a firm's products, if her value from spending the first dollar (v) is more than a dollar ($v > 1$), or equivalently, if the marginal utility from spending the first dollar (i.e., $v - 1$) is positive. We also assume that her marginal utility from spending ($v-1-x$) is decreasing in the amount of spending (x). Such a marginal utility implies that the customer utility function is of the form $U(x) = (v-1)x - x^2/2$ (see, for example, Shaked and Sutton 1990 and Tirole 1988, p.143-144).[2]

A customer's value for dollars spent is a function of three factors: i) the brand image or reputation of the firm (b), ii) the value-enhancing effort of the salesperson (e), and iii) the quality of the products (q).[3] In other words, $v = f(b, e, q)$. Without loss in generality, we assume that f is linear (i.e., $v = b + e + q$).

We also assume that the quality of the products is proportional to the firm's marginal cost (c), i.e., $q = kc$; and the constant of proportionality equals one ($k = 1$). Let $m = 1 - c$ be the contribution margin ratio or the "markup" of the firm's products. We can, therefore,

[2] In general, salesforce compensation models have diminishing marginal returns due to inventory holding costs, capacity enhancement or purchasing costs. For example, if the customer purchases more than its processing (e.g., manufacturing or stocking) capacity or demand for its goods, she needs to either increase capacity, incur inventory holding costs or both. On the other hand, if she purchases less than capacity, she may fail to meet the demand for which she may need to purchase additional quantity in the spot market (Chen 2005).

[3] The salesperson may provide additional information to obtain better matching of customer needs with the firm's offering, greater functional efficiency or reduction of customers' waste. Similar effects of "persuasive advertising" have been noted in the literature (Bagwell 2007).

write

$$v - 1 = b + e - m \Rightarrow U(x) = (b + e - m)x - x^2/2. \tag{1}$$

The first-order condition for customer utility maximization implies

$$x^* = \max\{0, b + e - m\}. \tag{2}$$

3.2 Customer Types

We assume there are two types $\theta \in \{L, H\}$ of customers in the market. One of the customers ("low-value customer") has a perception $b_L = 0$ of the firm's brand value, while the other ("high-value customer") has a significantly positive perception of the firm's brand value ($b_H > 0$). In this benchmark case of "pure" moral hazard without adverse-selection, we assume that both the firm and the salesperson can identify the two types customers at the point of sale. For simplicity, we initially assume that there is only one customer of each type in the market.

The risk-neutral firm (principal) hires a risk- and effort-averse salesperson (agent) to exert selling effort (e_L, e_H) to enhance the value of the firm's offer as perceived respectively by the low- and high-value customers. As in Lal and Srinivasan (1993), enhancing value is an increasingly time-consuming activity which is mitigated by the salesperson's ability a. In other words, the time (t_θ) it takes to enhance a customer's value by e_θ is assumed to be convex (quadratic) in e_θ, i.e., $t_\theta = e_\theta^2/(4a)$. The salesperson's opportunity cost per hour is h such that the salesperson's cost of efforts is given by $C(e_L, e_H) = ht(e_L, e_H) = \left(e_H^2 + e_L^2\right)/(4d)$ where $d = a/h \in [0, 1)$ is a measure of the salesperson's effectiveness or productivity.

3.3 The Timeline

At the beginning of the period: The firm chooses prices and incentives, both types of customers come to know the quality and price, and based on her incentives, the salesperson decides how much time to spend on each customer.

During the period: Customers decide whether to enter the market and engage with the salesperson who exerts selling effort.

At the end of the period: Sales are realized from each customer and the salesperson is compensated based on realized sales.

Let x_H and x_L denote the dollar sales to the high- and low-value customers respectively.

From customer utility maximization, we get

$$x_H = \max\{0, b_H + e_H - m\} \tag{3a}$$

$$x_L = \max\{0, e_L - m\} \tag{3b}$$

The firm offers an incentive contract to the salesperson based on the dollar sales to the two customers:

$$w(x_H, x_L) = A + B_H x_H + B_L x_L. \tag{4}$$

Here A is the fixed salary, and B_L and B_H are commissions on x_L and x_H respectively.[4] This compensation scheme exposes the salesperson to risk because she does not know the exact value of the high-value customer but she knows that it follows a normal distribution with mean μ and variance σ^2.

The salesperson's utility $u(w) = 1 - \exp[-r(w - C(e_L, e_H))]$ is assumed to be exponential in net compensation (compensation net of cost of effort) with a constant absolute risk aversion (r). As in the literature, in this section, we assume that the salesperson's selling effort is not observable by the firm. All other information including the realized sales are commonly known to the firm and the salesperson. The firm solves this moral hazard problem through incentives based on realized sales from the two types of customers. We restrict our attention to linear contracts following Holmström and Milgrom (1987).[5]

3.4 Salesperson Effort Decision (Incentive Compatibility)

The LEN (Linear contract, Exponential utility, Normal distribution) framework simplifies the salesperson's certainty equivalent as

$$\begin{aligned} CE(e_H, e_L) &= A + B_H x_H + B_L x_L - \frac{e_H^2 + e_L^2}{4d} - \frac{r\sigma^2 B_H^2}{2} \\ &= A + B_H(b_H + e_H - m) + B_L(e_L - m) - \frac{e_H^2 + e_L^2}{4d} - \frac{r\sigma^2 B_H^2}{2} \end{aligned} \tag{5a}$$

Here $r\sigma^2/2$ is a measure of the risk.[6] The salesperson maximizes her certainty equivalent by choosing efforts. First order conditions imply

$$e_H^* = 2dB_H \text{ and } e_L^* = 2dB_L. \tag{6}$$

[4] If the customer types are unknown, $B_H = B_L = B$.

[5] They show that when a risk-averse agent (the salesperson) chooses efforts, continuously, over time, and can observe her cumulative performance before acting, the efficient wage contract is linear in the total output (sales) over the accounting period even if the firm can base the salesperson's compensation on the sales history over the entire accounting period.

[6] We can therefore write $w(e_H, e_L) \sim N\left(A + B_H(\mu + e_H - m) + B_L(e_L - m), B_H^2\sigma^2\right)$ when $x_L \geq 0$.

Note that the selling effort exerted by the salesperson on a segment is a function of the level of incentives and the salesperson productivity.

3.5 Salesperson's Employment Decision (Individual Rationality)

Supposing the salesperson's reservation wage (certainty equivalent of the reservation utility) is w_0, then accepting the firm's employment contract requires (from equations 5a and 6) that:

$$CE\left(e_H, e_L\right) \geq w_0 \Rightarrow E\left[A + B_H x_H + B_L x_L\right] \geq d\left(B_L^2 + B_H^2\right) + \frac{r\sigma^2 B_H^2}{2} + w_0. \tag{7}$$

Note that the fixed component A is independent of the incentive compatibility condition derived in equation 6 and hence can be used to ensure that the firm does not pay more than necessary to employ the salesperson.

3.6 Firm Decisions

The risk-neutral firm's decisions are given by $\max_{m,\, B_H,\, B_L} \pi = mE\left[x_H + x_L\right] - E\left[A + B_H x_H + B_L x_L\right]$. Simplifying using equations 6 and 7, we get

$$\begin{aligned}
\max_{m,\, B_H,\, B_L} \quad \pi &= mE\left[x_H + x_L\right] - \left[w_0 + d\left(B_L^2 + B_H^2\right) + \frac{r\sigma^2 B_H^2}{2}\right] \\
&= \text{Expected Gross Profit} - [\text{Reservation wage } + \text{ Cost of effort } + \text{ Risk}] \\
&= m\left[\mu + 2d\left(B_L + B_H\right) - 2m\right] - dB_L^2 - \left(d + \frac{r\sigma^2}{2}\right) B_H^2 - w_0. \qquad (8)
\end{aligned}$$

First order conditions imply

$$B_L^0 = 0,\ B_H^0 = \frac{1}{2}\frac{\mu}{1 - d + r\sigma^2/2d},\ \text{ and } m^0 = \frac{1}{2}\frac{\mu}{1 - \frac{d}{1 + r\sigma^2/2d}}.$$

This leads to profit $\pi_H^0 = \left(\frac{\mu}{2}\right)^2 \frac{d + r\sigma^2/2}{(1-d)d + r\sigma^2/2} - w_0$.

The following proposition explains firm decisions when the salesperson can identify perfectly the low-value customers.

3.7 "Unprofitability" of the Low-value Customer

Proposition 1 *When customers can be identified, the firm finds the low-value customer unprofitable and chooses to target only the high-value customer.*

All proofs are given in the Appendix.

Low-value customers are not profitable for the firm because utility maximization (equation 3b) by these customers leads to positive sales only if the value enhancement is sufficiently high to exceed the markup ($e_L \geq m$). Given the cost of selling effort, such high levels of value enhancement leads to a negative profit $\left(= -m^2 (1-d)\right)$ on sales to these customers. In other words, the firm does not sell its product to low-value customers. Utility maximization of the high-value customers, on the other hand, leads to positive sales at lower levels of value enhancement, $e_H \geq m - \mu$ (refer equation 3a).[7] Therefore, when customers are perfectly identifiable, the firm offers incentives to the salesperson to devote her time exclusively to the high-value customers. Knowing this, low-value customers will choose to stay away from the market.

3.8 Role of the Salesperson

Corollary 1 *When there is no salesperson, the monopoly (denoted by the superscript M) price, expected sales to high and low value customers, and firm profits are respectively* $m^M = x_H^M = \mu/2$, $x_L^M = 0$ *and* $\pi_H^M = \mu^2/4$.

Note that if the firm does not hire a salesperson, the low-value customers will not enter the market because their utility from purchase is negative. Accordingly, the firm sets a monopoly price at which only high-value customers purchase the product. In other words, when there is no salesperson, the low-value customers stay away from the market. Only when the firm employs a salesperson to improve profitability by enhancing the value of the product for the high-value customers, the low-value customers may be attracted to enter the market.

Corollary 2 *Notwithstanding the downward sloping demand in prices/markup, the value-enhancing effort of the salesperson helps increase both the expected sales and the markup obtained from the high-value customers. The optimal effort increases in the brand value for the target customers and the productivity of the salesperson and decreases with the risk. (See Figure 1.)*

The salesperson therefore increases the product value of the target customers, thereby increasing both the markup and the spending level, which in turn leads to higher profitability of the firm. Next we examine the behavior of the low-value customers given the optimal levels of markup and incentives intended for the target customers.

[7] Note that the sales commision corresponding to $e_H^0 = \frac{\mu d^2}{(1-d)d + r\sigma^2/2}$ is $B_H^0 = \frac{\mu}{2} \frac{d}{(1-d)d + r\sigma^2/2}$.

3.9 The Entry of Unprofitable Customers

Given that customers expect the salesperson to offer value-enhancing effort, an interesting question is whether the price and effort meant for the profitable customers could also attract the unprofitable customers. The following proposition below identifies the condition under which this is indeed the case.

Proposition 2 *When $d\left(d-\frac{1}{2}\right) \geq r\sigma^2/4$, the selling effort and the markup optimal for selling to the high-value customers will also attract the unprofitable customers.*

Under the necessary condition $d\left(d-\frac{1}{2}\right) \geq r\sigma^2/4$, which requires that the salesperson productivity be relatively high ($d > \frac{1}{2}$) and the risk be relatively low ($r\sigma^2/2 < 1$), the low-value customers also find the firm's offer attractive and enter the market. If, on the other hand, $d\left(d-\frac{1}{2}\right) < r\sigma^2/4$, the low value customers stay out of the market and do not impact firm decisions. Therefore, if firms decide on salesforce compensation and pricing without considering the possible entry of low-value customers, the normative guidelines from the literature are still valid when $d\left(d-\frac{1}{2}\right) < r\sigma^2/4$. On the other hand, when $d\left(d-\frac{1}{2}\right) \geq r\sigma^2/4$, firms may offer higher incentives to the salesperson based on the literature that did not consider the possibility of the low-value customers entering the market. We show that under these conditions, the potential entry of low-value customers in the market exerts a negative externality on the sales incentives.

Figure 1 illustrates how the higher levels of selling effort can lead to higher perceived value, a positive surplus, and hence a positive demand from the low-value customers.[8]

Corollary 3 *The condition under which the low-value customers enter the market is independent of the perceived brand value of the profitable customers. In other words, the entry can occur under conditions that may favor high- or low-powered incentives.*

[8] In a model where a firm serves the same market by providing an **after-sales** service e in addition to value v at a cost $C_f(e)$ where $C_f'(e) > 0$ and $C_f''(e) > 0$, it can offer a two-part tariff linear in e to achieve second degree price discrimination (see for example, Tirole 1988, Chapt. 3). For example, if $C_f(e) = \frac{\gamma}{2}e^2$, the firm offers $m(e) = a + be$ such that $\max\limits_{a,b,\ e_H,e_L} \pi = (a + be_H)\, Q_H + (a + be_L)\, Q_L - \frac{\gamma}{2}\left(e_H^2 + e_L^2\right)$ where $Q_H = \Delta + e_H - a - be_H$ and $Q_L = e_L - a - be_L$. Solving for non negative roots, we get $a^* = 0$, $b^* = \gamma$, $e_H^* = \frac{\Delta}{2\gamma-1}$ and $e_L^* = 0$ when the cost of service is significant, i.e., $\gamma > \frac{1}{2}$. In other words, the firm charges $m(e) = \gamma e \Leftrightarrow p(e) = \frac{c}{1-\gamma e}$ where $e \in \{e_H^*, e_L^*\}$ and customers of each type choose the level of service intended for them. A key difference, however, with our model is that the salesperson offers 'service' through her selling effort **before** sales are realized. Therefore, the salesperson is not only unaware of the customer type, but also whether a customer who has received her service will ultimately buy. In other words, a part of the effort can be unproductive in our model unlike those where the service is offered **after** the sales are transacted.

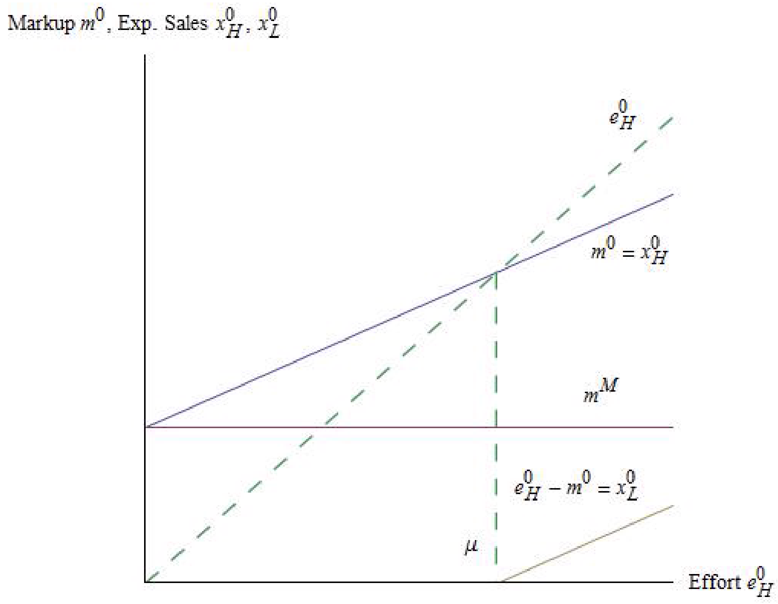

Figure 1: The Impact of Value-enhancing Effort

Note that the necessary condition for the low-value customers (Proposition 2) depends only on the salesperson's productivity (d) and risk ($r\sigma^2/2$). It does not depend on the expected brand image (μ) obtained from the high-value customers. In other words, even when the brand image is low (favoring "low-powered" incentives and markup in the literature), low-value customers may enter the market.

Figure 2 shows the region in the parameter space where the low-value customers enter the market. As shown in the figure, these customers do not enter the market if the salesperson productivity is low ($d \leq \frac{1}{2}$) and risk is high ($r\sigma^2/2 > 1$) because the surplus of the low-value customers is negative ($e_H^0 - m^0 < 0$) in these regions. In other words, under conditions seemingly less favorable for selling, there is no impact of the presence of low-value customers. Only in the shaded region in the top left corner of the plot where $e_H^0 - m^0 \geq 0$, the low-value customers enter the market.[9]

Next we consider firm strategies when low-value customers enter the market.

[9] Note that Figure 2 uses the risk which is the reduced form $r\sigma^2/2$ as the x-axis to parsimoniously represent the effects of the salesperson risk aversion (r) and the variance of the uncertainty (σ^2) which always appear together in this model.

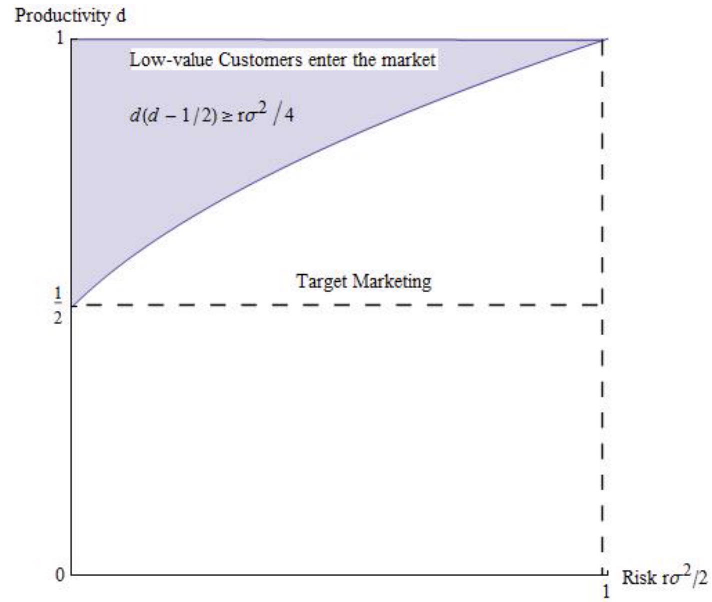

Figure 2: Low-value Customers enter the market

3.10 Spot and Serve Only High-value Customers

An intuitive firm strategy to deal with unprofitable customers when they enter the market is to ask the salesperson identify or "spot" them and serve only those who are identified as high-value customers as stated in the following Proposition.

Proposition 3 *When unprofitable customers are identifiable, their entry is not a major problem. The firm can reward the salesperson only for sales generated from the high-value customers inducing her to deny services to the low-value customer.*

This approach is similar to the 'spot and serve' strategy reportedly adopted by Best Buy (McWilliams 2004). Since the cost of serving the low-value customers outweighs the benefits (Proposition 1), firms will encourage their salespeople to identify and disregard these unprofitable customers. The low-value customers may be, however, attracted by the value-enhancing effort targeting the high-value customers notwithstanding the higher prices because the increase in value due to the selling effort (the primary effect) may offset the impact of increased prices (the secondary effect). Knowing, however, that revealing their type will prompt the salesperson to ignore them, the unprofitable customers may like to masquerade as high-value customers and enter the market. Inaccuracies in identification of customer types may, however, jeopardize a firm's reputation due to disaffection of profitable customers mistakenly identified as "unprofitable" at the point of sale.

Moereover, even if the salesperson is able to identify the two types of customers at the point of sale, denying them service can also exacerbate ethical concerns about target marketing. Targeting as a marketing practice has already been criticized for either targeting vulnerable groups (Smith and Cooper-Martin 1997) or for often excluding the disadvantaged sections of the population (Prahalad 2006). Moreover, refusing to serve even unprofitable customers can trigger negative publicity for the firm. For example, numerous consumer "gripe sites" have emerged on the Internet following individual customer's unpleasant experiences with firms (Krishnamurthy and Kucuk 2008). Such websites carry messages that tend to dissuade potential customers from buying the firm's products. This can set off a vicious cycle of a higher likelihood of errors, leading to greater disaffection and potential legal costs to firms.

In view of the above, in the next section we assume explicitly that the customer types cannot be observed and characterize two possible solutions to an adverse selection problem created for the salesperson when the unprofitable low-value customers enter the market unrecognized.

4 A Model with Both Moral Hazard and Adverse Selection

When the customer type is not observable, one way the firm can deal with the adverse selection problem faced by the salesperson is by re-setting the markup and sales incentives in a way that the low-value customers find the firm's offer unattractive as discussed below.[10]

4.1 Screening of Unprofitable Customers

A possible solution to the adverse selection problem may be to offer sales incentives and prices that ensure that low-value customers do not enter the market ("screening"). Under such a contract the salesperson does not face an adverse selection of customers since the low-value customers stay out of the market. The necessary condition for this is given by $x_L = e - m \leq 0$, which enters the decision problem of the firm as a constraint. The firm's decision problem is

[10] Note that if the customer type is known before the salesperson exerts her selling effort, the salesperson can decide her effort level according to the type of the customer she is entering. However, the salesperson cannot do so if the customer type becomes known after she exerts effort.

therefore

$$\max_{m,\ B} \quad \pi_S = mE\left(x_H\right) - E\left(A + Bx_H\right) \tag{9a}$$

Subject to:

$$Eu\left[A + Bx_H - \frac{e^2}{4d}\right] \geq u\left(w_0\right) \text{ (IRC)} \tag{9b}$$

$$e_S \in \quad \arg\max_{e} \quad Eu\left[A + Bx_H - \frac{e^2}{4d}\right] \text{ (ICC)} \tag{9c}$$

$$e_S - m \leq 0 \text{ (Screening Constraint).} \tag{9d}$$

The following proposition describes the selling effort and prices at which the low-value customers opt to stay out of the market.

Proposition 4 ***Screening*** *low-value customers from entering the market requires the firm to lower not only the value-enhancing effort ($e_S^* \leq e_H^0$) but also the prices charged to the high-value customers ($m_S^* \leq m^0$). Furthermore, it constrains the expected sales to remain at a fixed level ($x_S^* = \mu < x_H^0$) irrespective of the level productivity (d) or risk ($r\sigma^2/2$). The screening contract involves $e_S^* = \frac{2d^2\mu}{d+r\sigma^2/2}$, $m_S^* = \frac{2d^2\mu}{d+r\sigma^2/2}$, $x_S^* = \mu$, and $\pi_S^* = \frac{d^2\mu^2}{d+r\sigma^2/2} \leq \pi_H^0$.*

Proposition 4 suggests that firms can keep the low-value customers out of the market by charging a lower price and offering lower sales incentives ($B_S^* = \frac{d\mu}{d+r\sigma^2/2} < B_H^0$) leading to a lower value-enhancing effort $e_S^* \leq e_H^0$. Normally, in the absence of the value-enhancing selling effort, the same thing can be achieved by setting the price sufficiently high for only the high-value customers to buy (see, for example, Tirole 1988, Chapt. 3). However, in this model, we have shown that adverse selection occurs when the value-enhancing effort exceeds the markup. At such high levels of effort, the marginal cost of effort is also very high. As such, the firm finds reducing surplus through reduction in effort more profitable than doing so through increased markups. However, given that the higher effort allows the firm to charge a higher markup, lowering of the selling effort also requires lowering of the markup. Both, the lower markup and lower effort lead to the low-value customers deriving non-positive surplus, thereby allowing the firm to "screen" or prevent the low-value customers from entering the market. Nonetheless, since screening requires the firm to restrict the customer surplus, the demand from the high-value customers is also lower. In fact, the expected "sales is trapped" at a fixed level equal to μ and the firm earns a lower profit (both due to lower markup and lower demand) than under pure moral hazard. Note that when adverse selection occurs,

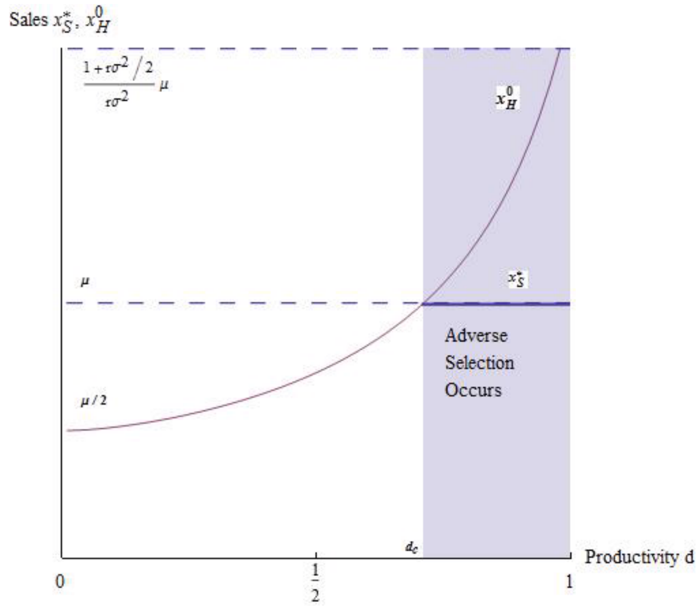

Figure 3: Sales volumes under Screening and Targeting as a function of Salesperson Productivity

i.e., under the condition $d\left(d-\frac{1}{2}\right) \geq r\sigma^2/4$ (refer Proposition 2), the expected sales under screening ($x_S^* = \mu$) is lower than sales under pure moral hazard ($x_H^0 = \frac{\mu}{2}\frac{d+r\sigma^2/2}{(1-d)d+r\sigma^2/2}$ shown under Proposition 1). In other words, the cost of keeping the low-value customers out of the market is a drop in profit obtained from sales to high-value customers. Figure 3 illustrates how screening leads to lower sales volume relative to pure moral hazard. This strategy, however, avoids potential disadvantages arising from inadvertently attracting non-targeted customers while aiming to target the high-value customers. In particular, the firm does not face the potentially negative consequences of customer mis-identification.

Thus, although screening achieves resolution of the adverse selection problem faced by the salesperson, it results in lower surplus for the high-value customers and lower profits for the firm. The more effective the salesperson, the lower the customer surplus under screening relative to pure moral hazard. Therefore when the salesperson is highly productive and risk tolerant, screening may result in "under-utilization" of the salesperson by the firm.

4.2 Accommodation of Unprofitable Entrants

We examine conditions under which the firm may choose pooling or accommodation instead of screening to deal with the adverse selection problem. In other words, the firm can charge a markup and induce a level of value-enhancing effort which allows the salesperson to serve both types ("pooling") of customers entering the market. Under this strategy the firm offers incentives to the salesperson to exert the same effort irrespective of the customer type, i.e., $B_H = B_L \Leftrightarrow e_H = e_L$. The risk neutral firm's decision problem therefore is given by

$$\max_{m,\ B} \quad \pi_A = mE\left(x_H + x_L\right) - E\left(A + B\left(x_H + x_L\right)\right) \tag{10a}$$

Subject to:

$$E\left[u\left(A + B\left(x_H + x_L\right)\right) - \frac{2e^2}{4d}\right] \geq u\left(w_0\right) \text{ (IRC)} \tag{10b}$$

$$e^* \in \quad \arg\max_e \quad E\left[u\left(A + B\left(x_H + x_L\right)\right) - \frac{2e^2}{4d}\right] \text{ (ICC).} \tag{10c}$$

The following results describe the conditions when the firm chooses an accommodation contract over screening.

Proposition 5 *In the region of the parameter space where* $\frac{1}{8d^2}\frac{\left(2d+r\sigma^2/2\right)d+r\sigma^2/2}{2(1-d)d+r\sigma^2/2} \geq 1$, *the firm prefers accommodating the low-value customer to screening. When the firm chooses accommodation, the levels of the selling effort and the markup are higher than that under screening,*$(e_S^* \leq e_A^* < e_H^0$ *and* $m_S^* \leq m_A^* < m_H^0)$. *Here* $m_A^* = \frac{1}{4}\frac{\mu\left(2d+r\sigma^2/2\right)}{2d(1-d)+r\sigma^2/2}$, $e_A^* = \frac{\mu d^2}{2d(1-d)+r\sigma^2/2}$, $x_A^* = \frac{\mu}{2}\frac{2d+r\sigma^2/2}{2d(1-4d)+r\sigma^2/2}$ *and* $\pi_A^* = \frac{\mu^2}{8}\frac{2d+r\sigma^2/2}{2(1-d)d+r\sigma^2/2}$.

We show that when the productivity of the salesperson is very high and the risk is very low (see Figure 4), the preferred strategy of the firm is to allow the salesperson to serve even the seemingly unprofitable customers ("pooling"). The firm charges a markup and induces a level of selling effort which are both higher than under screening, but still lower than under a pure moral hazard.[11] Notwithstanding the entry of low-value customers in the market, the ability to charge a higher markup and induce higher effort (sales) from the high-value customers allows the firm to better utilize the salesperson's productivity and risk tolerance. To earn more from the high-value customers, the firm finds it necessary to allow the salesperson to serve also the "unprofitable" low-value customers. This strategy has not received adequate consideration in practice as there seems to be a tendency toward deliberate exclusion of low-value customers as recipients of firms' marketing efforts. Note that under the accommodation strategy, the low-value customers do not directly become profitable and attractive for the firm. Yet, by accommodating them, the firm earns even higher profits from the high-value customers.

[11] The sales commission is also lower, i.e., $B_A^* = \frac{1}{2}\frac{\mu d}{2d(1-d)+r\sigma^2/2} < B_H^0$.

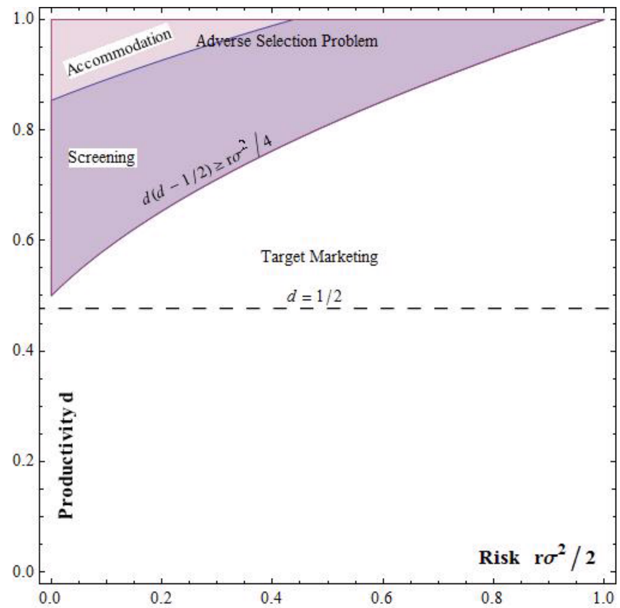

Figure 4: Accommodation and Screening under Adverse Selection and Moral Hazard

In many situations such as insurance markets, pooling under adverse selection, i.e., engaging the low-type players in the market, leads to a reduction in the surplus of the high-types relative to screening and firm profits (see, for example, Bolton and Dewatripont 2005, Chapt. 2). In this model, however, because the increase in optimal effort allows the firm to charge a higher markup, profits are higher under accommodation. High-value customers pay a higher price but also derive relatively higher service from the salesperson which leads to a higher surplus than under screening. Thus, incentives are "higher-powered" under accommodation compared with that of screening, yet lower compared with pure moral hazard. In other words, in the screening region, the incentives are a lot lower than that predicted in the extant literature whereas it is only somewhat lower in the accommodation region.

5 A Model with Pure Adverse Selection

We now consider the situation where the firm (or the manager) can observe the salesperson's selling efforts as in Starbucks, for example.[12] Note that the only change in the model is that the firm can extract an optimal selling effort from the salesperson, implying that there is no

[12] All the qualitative results of this paper hold also when the salesperson is risk-neutral and can be obtained by substituting $r\sigma^2/2 = 0$ in the results.

IC constraint for the firm ($B_H = B_L = 0$). The firm's decision problem can be written as

$$\max_{m,\, w(e_H,\, e_L)} \quad \pi = mE\left(x_H + x_L\right) - A. \tag{11a}$$

Subject to:

$$Eu\left[A - \frac{e_H^2 + e_L^2}{4d}\right] \geq u\left(w_0\right) \text{ (IRC)} \tag{11b}$$

Simplifying, we get

$$\max_{m,\, e_H,\, e_L} \quad \pi = mE\left(x_H + x_L\right) - \frac{e_H^2 + e_L^2}{4d} \tag{12}$$

The following Proposition explains the effect of no moral hazard on adverse selection.

Proposition 6 *The adverse selection problem and the accommodation solution become more likely when there is no moral hazard.*

When the firm can observe the selling effort, the value-enhancing effort $e_H^0 = \frac{\mu d}{1-d}$ and the markup $m^0 = \frac{\mu}{2(1-d)}$ that optimally targets the high-value customers will lead to an adverse selection problem if $d \geq \frac{1}{2}$. When the adverse selection is a problem, the firm can screen the unprofitable customers by lowering both the value-enhancing effort and markup. However, when the salesperson's productivity is very high $d > d_c > \frac{1}{2}$ where d_c solves $1 \geq 8d\left(1-d\right)$, the firm accommodates the unprofitable customers by increasing the value-enhancing effort $e_S^* < e_A^* < e_H^0$ and the markup $m_S^* < m_A^* < m^0$.

In many retail situations, firms can monitor the selling efforts of the salespeople. Following our analysis, we can conjecture that Best Buy, which reportedly employed highly productive salespeople (high d), is likely to be accommodating some low-type or unprofitable customers. WalMart whose salespeople, on the other hand, may have low productivity (low d), may not be facing the problem of unprofitable customers entering while others like Ace Hardware (moderate d) may be adopting a screening strategy with lower prices and services.

Figure 5 illustrates how the adverse selection problem intensifies in the absence of moral hazard, i.e., in the entire shaded region above $d \geq \frac{1}{2}$ compared to the top left corner defined by $d\left(d - \frac{1}{2}\right) \geq r\sigma^2/4$ as is the case under moral hazard. In other words, the adverse selection problem we have identified is more pronounced where there is no moral hazard problem such as when the salespeople are offered fixed salaries or there are no salespeople at all. The value-enhancing effort in such environments can be interpreted as level of advertising or in-store display, targeting high-value customers. More importantly, the higher the productivity of

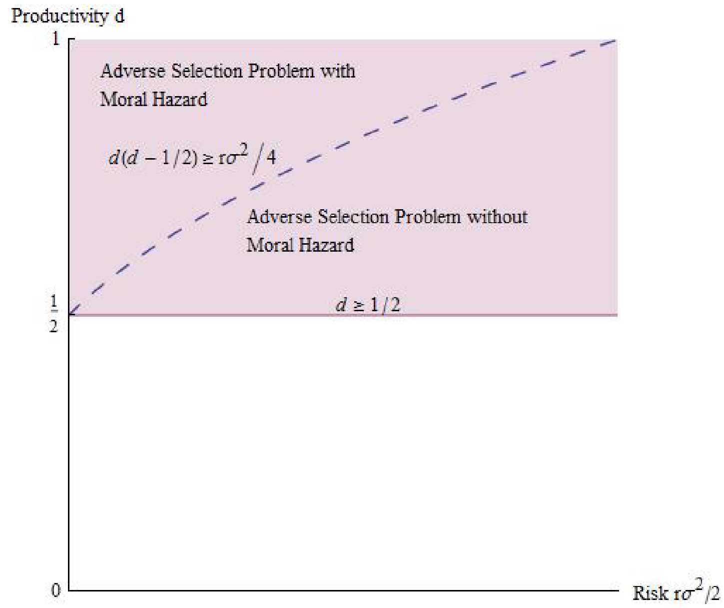

Figure 5: Adverse Selection Problem without Moral Hazard

these efforts, the more preferable is the accommodation strategy vis-a-vis screening as shown in Figure 6.

6 Robustness Check

We have shown that adverse selection by unprofitable customers poses an additional problem for salesforce compensation and examined possible solutions for this problem. For simplicity, we focused on a single product with a the quality to cost ratio = 1 and a single customer in each of the two types. We now generalize our results to situations where a) there are many customers in each type, and b) examine the effect of changing the ratio (k) of quality to marginal cost on our results.

First we consider the effect of multiple customers of each type.

6.1 A Market with Several Customers of each Type

So far we have considered a single customer under each of the two types. To generalize our results further, we consider a market with n_θ number of customer of type θ. In addition, we assume that the high-value customers are heterogeneous in terms of their valuation of the product but still with the same mean μ, variance σ^2 and error terms that are independently

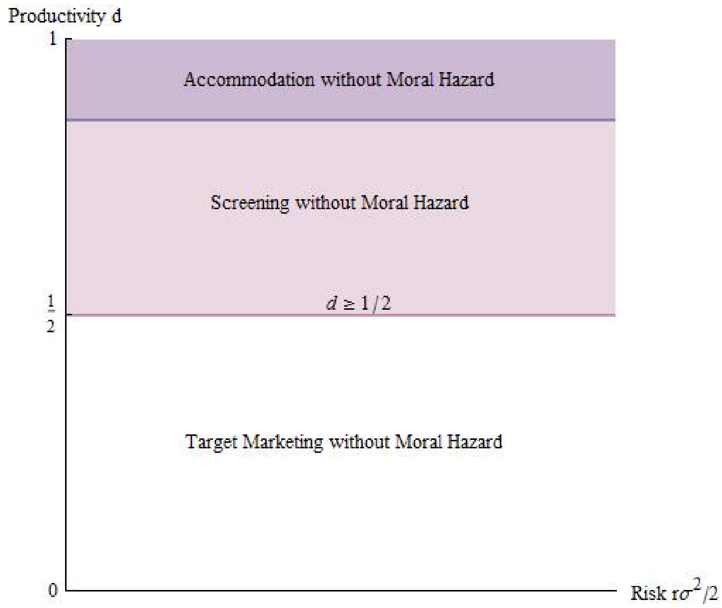

Figure 6: Accommodation and Screening under Adverse Selection Problem without Moral Hazard

and identically distributed. Following the same logic as in Section 3.1, customer utility maximization leads to total sales given by

$$x_H = \sum_{i}^{n_H} x_{H_i} \text{ and } x_L = \max\{0, n_L x_{L_i}\} \text{ where}$$
$$\sum_{i}^{n_H} x_{H_i} = n_H(\mu + e_H - m) + \sum_{i}^{n_H} \varepsilon_i \text{ and } x_{L_i} = \max\{0, e_L - m\}$$

The risk-neutral firm's decision problem can be written as

$$\max_{m,\ B_H,\ B_L} \quad \pi = mE(x_H + x_L) - E(A + B_H x_H + B_L x_L). \tag{13a}$$

Subject to:

$$E\left[u(A + B_H x_H + B_L x_L) - \frac{n_H e_H^2 + n_L e_L^2}{4d}\right] \geq u(w_0) \text{ (IRC)} \tag{13b}$$

$$\{e_H^*, e_L^*\} \in \quad \underset{e_H, e_L}{\arg\max} \quad E\left[u(A + B_H x_H + B_L E x_L) - \frac{n_H e_H^2 + n_L e_L^2}{4d}\right] \text{ (ICC)} \tag{13c}$$

Simplifying, we get

$$\max_{m,\ B_H,\ B_L} \quad \pi \quad = \quad mE(x_H + x_L) - \left(\frac{n_H e_H^2 + n_L e_L^2}{4d} + n_H r\sigma^2/2B_H^2\right) \tag{14a}$$

$$\text{Subject to} \quad : \quad e_H^* = 2dB_H \text{ and } e_L^* = 2dB_L. \tag{14b}$$

Substituting the optimal efforts above, we get

$$\max_{m,\ B_H,\ B_L} \quad \pi = m\left[n_H\left(\mu + 2dB_H - m\right) + n_L\left(2dB_L - m\right)\right] - \left[n_H\left(d + r\sigma^2/2\right)B_H^2 + n_L d B_L^2\right] \tag{15}$$

We define $\alpha := \frac{n_H}{n_H+n_L}$ as the proportion of the high-value customers in the market. The following Proposition explains the effect of the presence in the market of several customers of a given type on the results.

Proposition 7 *When there are multiple customers of each type, the adverse selection problem arises under the same condition as before, i.e., when $d\left(d-\frac{1}{2}\right) \geq r\sigma^2/4$. However, the higher the proportion (α) of high-value customers, the more profitable is the accommodation strategy relative to screening.*
Accommodation is preferable to screening if $\frac{\alpha\left(d+r\sigma^2/2\right)}{4d^2}\left(1+\frac{d^2}{d(1-d)+\alpha r\sigma^2/2}\right) \geq 1$.

We show that the possibility of adverse selection in this market remains unaffected by the number of high and low-value customers. In other words, the likelihood of adverse selection depends only on the productivity (d) and risk ($r\sigma^2/2$), exactly the same way as in a market with only one consumer of each type. We find that the markup and the level of the value-enhancing effort also remain the same in the case of both pure moral hazard and screening strategies. Similarly, screening, as earlier, results in both loss of firm profit and customer surplus due to a "sales trap" or a restriction on the amount spent by each customer. Accordingly, if the proportion of high-value customers is high, the firm prefers to relieve itself of the sales trap and utilize better the salesperson's efforts by choosing accommodation over screening. In fact, when the proportion of high-value customers in the market increases, the firm chooses to induce higher efforts and markups using accommodation. (See Figure 7.) The resulting profits are traded-off against the losses from serving unprofitable customers. In other words, the high-value customers, when present in the market in higher proportion "subsidize" the low-value customers in the market. Note as before, that a higher productivity of the salesperson and a lower risk also favor this subsidization. Next we examine the effect of the changing quality to cost ratio k on the adverse selection problem and firm strategies.

6.2 The Effect of Quality to Cost Ratio (k)

When the firm decides markup and incentives focusing only on the high value customers, as discussed under Proposition 2, the low value customers may also find the firm's offer attrac-

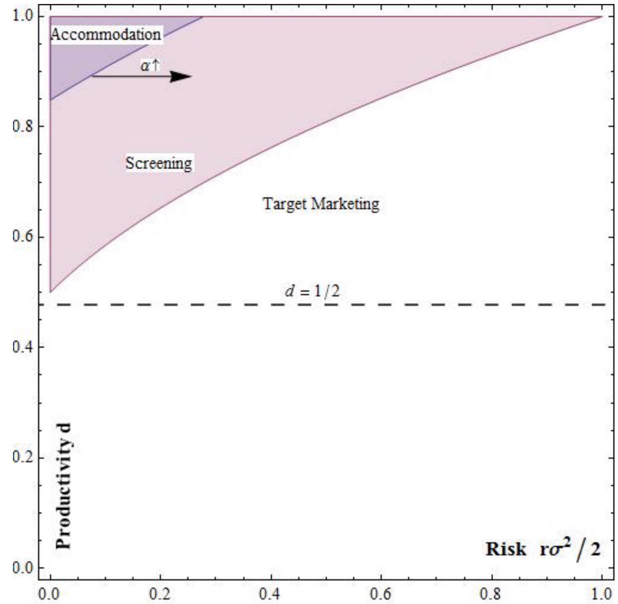

Figure 7: The Effect of a Proportion α of High-value Customers in the Market

tive. We show that the conditions for both adverse selection problem and accommodation also depends on the quality to cost ratio (k) as explained below in Proposition 8.

Proposition 8 ***Effect of the ratio of quality to cost:*** *When customers are unidentifiable, low-value customers enter the market ($x_L^0 \geq 0$) when $\mu \geq 2(1-k)\frac{d^2+k\left(d+r\sigma^2/2\right)}{2d^2-k\left(d+r\sigma^2/2\right)}$. The firm prefer screening (accommodation) when the brand value is below (above) a threshold.*

Proposition 8 illustrates the effect of the ratio of quality to cost on the entry of low-value customers and firm strategies. The low-value customers enter the market only if the mean brand value is above a threshold.

As before, a screening strategy which requires the sales volume to be restricted to $x_H^S = \mu - 2(1-k)$. When the brand value is above a threshold, however, accommodation becomes more profitable. In other words, the higher the brand value of a firm, the more likely that accommodation will be preferred to screening.

7 Conclusions

In general, our research contributes to the growing literature on the interaction between salesforce compensation and the marketing mix of firms. While most studies in this area have focused on the interaction between sales incentives and pricing decisions, we demonstrate the need to align salesforce incentives and prices with the targeting strategy of firms. Our results, therefore, have important implications for managers.

First, we highlight that targeting marketing-mix to a high-value segment can also attract unprofitable customers. We also caution against assuming that high prices will deter such entry of unprofitable customers because dissuasion from higher prices can be offset by the higher levels of service offered by salespeople to attract high-value customers.

Second, we point out that this problem is more likely when salespeople are monitored and highly productive. It can also occur when there are no salespeople, but there are other means of value-enhancement such as advertising, in-store displays to attract the target customers. The important question is how effective are the value-enhancing efforts. Recall that the adverse selection condition depends on the brand value (μ).

Third, we show that such entry is not necessarily a bad thing but an indicator of highly productive value-enhancing efforts. A 'find and fire' strategy, therefore, is perhaps not the way to deal with unprofitable customers. Moreover, such a strategy, because it relies on the accuracy of identification, may require development of expertise and expensive customer database management systems.

Fourth, it is also worth noting that a 'find and fire' strategy may not even be feasible when the customer types are unobservable or can vary with purchase occasion. Even when it is feasible, this strategy can hurt the long-term interests of the firm due to ethical concerns and loss of reputation. More seriously, such a strategy can lead to unprofitable customers masquerading as profitable ones, making detection costlier and inaccurate. The resulting miss-identification of customers can further damage firm reputation.

Fifth, we show that the best way to deal with the unprofitable customers depends on the characteristics of the firm, salesperson and the market. For example, it is better for highly efficient firms (with very high productivity of value-enhancing efforts and profitability/proportion of high value customers) to accommodate unprofitable customers. Screening is better only for firms with moderate efficiency. Firms that are not efficient will not face this adverse selection problem.

Sixth, we offer guidelines to managers to implement the optimal strategy. For example, a screening strategy requires lowering the price unlike the standard approach which requires an increase in price to achieve second degree price discrimination. However, it is important that the decrease in price is accompanied by a decrease in value-enhancing efforts which is the reason for the entry of unprofitable customers in the first place. Moreover, this lowering of the price-effort combination has to be significant enough for the screening strategy to be effective. But when accommodation is the optimal response, price-effort combination needs to be lowered only moderately.

Our research also has several implication for researchers interested in salesforce compensation. For example, it leads to several predictions that can be tested empirically: 1) Are the characteristics of firms, salespeople and markets where entry of unprofitable customers occurs consistent with our predictions? 2) Do firms follow the screening or accommodation strategy as we predict? 3) How prevalent is the "find and fire" strategy as a way of dealing with the entry of unprofitable customers? 4) Do firms use other kinds of strategy to deal with this problem?

We surmise that firms use a "find and fire" strategy more often than screening or accommodation because the different forces in play may not be clearly understood. This also creates consulting opportunities using this line of research as a guiding framework. Nevertheless, further research is needed for us to fully comprehend the nature of all the forces at play. For example, one can investigate the following questions: 1) How does customer heterogeneity in the efficiency of the value-enhancing effort impact our results? 2) How can a firm and salesperson "convert" an unprofitable customer into a profitable one? 3) How does competition affect firm strategies under adverse selection? 4) What are the implications of the screening and accommodation strategies on customer relationship management (CRM) and customer profitability analysis (CPA)?

With the rise of the BRIC economies, increasingly firms are paying attention to customers who were previously considered unprofitable. In conclusion, we caution against characterizing and 'firing' interested customers as 'devils' which is not only unethical but also may be unprofitable.

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Appendix

Proof of Proposition 1

From equations 3a and 3b, we have $E(x_H) = \mu + e_H - m$ and $x_L = e_L - m$. Further using the efforts from equation 6 and substituting these in equation 8, we get

$$\max_{m,\, B_H,\, B_L} \quad \pi = m(\mu + 2dB_H - m + 2dB_L - m) - \left(d + \frac{r\sigma^2}{2}\right) B_H^2 - dB_L^2 - w_0. \tag{16}$$

Note that the second order conditions for a maximum are satisfied. Since customer type is identifiable and the maximization problem is separable, the firm can set incentives to sell toward different types. Starting with the low type customers, we have

$$\max_{B_L} \quad m(2dB_L - m) - dB_L^2 - w_0. \tag{17}$$

Solving the first order conditions, we get $\hat{B}_L = m$ which results in the profit $m^2(d-1) \le 0$ since $d \le 1$ under the assumptions of the model. This implies that the maximum profit obtained from sales to the low-type customers is negative. The firm therefore sets $B_L^0 = 0$ and eliminates the loss from selling to these customers. The low-value customers are therefore unprofitable. **Q.E.D**.

Solving the first order conditions, for the remainder of the optimization problem, i.e., $\max\limits_{m,\, B_H} \quad \pi_H = m(\mu + 2dB_H - m) - \left(d + \frac{r\sigma^2}{2}\right) B_H^2$, we get

$$m^0 = \frac{\mu}{2} \frac{d + r\sigma^2/2}{(1-d)\,d + r\sigma^2/2},\; B_H^0 = \frac{\mu}{2} \frac{d}{(1-d)\,d + r\sigma^2/2} \Leftrightarrow e_H^0 = \frac{\mu d^2}{(1-d)\,d + r\sigma^2/2}. \tag{18}$$

Here $m^0 \ge 0$ and $B_H^0 \ge 0$ as long as $(1-d)\,d + r\sigma^2/2 > 0$ which is satisfied since $d \le 1$. The resulting profits are

$$\pi_H^0 = \left(\frac{\mu}{2}\right)^2 \frac{d + r\sigma^2/2}{(1-d)\,d + r\sigma^2/2} - w_0. \tag{19}$$

The expected sales and customer surplus are respectively given by

$$x_H^0 = \mu + e_H^0 - m^0 = \frac{\mu}{2} \frac{d + r\sigma^2/2}{(1-d)\,d + r\sigma^2/2} \text{ and } u_H^0 = \frac{1}{2}\left[\frac{\mu}{2} \frac{d + r\sigma^2/2}{(1-d)\,d + r\sigma^2/2}\right]^2. \;\textbf{Q.E.D}. \tag{20}$$

Proof of Corollary 1

In the absence of a salesperson, $e = 0$ which leads to $u_L(e_L = 0, m) = -mx_L - x_L^2/2 \le 0$. The firm decision problem therefore reduces to $\max\limits_{m} mE(x_H)$ where $E(x_H) = \mu - m$ which leads to $m^M = \mu/2 = x_H^M$ (expected sales) and $\pi_H^M = \mu^2/4$. **Q.E.D**.

Proof of Corollary 2

From equations 18 and 20, we can write $x_H^0 = \frac{d+r\sigma^2/2}{2d^2} e_H^0$ and $m^0 = \frac{d+r\sigma^2/2}{2d^2} e_H^0$ which are both increasing in e_H^0. Further, we have $\frac{de_H^0}{d\mu} \geq 0$, $\frac{de_H^0}{dd} \geq 0$ and $\frac{de_H^0}{d(r\sigma^2/2)} \leq 0$. **Q.E.D.**

Proof of Proposition 2

From equation 18, $x_L^0 = e_H^0 - m^0 = \mu \frac{d\left(d-\frac{1}{2}\right) - r\sigma^2/4}{(1-d)d + r\sigma^2/2} \geq 0 \Rightarrow d\left(d - \frac{1}{2}\right) - r\sigma^2/4 \geq 0$. **Q.E.D.**

Proof of Proposition 3

Follows directly from the Proof of Proposition 1. If they are identifiable, the firm chooses not to serve the low-value customers because the firm earns a negative profit from any sale to them. **Q.E.D.**

Proof of Proposition 4

Substituting for equations 9b and 9c, and using the constraint $x_L(m, B) \leq 0$, we get the firm's reduced problem:

$$\max_{m,\ B} \quad \pi_S = m(\mu + 2dB - m) - \left(d + r\sigma^2/2\right) B^2 - w_0 \text{ s.t. } 2dB \leq m. \tag{21}$$

Solving simultaneously the marginal conditions, we get $m_S^* = \frac{2d^2\mu}{d+r\sigma^2/2}$, $B_S^* = \frac{d\mu}{d+r\sigma^2/2} \Leftrightarrow e_S^* = \frac{2d^2\mu}{d+r\sigma^2/2}$, and the expected demand and customer utility are respectively $x_S^* = \mu$ and $u_S^* = \frac{\mu^2}{2}$. The screening profits are

$$\pi_S^* = \frac{d^2\mu^2}{d + r\sigma^2/2} - w_0. \tag{22}$$

Comparing with equations 18, 19, and the conditions of adverse selection $d\left(d - \frac{1}{2}\right) > \frac{r\sigma^2/2}{2}$ and $d \leq 1$, we can see that

$$\begin{aligned}
m^0 - m_S^* &= \frac{\mu}{d + r\sigma^2/2}\left(\frac{d^2}{(1-d)\,d + r\sigma^2/2} - 1\right)\left(d\left(d - \frac{1}{2}\right) - r\sigma^2/4\right) \geq 0 \\
B_S^* &< B_H^0 \Leftrightarrow e_S^* < e_H^0 \text{ since } B_H^0 - B_S^* = \frac{d\mu}{d + r\sigma^2/2}\frac{d\left(d - \frac{1}{2}\right) - r\sigma^2/4}{(1-d)\,d + r\sigma^2/2} \geq 0, \\
x_S^* &\leq x_H^0 \text{ since } x_H^0 - x_S^* = \mu\frac{d\left(d - \frac{1}{2}\right) - r\sigma^2/4}{(1-d)\,d + r\sigma^2/2} \geq 0, \text{ and} \\
\pi_S^* &\leq \pi_H^0 \text{ since } \pi_H^0 - \pi_S^* = \frac{\mu^2\left(d\left(d - \frac{1}{2}\right) - r\sigma^2/4\right)^2}{\left((1-d)\,d + r\sigma^2/2\right)\left(d + r\sigma^2/2\right)} \geq 0. \ \textbf{Q.E.D.}
\end{aligned}$$

Proof of Proposition 5

As before from equations 10b, and 10c we get the firm's reduced problem:

$$\max_{m,\ B} \quad \pi_A = m\left[\mu + 2\left(2dB - m\right)\right] - \left(2d + r\sigma^2/2\right) B^2 - w_0.$$

Solving the first order conditions as before, we get

$$\begin{aligned}
m_A^* &= \frac{1}{4}\frac{\mu\left(2d + r\sigma^2/2\right)}{2d\left(1-d\right) + r\sigma^2/2} \\
B_A^* &= \frac{d}{2}\frac{\mu}{2d\left(1-d\right) + r\sigma^2/2} \Leftrightarrow e_A^* = \frac{\mu d^2}{2d\left(1-d\right) + r\sigma^2/2}, \\
x_A^* &= \frac{1}{2}\frac{\mu\left(2d + r\sigma^2/2\right)}{2d\left(1-d\right) + r\sigma^2/2}, \text{ and} \\
\pi_A^* &= \frac{1}{8}\frac{\left(2d + r\sigma^2/2\right)\mu^2}{2(1-d)d + r\sigma^2/2} - w_0.
\end{aligned}$$

Comparing with equation 18, we can see that

$$\begin{aligned}
e_A^* &< e_H^0 \text{ since } -\frac{\left(1-d\right)d\mu}{\left(1-d\right)d + r\sigma^2/2}\frac{d^2}{2(1-d)d + r\sigma^2/2} < 0, \\
m_A^* &< m_H^0 \text{ since } -\frac{1}{2}\left(d\frac{\mu\left(1-d\right)\left(d + r\sigma^2/2\right)}{\left(1-d\right)d + r\sigma^2/2} + \mu r\sigma^2/4\right)\frac{1}{2(1-d)d + r\sigma^2/2} < 0, \text{ and} \\
\pi_A^* &< \pi_H^0 \text{ since } \frac{d{+}r\sigma^2/4}{d + r\sigma^2/2} < 1 < \frac{2(1-d)d + r\sigma^2/2}{\left(1-d\right)d + r\sigma^2/2}.
\end{aligned}$$

Note that $\pi_A^* \geq \pi_S^*$ (ref. equation 22) if

$$\frac{1}{8}\frac{2d + r\sigma^2/2}{2(1-d)d + r\sigma^2/2} - \frac{d^2}{d + r\sigma^2/2} \geq 0 \tag{23}$$

Under this condition, we can see that also $m_A^* \geq m_S^*$. Also given the condition of adverse selection, $B_A^* \geq B_S^* \Leftrightarrow e_A^* \geq e_S^*$ since $d\left(d - \frac{1}{2}\right) - r\sigma^2/8 \geq 0$ (refer Proof of Proposition 2).[1] **Q.E.D**.

Proof of Proposition 6

Solving the first order conditions for efforts, we get $e_H^0 = 2dm$ and $e_L^0 = 0$ (since $\hat{e}_L = 2dm$ results in negative sales). The remainder of the problem is

$$\max_{m} \quad \pi_H = m\left(\mu + 2dm - m\right) - m^2 d - w_0.$$

Solving, we get $m^0 = \frac{\mu}{2(1-d)}$ and $\pi_H^0 = \frac{1}{1-d}\left(\frac{\mu}{2}\right)^2 - w_0$.[2] Notice that $x_L^0 = e_H^0 - m^0 = \frac{(d-1/2)\mu}{1-d}$ iff $d \geq \frac{1}{2}$.

Similarly the screening decision is given by

$$\max_{m,\ w(e_S)} \quad \pi_S = m\left(\mu + e - m\right) - \frac{e^2}{4d} - w_0 \text{ s.t. } e \leq m.$$

Solving, we get $m_S^* = 2d\mu$, $e_S^* = 2d\mu$, and $\pi_S^* = \mu^2 d - w_0$.

---

[1] On the other hand, when $\pi_A^* < \pi_S^* \Leftrightarrow \frac{1}{8d^2}\frac{\left(2d+r\sigma^2/2\right)\left(d+r\sigma^2/2\right)}{2(1-d)d+r\sigma^2/2} < 1$, also $p_A^* < p_S^*$. However, $B_A^* \geq B_S^*$ $\Leftrightarrow e_A^* \geq e_S^*$ iff $2d\left(d - \frac{3}{4}\right) - r\sigma^2/4 \geq 0$.

[2] This proof can also be obtained by substituting $r\sigma^2/2 = 0$ in Propositions 1-5.

The accommodation or pooling problem is given by

$$\max_{m,\ w(e)} \quad \pi_A = m\left(\mu + 2\left(e - m\right)\right) - \frac{2e^2}{4d} - w_0.$$

Solving, we get $m_A^* = \frac{1}{4}\frac{\mu}{1-d}$, $e_A^* = \frac{1}{2}\frac{\mu d}{1-d}$,and $\pi_A^* = \frac{1}{8}\frac{\mu^2}{1-d} - w_0$. Comparing, we can see that

$$\pi_A^* \gtreqless \pi_S^* \text{ if } \frac{1}{8} \gtreqless d\left(1-d\right).$$

Note that if $\pi_A^* \gtreqless \pi_S^*$, also $m_A^* \geq m_S^*$. However, $e_A^* \geq e_S^*$ only if $\frac{1}{4} \geq 1-d$ which also holds if $\pi_A^* \geq \pi_S^*$. **Q.E.D**.

Proof of Proposition 7

Refer equation 15. As in the Proof of Proposition 1, when customer types are known, the firm offers zero incentives to the salesperson to serve the low-value customers,because the firm decision problem

$$\max_{B_L} \quad \pi = n_L m\left(2dB_L - m\right) - n_L d B_L^2 - w_0 \text{ solves as } \hat{B}_L = m$$

The above results in negative profit. The firm therefore sets $B_L^0 = 0$.

The remainder of the optimization problem is given by

$$\max_{m,\ B_H} \quad \pi_H = n_H m\left(\mu + 2dB_H - m\right) - n_H\left(d + r\sigma^2/2\right)B_H^2 - w_0.$$

Solving, we get

$$m^0 = \frac{\mu}{2}\frac{d + r\sigma^2/2}{d\left(1-d\right) + r\sigma^2/2}, B_H^0 = \frac{\mu}{2}\frac{d}{d\left(1-d\right) + r\sigma^2/2} \Leftrightarrow e_H^0 = \frac{\mu d^2}{d\left(1-d\right) + r\sigma^2/2}.$$

The firm profits are $\pi_H^0 = n_H\left(\frac{\mu}{2}\right)^2\frac{d + r\sigma^2/2}{d(1-d) + r\sigma^2/2} - w_0$.

If the firm follows a strategy by setting $\left(m^0, B_H^0\right)$ as above, the low-value customers will enter the market if

$$x_L^0 = e_H^0 - m^0 = \mu\frac{d\left(d - \frac{1}{2}\right) - r\sigma^2/4}{d\left(1-d\right) + r\sigma^2/2} \geq 0.$$

The necessary condition for the above is exactly the same as in case of one customer of each type (Proposition 2**)**, i.e.,

$$d\left(d - \frac{1}{2}\right) \geq r\sigma^2/4.$$

The screening decisions are given by

$$\max_{m,\ B} \quad \pi_S = n_H m\left(\mu + 2dB - m\right) - n_H\left(d + r\sigma^2/2\right)B^2 - w_0 \text{ s.t. } 2dB \leq m.$$

Solving we get the same results as in the case of single customer of each type (Proposition 4):

$$m_S^* = \frac{2d^2\mu}{d + r\sigma^2/2}, B_S^* = \frac{d\mu}{d + r\sigma^2/2} \Leftrightarrow e_S^* = \frac{2d^2\mu}{d + r\sigma^2/2}.$$

The profits (which increase as n_H increases) are $\pi_S^* = n_H\frac{d^2\mu^2}{d + r\sigma^2/2}$.

Similarly, accommodation decisions are given by

$$\max_{m,\ B} \quad \pi_A = m\left(n_H\left(\mu + 2dB - m\right) + n_L\left(2dB - m\right)\right) - \left(\left(n_H + n_L\right)d + n_H r\sigma^2/2\right)B^2 - w_0.$$

From the first order conditions using $\alpha = \frac{n_H}{n_H + n_L}$, we get

$$m_A^* = \frac{\alpha\mu}{2}\frac{d + \alpha r\sigma^2/2}{(1-d)\,d + \alpha r\sigma^2/2}, B_A^* = \frac{\alpha}{2}\frac{\mu d}{(1-d)\,d + \alpha r\sigma^2/2} \Leftrightarrow e_A^* = \frac{\alpha\mu d^2}{(1-d)\,d + \alpha r\sigma^2/2}.$$

Firm profit is $\pi_A^* = \frac{\alpha n_H \mu^2}{4}\frac{d + \alpha r\sigma^2/2}{d(1-d) + \alpha r\sigma^2/2} - w_0$. Assuming $\alpha = \frac{n_H}{n_H + n_L}$, we can see that $\frac{\pi_A^*}{\pi_S^*} \geq 1$ if

$$\frac{\alpha\left(d + r\sigma^2/2\right)}{4d^2}\left(1 + \frac{d^2}{d\,(1-d) + \alpha r\sigma^2/2}\right) \geq 1.$$

Therefore, $\frac{d}{d\alpha}\left(\frac{\pi_A^*}{\pi_S^*}\right) = \frac{d + r\sigma^2/2}{4}\frac{1 + \left(\frac{\alpha r\sigma^2/2}{d}\right)^2 - \left(d + \alpha r\sigma^2\left(1 - \frac{1}{d}\right)\right)}{\left(d(1-d) + \alpha r\sigma^2/2\right)^2} \geq 0$ if $1 + \left(\frac{\alpha r\sigma^2/2}{d}\right)^2 > d + \alpha r\sigma^2\left(1 - \frac{1}{d}\right)$ which is true since $d < 1$. Similarly, $\frac{dm_A^*}{d\alpha} = \frac{\mu d^2\left(1 + \left(\frac{\alpha r\sigma^2/2}{d}\right)^2 - \left(d + \alpha r\sigma^2\left(1 - \frac{1}{d}\right)\right)\right)}{2\left(d(1-d) + \alpha r\sigma^2/2\right)^2} \geq 0$ and $\frac{de_A^*}{d\alpha} = \frac{(1-d)d^3\mu}{\left(d(1-d) + \alpha r\sigma^2/2\right)^2} \geq 0$. **Q.E.D.**

Proof of Proposition 8

When $k < 1$, equation 1 becomes

$$v - 1 = b + kc + e - 1 = b + e - mk - (1-k) \Rightarrow U(x) = \left(b + e - mk - (1-k)\right)x - x^2/2.$$

Solving the utility maximization, we get

$$x^* = \max\left\{0, b + e - mk - (1-k)\right\}.$$

The above leads to the same optimal efforts as given by equation 6 but the firm decision changes to

$$\begin{aligned}\max_{m,\ B_H,\ B_L} \quad \pi &= mE\left[x_H + x_L\right] - \left[w_0 + d\left(B_L^2 + B_H^2\right) + \frac{r\sigma^2}{2}B_H^2\right] \\ &= \text{Expected Gross Profit} - [\text{Reservation wage } + \text{ Cost of effort } + \text{ Risk}] \\ &= m\left[\mu + 2d\left(B_L + B_H\right) - 2mk - 2\left(1-k\right)\right] - dB_L^2 - \left(d + \frac{r\sigma^2}{2}\right)B_H^2 - w_0\end{aligned}$$

Following the same logic as in the Proof of Proposition 1, we get

$$B_L^0 = 0,\ B_H^0 = \frac{1}{2k}\frac{\frac{\mu}{2} - (1-k)}{1 + \frac{r\sigma^2}{2d} - \frac{d}{2k}},\ \text{and } m^0 = \frac{1 + \frac{r\sigma^2}{2d}}{2k}\frac{\frac{\mu}{2} - (1-k)}{1 + \frac{r\sigma^2}{2d} - \frac{d}{2k}}.$$

This leads to profit:

$$\pi_H^0 = \frac{d + r\sigma^2/2}{k\left(d + r\sigma^2/2\right) - d^2/2}\frac{\left(\frac{\mu}{2} - (1-k)\right)^2}{2} - w_0.$$

Note here that here, the firm makes profit and offers positive incentives only if $k\left(d+r\sigma^2/2\right) \geq d^2/2 \Rightarrow k \gtrless \frac{d^2/2}{d+r\sigma^2/2}$, and $\frac{\mu}{2} \gtrless 1-k$.

If the firm follows a strategy by setting $\left(m^0, B_H^0\right)$ as above, the low-value customers will enter the market if

$$x_L^0 = e_H^0 - m^0 k - (1-k) = \frac{1}{2}\frac{\frac{\mu}{2}\left(2d^2 - k\left(d+r\sigma^2/2\right)\right) - (1-k)\left(d^2 + k\left(d+r\sigma^2/2\right)\right)}{k\left(d+r\sigma^2/2\right) - d^2/2} \geq 0.$$

The above implies that $x_L^0 \geq 0$ when $\mu \geq 2(1-k)\frac{d^2+k\left(d+r\sigma^2/2\right)}{2d^2-k\left(d+r\sigma^2/2\right)}$.

Considering the screening decision, we have using the constraint $x_L(m,B) \leq 0$, we get the firm's reduced problem:

$$\max_{m,\ B} \quad \pi_S = m\left(\mu + 2dB - mk - (1-k)\right) - \left(d+r\sigma^2/2\right)B^2 - w_0 \text{ s.t. } 2dB \leq mk + 1 - k.$$

Solving, we get

$$m_S^* = \frac{1}{k}\left(\frac{2d^2}{k}\frac{\mu-2(1-k)}{d+r\sigma^2/2} + 1 - k\right), B_S^* = \frac{d}{k}\frac{\mu-2(1-k)}{d+r\sigma^2/2}, \text{ and } \lambda^* = \frac{2d^2}{k^2}\frac{\mu-2(1-k)}{d+r\sigma^2/2} - \frac{\mu-3(1-k)}{k}.$$

Note that $\lambda^* > 0$ if $\frac{2}{k}\frac{d^2}{d+r\sigma^2/2} > 1 - \frac{1-k}{\mu-2(1-k)}$. Resulting sales are given by $x_H\left(m^S, B^S\right) = \mu - 2(1-k)$ and profits are given by

$$\pi_S^* = 2\left(\frac{\mu}{2} - (1-k)\right)\left(1 - \frac{2d^2}{k^2}\frac{\frac{\mu}{2} - (1-k)}{d+r\sigma^2/2}\right) - w_0.$$

When the firm chooses to accommodate the low-value customers, it solves

$$\max_{m,\ B} \quad \pi_A = m\left(\mu + 4dB - 2mk - 2(1-k)\right) - \left(2d + r\sigma^2/2\right)B^2 - w_0.$$

Solving the first order conditions, we get

$$m_A^* = \frac{1}{4}\frac{\mu-2(1-k)}{k - \frac{2d^2}{2d+r\sigma^2/2}}, B_A^* = \frac{d}{2}\frac{\mu-2(1-k)}{k\left(2d+r\sigma^2/2\right) - 2d^2} \Leftrightarrow e_A^* = d^2\frac{\mu-2(1-k)}{k\left(2d+r\sigma^2/2\right) - 2d^2}.$$

The resulting profit is given by

$$\pi_A^* = \frac{1}{2}\frac{\left(\frac{\mu}{2} - (1-k)\right)^2}{k - \frac{2d^2}{2d+r\sigma^2/2}} - w_0.$$

We can see that $\pi_A^* \geq \pi_S^*$ if

$$\mu \geq 2\left[1 - k + \frac{4}{\frac{1}{k - \frac{2d^2}{2d+r\sigma^2/2}} + \frac{8d^2}{k^2}\frac{1}{d+r\sigma^2/2}}\right]. \textbf{ Q.E.D.}$$

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