**Can Profits Increase with Uncertainty in a Principal-Agent Model?**

**Implications for the Choice between Generalist and Specialist Sales Structures**

Niladri Syam

Department of Marketing and Entrepreneurship

University of Houston

Houston, TX 77204

Email: nbsyam@uh.edu

Phone: 713-743-4568

James D. Hess

Department of Marketing and Entrepreneurship

University of Houston

Houston, TX 77204

Email: jhess@uh.edu

Phone: 713-743-4175

Ying Yang

Department of Marketing and Entrepreneurship

University of Houston

Houston, TX 77204

Email: yyang24@uh.edu

Phone: 713-743-4579

**September 12, 2012**

**Can Profits Increase with Uncertainty in a Principal-Agent Model?**

**Implications for the Choice between Generalist and Specialist Sales Structures**

**Abstract:** The question of how a firm can extract and use information in principal-agent models has a long history. We add to this literature by showing that a firm can sometimes benefit from more sales uncertainty. This is contrary to the usual finding that sales uncertainty hurts the firm when agents are risk-averse. Our result holds when the firm can receive signals of random demand and exploit it in its pricing and lead qualifying. When uncertainty is high there is more information potential for the firm to exploit profitably.

 This theoretical finding has consequence for an important managerial question about sales force structure: Should the firm have a generalist sales force to sell to both its new and existing customer or should it use a specialist sales force for each customer type?

 Our key managerial insight is that a generalist sales force allows the firm to better exploit information about the selling environment. In a generalist sales force the same agent sells to both new and existing customers, so the customer’s attitude-towards-agent can be filtered out, and information about attitude-towards-brand can be learnt. Such information gathering is not as efficient with a specialist sales force. When the uncertainty about attitude-towards-brand is high the firm prefers a generalist rather than a specialist sales force.

Keywords: principal-agent, uncertainty, information, sales force

**1. Introduction**

Informational aspects of principal-agent models have a long history, focusing on the questions of who has what information, when they have it, and more importantly, how they can use it (Nalebuff and Stiglitz 1983; Singh 1985; Sobel 1993). Our goals in this paper are twofold, one theoretical and one managerial. First, we make a theoretical contribution by demonstrating that, information extraction can overturn a key result of the standard principal-agent model: that the firm’s profit decreases with higher uncertainty because risk-averse agents must be paid more to absorb more risk. We show that information about random demand can be extracted and used in a way that the firm can actually benefit from higher uncertainty! Second, practical imports flow from this theoretical finding. In an uncertain marketplace, specialized sales forces lose their advantage over generalists. Because a generalist sales person selling to all types of customers has the capability of learning more information, it leads to information-based improvements in decisions. Therefore, when demand is volatile, the sales force should consist of generalist rather than specialist salespeople, even if being a jack-of-all-trades is difficult.

Zoltners et al. (2008) identifies sales force structure as one of the areas of greatest concern to sales executives and also one in which there is a dearth of research. Mantrala et al. (2010) in their recent survey article mention that the issue of generalist versus specialist sales forces is a major open question in the area of sales force structure. They note, “However with the notable exception of Rangaswamy et al. (1990), there is very little research that provides directions for *when and how to specialize* [their italics] sales forces” (pp. 263). We provide two illustrations of how our theoretical insight on information use impacts the choice of generalist or specialist sales force in two different contexts: (1) selling to new and existing customers, and (2) qualifying sales leads.

Product-based and customer-based schemes are two common ways of structuring the sales force (Zoltners et al., 2003), but in recent times the latter has been acknowledged to be better, in consonance with a move towards customer focus of marketing activity (Futrell, 2001 p. 87; Sheth and Sharma 2008). Most firms that have been in business for a length of time will have both new and existing customers. Should they have a generalist sales force wherein each salesperson sells to both new and existing customers, or should they have a specialist sales force wherein different salespeople sell to new and existing customers? The trade press frames this as the choice of having a ‘hunter-farmer model’ of sales force organization or not. The academic literature too has pointed to the importance of this topic (Johnston and Marshall, 2006 p. 119; Sheth and Sharma 2008; Dubinsky et al. 2003). For example, Avon salespeople are generalists who sell to both customer types, new and existing, whereas many firms in the computer industry organize their sales forces into a hunter/farmer structure (Zoltners et al., 2003, pp. 130).

The second illustration of how the generalist and specialist differ in their ability to extract and use information is in the context of qualifying sales leads. The importance for salespeople of customer/territory information has already been recognized in the literature (Lodish 1971; Weitz et. al. 1986). Darmon (2002) argues that collecting customer information is a major aspect of a salesperson’s task and investigates how salespeople can collect such information in order to qualify or disqualify potential customers. We add to this literature by demonstrating that the sales force structure also has implications about how much customer information can be gathered and how it can be used to properly qualify leads.

***1.1 Related Literature***

Our research connects to the rich literature in marketing that investigates the role of sales uncertainty in various aspects of interest to a selling organization. Some authors like Coughlan and Narasimhan (1992), Lal et al (1994) and Joseph and Kalwani (1995) have studied how sales uncertainty affects the firm’s compensation decision. Closer to our work are Anderson (1985) and Krafft et al. (2004) who also study the role of uncertainty in determining salesforce structure. These authors investigate how sales uncertainty determines the choice between an outside agent and an employee. Like the generalist/specialist decision, the decision regarding outside-agent/employee is also an aspect of salesforce structure (Johnston and Marshall 2006, page 111). Krafft et al. (2004) hypothesize that a higher uncertainty favors a direct salesforce. Based on our analytical model we find that a higher uncertainty also favors a generalist salesforce.

Since the problem of selling to existing and new customers can be viewed as a multiproduct and/or multitask situation, our work also relates to that literature (Mantrala et al. 1994; Rangaswamy et al. 1990). The latter paper casts the debate as one of effectiveness versus efficiency, arguing that more complex sales processes require more specialization and thus more people. Zoltners and Sinha (2005) discuss the tradeoff of generalist versus specialist sales forces in the context of territory alignment. Holmstrom and Milgrom (1991) have pointed out the effort substitution problems of multitask agency. They find on efficiency grounds that it is better to have each task to be assigned to a separate employee. Finally, Godes (2004) also finds that when risk is endogenous, firms may not be able to design a scheme in which the agent splits her effort across multiple tasks, and therefore argues for specialization.

Finally, since we model how a firm can extract and use information over time, our paper is also related to the literature incorporating various aspects of dynamics in principal-agent models. Misra et. al. (2005) investigates the robustness of salesforce compensation schemes over time. Misra and Nair (2011) implement model-based recommendations at a focal firm and find support for the applicability of dynamic agency theory in real-world compensation design. Since we endogenize price in our model our paper is also related to research that incorporates marketing mix variables other than effort in principal-agent models (Weinberg 1975; Bhardwaj 2001; Joseph 2001; and Kalra, Shi and Srinivasan 2003, Ham 2009).

***1.2 Numerical Illustration of the Benefits of Greater Uncertainty***

It is important to note that our main theoretical insight - that profit can *increase* with higher uncertainty in sales - stands on its own and is independent of the decision to employ a generalist or a specialist sales force. This surprising result is contrary to that found in standard principal agent models where sales uncertainty decreases profits (Bolton and Dewatripont, 2005, page 137). The theoretical result depends on the firm being able to exploit signals of random demand, and the generalist/specialist decision is an illustration of how such signals can occur quite naturally in many situations where firms make managerially relevant decisions.

There are two opposite economic forces engendered by uncertainty. Since the agents are risk-averse, uncertainty has a negative impact on profits as already established in the literature. Our contribution lies in recognizing that higher uncertainty also implies higher information potential for the principal to take advantage of through its pricing or lead qualification decision, and this is a positive impact on firm profits. We show that the latter force can dominate when the signal is fairly accurate. To foreshadow the mathematical model, the following numerical example illustrates the forces at work.

 Consider a firm that sells through risk-averse agents and has a random demand function. Suppose that, prior to choosing its price and compensation, the firm receives news about its demand where the news could be good or bad. The various quantities of interest can be derived from our model in Section 2 and are presented in Table 1.

**Table 1: Illustration of the Benefits of Greater Uncertainty**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Adaptive Selling  |  |
| Good/Bad News | Sales Effort | Commission Rate | Salary | Price | Sales | Profit |
| +0.3SD | 8,300 | $8/unit | $5,000  | $14 | 14,500 | $84,000 |
| 0.0 | 7,200 | $7/unit | $19,000  | $12 | 12,600 | $48,000 |
| -0.3SD | 6,100 | $6/unit | $32,000  | $11 | 10,700 | $17,000 |
|  |  |  |  |  |
|  |  | Uninformed Selling |  |
| – | 6,000 | $6/unit | $28,000 | $12 | 12,000 | $42,700 |

Good news could be that the customers have a high demand for the product (0.3 standard deviations larger than normal).  If the news is good, the firm raises the commission rate from $7 to $8 and this motivates a surge in effort from the salesperson (from 7,200 sales calls to 8,300 calls per year). The greater sales and higher commission rates that result imply that the salary of the sales people can be reduced without fear of them quitting.  In the good condition, because the inherent demand by customers is large and the sales force is exerting extra effort, the firm can both raise the price to the existing customers and manufacture an additional 1,900 units (14,500-12,600) that will be sold.  Thus, with good news, the firm doubles-down on both price and quantity and this magnifies the profits (profits rise by $36,000).  On the other hand, if the news is bad, the firm would reduce the commission rate while increasing the salary (to prevent turnover in the sales force).  The firm also cuts back on manufacturing and reduces the price to the customers.  This mitigates the loss in profits (profits only fall $31,000).  The symmetric good and bad news are equally likely to occur (38% of the time) so the expected profit from adaptation to the news is $49,900. In the second panel, an uninformed organization cannot adapt their tactics this way and expected profits are $42,700.

The economic force of uncertainty alluded to in the preceding paragraphs is clearly independent of the discussion of sales force structure, however it does inform how uncertainty can determine the firm’s choice between a generalist or a specialist sales force. The main managerial insight that we offer is that the information extraction mentioned above is more efficient with a generalist sales force than with a specialist one. The demand for the product depends on both the customer’s attitude-towards-agent and on the attitude-towards-brand. The common attitude-towards-agent can be filtered out with the generalist sales force but not with the specialist sales force, and therefore more information about the uncertain attitude-towards-brand can be learnt and exploited through the firm’s pricing or customer qualification decision when it uses a generalist. Thus, when the uncertainty is high the firm prefers a generalist sales force.

In Section 2 we will first present a general analysis about the benefit from uncertainty when the firm can exploit signals about the random demand. In Sections 3 and 4 we have two specific illustrations of how this economic force affects the choice between a generalist and a specialist sales force: flexible pricing and customer lead qualifying.

**2. Profit Can Increase in Sales Uncertainty in a Principal Agent Model**

A firm markets its brand through a sales force. The sales response function is

|  |  |  |
| --- | --- | --- |
|  | s=1+e-p+β. | ( |

Sales s are affected by the sales agent’s effort e and the price p set by the firm. The random demand term β is distributed Normal with mean 0 and variance V.

Prior to the agent choosing effort and the firm choosing its compensation and price, suppose both firm and agent receive a signal  about demand fluctuations β. In the following sections we will propose specific processes by which the signal is created, but for now suppose it is distributed Normal with mean 0 and variance W and let the joint distribution of β and Δ be

|  |  |  |
| --- | --- | --- |
|  |  | ( |

The squared correlation of β and Δ can be expressed as. Thus, ρ2 is a measure of the accuracy of the signal Δ, with ρ2 =1 implying that the signal is completely accurate and ρ2 =0 implying that the signal is completely inaccurate (i.e., β and Δ are independent of each other).

The conditional distribution of β given Δ is

|  |  |  |
| --- | --- | --- |
|  | . | ( |

 Assume the agent is paid a salary and commission on sales: Pay=S+Cs. Further the agent’s cost of effort is . The risk-averse salesperson’s utility is . Using properties of Normal distributions and constant risk aversion we can calculate the certainty equivalent for the agent (CE is the certain payment that gives identical expected utility), contingent upon the information . The expected utility is, so the certainty equivalent is

|  |  |  |
| --- | --- | --- |
|  |  | ( |

The effort that maximizes this certainty equivalent is

|  |  |  |
| --- | --- | --- |
|  | e=C. | ( |

Substituting the effort from (5) gives  The firm will choose a salary that holds the agent’s CE to zero:

Given  the firm’s expected profit is. Substituting for the salary, the conditional expected profit becomes The profit maximizing price is

|  |  |  |
| --- | --- | --- |
|  | . | ( |

Back-substituting this price gives the firm’s profit as a function of the commission only: Finally, we can obtain the optimal commission rate,

|  |  |  |
| --- | --- | --- |
|  | . | ( |

Substituting (6) and (7) gives the firm’s optimal expected profit in terms of parameters as

|  |  |  |
| --- | --- | --- |
|  | . | ( |

Note that this is the firm’s profit *conditional* on the information . The firm must eventually calculate the ex-ante *unconditional expected* profit as anticipated prior to observing Δ.

Using the fact that Δ is distributed N(0, W) the ex-ante expected profit can be expressed as a function of the parameters:

|  |  |  |
| --- | --- | --- |
|  | . | ( |

 The response of the expected profit (9) to increasing demand uncertainty (the

variance V) is clearly a function of the accuracy of the information, ρ2, and the risk aversion of the agent, r. In fact, the sign of the derivative is the same as the term . It is easily seen that the derivative with respect to uncertainty V must be positive if ρ2=1 and must be negative if ρ2=0 for all r>0 and V>0.

**Proposition 1:** If pricing, effort and compensation decisions are based upon

**a.** inaccurate signals (ρ2 near 0), then because agents are risk averse, increased demand uncertainty leads to a reduction in the principal’s expected profits,

**b.** accurate signals (ρ2 near 1), then even though agents are risk averse, increased demand uncertainty leads to an improvement in the principal’s expected profits.

Proposition 1b provides the novel theoretical insight of the paper: a firm’s profit can *increase* in demand uncertainty even though agents are risk averse. This is in contrast to the standard principal-agent model where increased sales uncertainty *always* decreases profits because the agents must be paid more to bear greater risk (see Bolton and Dewatripont, 2005, page 137). The result of the standard principal-agent model is reflected in Proposition 1a since no information on demand implies a signal with ρ2 =0. The intuition for the result lies in the fact that the signal about random demand allows the firm to better tailor both its price and demand, allowing it to doubly benefit from information learnt in computing profit (profit involves the product of price times demand). With higher uncertainty there is more information potential in the system for the flexible firm to exploit. Of course, such information is beneficial only when it is fairly accurate.

The analysis above is abstract and the exact nature of the signal about random demand is unspecified. Clearly in many dynamic situations a firm may get demand signals in a given period which it may then use in later periods. In what follows we will demonstrate how such signals can occur naturally in a managerially relevant decision about sales force structure: the choice between a generalist and a specialist sales force. To underscore the diversity of contexts where the generalist versus specialist decision is impacted by uncertainty and information, we will illustrate the tradeoff in two different contexts. In Section 3 we address whether the firm should have a generalist or specialist when serving new and existing customers, and in Section 4 we address whether the generalist or specialist is better for qualifying sales leads.

**3. Selling to New and Existing Customers: Generalist versus Specialist**

***3.1 Overview***

Consider a two-period model with a firm selling through risk-averse agents to two overlapping generations of customers (Samuelson 1958). The market always has two types of customers, one old and one young. After period 1 the old customer dies and the young customer ages to becomes the old customer in the period 2. A new generation of young customers is born in period 2. We will use the names “Existing” to refer to the market segment made up of the old generation and “New” to refer to the young generation segment.

 What determines demand in each segment? Sales may be increased by greater sales effort (number of sales presentations, time spent with potential customers, etc.) and also by price reductions. In addition to these controllable factors, demand is influenced by two types of latent factors. First, there is market or environmental randomness that affects sales response and this has been commonly assumed in the principal-agent literature. For example, the market potential for a segment of customers varies due to population changes, interest in the category, attitude towards the firm’s and rival’s brands and other unmeasured facets. Second, the personality and other traits of a salesperson may be more or less attractive to customers, so the sales response function has a component that depends upon the attitudes toward the individual who makes the sales calls. In summary, sales response consists of Accountable Factors + Attitude-towards-Brand + Attitude-towards-Agent.

 The empirical sales literature has pointed out the importance of the customer’s attitude- towards-agent. Palmatier et al. (2007) make a distinction between the loyalty that the customer has to the firm and the loyalty that it has to the salesperson. They go on to state that the loyalty to the salesperson exists independently of any loyalty to the firm. Beatty et al. (1996) show the significance of the customer’s relationship with the salesperson in a detailed qualitative study of a high-profit, high-growth, multi-unit fashion company. Bendapudi and Leone (2002) argue that the customer’s relationship with the key contact (salesperson) can be even stronger than their relationship with the firm. In an early classic study, Walker et al. (1977) suggest that salesperson factors and salesperson aptitude are important antecedents of sales performance. According to Tax and Brown (1998), American Express reports that 30% of customers would follow their financial advisor to a new firm.

***3.2 The Model Elements***

In period t for generation g∈{N=new, E=existing}, sales are determined by the efforts of the salesperson, , the price set by the firm, , the latent attitude-towards-brand or brand market potential, , and an agent-specific latent term, tg, capturing the customer’s attitude-towards-agent.[[1]](#footnote-1) Specifically, the sales response of the existing and new customers in period 1 are

|  |  |  |
| --- | --- | --- |
|  | = 1+-++,= 1+-++, | ( |

and the sales response functions in the period 2 are

|  |  |  |
| --- | --- | --- |
|  | = 1+-++,= 1+-++. | ( |

The first three terms of these sales response functions form the accountable demand while the last two are the latent attitude-toward-brand (or market potential) and attitude-to-agent components discussed above. Because the brand is unchanged over time and new customers of period 1 become the existing customers of period 2, it is assumed that 1N2E. The latent variables tg, tg are distributed Normal with mean zero and variances 1 and V respectively.

 As is traditional in sales compensation models, we assume that the firm pays the salesperson with a salary S plus commission rate C on sales. We assume that salespeople have a constant absolute risk-averse von Neumann-Morgenstern utility of their net income, -e-r(pay-costs), where r is the Arrow-Pratt measure of risk-aversion. Combined with Normal random variables, this leads to the certainty equivalent approach of the principal-agent model. We will first analyze a generalist sales organization where both customer segments have a common salesperson. Subsequently, we study a specialist sales force.

***3.3 Generalist Sales Force Selling to both New and Existing Customers***

Consistent with the multitask literature (Holmstrom and Milgrom 1991), we assume that the cost of selling is a convex function of effort devoted to the two market segments. This could be interpreted economically as follows. Suppose customers within a market segment have equal likelihood of making a purchase, but the cost of making a presentation differs within the population. Effort is measured in number of sales presentations. For efficiency sake, the salesperson will rank order the customers from the least to the most costly, and contact them in this order. As a consequence the average cost of selling to customers will increase with sales effort and the total costs, equal to average cost times number of a sales presentations, will rise at an accelerating rate. That is, costs will be convex upward.

If a salesperson is a generalist who must sell to both New and Existing customers, the cost may exhibit either economies or diseconomies of scope (Willig 1979). That is, joint effort targeted at two segments may be less or more costly than the combined costs of two specialized salespeople. For example, if there are New customers located geographically near Existing customers, then duplicate transportation costs may be avoided if a single generalist salesperson can make presentations to both. This is an economy of scope. On the other hand, calling on one market segment at its most convenient time may force sales presentations to the other segment to occur at inopportune times, increasing the time needed to close a sale, a diseconomy of scope.

 The generalist salesperson makes calls on both new and existing customers, and the resulting cost function is assumed to be

|  |  |  |
| --- | --- | --- |
|  | TC(,)=, | ( |

which is convex if -1<<1. The marginal cost of effort to sell to generation g, = , increases with effort for that generation, but also depends upon sales effort exerted for the other generation. While this cost structure could capture the phenomenon of economies-of-scope (the marginal cost decreases in the effort for the other generation, δ<0), we will focus on the phenomenon of diseconomies-of-scope or task conflict (the marginal cost of sales to one market segment is increased by also selling to the other, δ>0). In particular, if a single sales person is required to develop different skills and styles for calling on new and existing customers, the proverb recommending against “changing horses in midstream” implies that the cost of sales to new customers increase if the salesman also has to call on existing customers. Had sales people specialized in just one generation of customers or the other, we assume that this cost of interference vanishes (=0 in the above) (Holmstrom and Milgrom 1991; Bolton and Dewatripont 2005, page 220). In summary, we assume that specialization is more cost effective than generalization because it eliminates task interferences. In this paper unspecialized sales roles must overcome cost disadvantages.

 For the generalist sales organization the same salesperson calls on both the customer segments. This commonality implies that the latent attitude-towards-agent is similar for all customers. For analytic simplicity we make this most obvious by assuming that tEttN. This limiting case is a conservative approach because there are not cancelling risks for a risk-averse generalist salesperson.

*3.3.1 Second period with a generalist sales force*

Consider the information available with a generalist sales organization at the end of the first period. The purchases by the existing customers, prices and effort expended on them are also known.[[2]](#footnote-2) Similarly, the purchases by the new customers, prices and effort expended on them are also known. Because the salesperson is common to both segments, the salesperson-specific random terms cancel out in a sales comparison - =  –. Accounting for the prices and efforts, this comparison allows the difference in attitudes toward the brands, -≡ to be identified. Because the New customer in the first period becomes the Existing customer in the second period, and the attitudes carry over, the firm can condition the distribution of attitudes  in period 2 on the observed difference  from period 1, as follows (all proofs are found in the online appendix).

**Lemma 1:** The conditional distribution of attitudes-toward-the-brand by Existing customers in period two, , given the differencesinferred from period 1 sales is.

A positive value for  is good news because it indicates that the existing customers have a stronger than expected demand for the brand. The informational content implies that conditional variance is half of the prior variance of the attitude to the brand by existing customers.

 Assume that the firm pays the generalist salesperson with a salary plus commission on total sales[[3]](#footnote-3) in period 2:

|  |  |  |
| --- | --- | --- |
|  |  | ( |

The generalist salesperson’s utility in the second period is

|  |  |
| --- | --- |
|  | ( |

Using Lemma 1, the certainty equivalent (the certain payment that gives the identical expected utility) contingent upon the information  equals

|  |  |  |
| --- | --- | --- |
|  |  | ( |

The optimal efforts for the generalist salesperson maximize this certainty equivalent:

|  |  |  |
| --- | --- | --- |
|  |  | ( |

Keeping in mind that =, the expected sales are  and 

 The firm sets the salary so that the salesperson is indifferent between participating and taking the second best job (which has a certainty equivalent of 0). The salary is  If the production cost per unit is zero, the firm’s profit in the second period with a generalist salesperson is Substituting expected sales and salary gives expected profits as a function of the prices and commission rate:

|  |  |  |
| --- | --- | --- |
|  |  | ( |

 The optimal second period prices are

|  |  |  |
| --- | --- | --- |
|  | p2EG =; p2NG = , | ( |

where

|  |  |  |
| --- | --- | --- |
|  | . | ( |

The optimal commission rate is

|  |  |  |
| --- | --- | --- |
|  | . | ( |

Notice that the prices in the second period depend upon the sales difference Δ observed in period 1. If the market potential 2E of returning period 2 customers’ were larger (larger values of Δ) the firm would charge a higher price. This adaptation due to the information gleaned in period 1 enhances profits in period 2. The commission also depends on Δ. If the customers’ market potential 2E were larger, the commission rate would be higher. Essentially, the firm would do two things: first, incentivize the agent to sell more and second, charge a higher price for its product thus gaining a significant advantage from the learned information.

It is straightforward to obtain the optimal values for all other variable, and in the interest of readability these expressions are recorded in Table 2.

**---Insert Table 2 here---**

 From the first column of Table 2, the second period profit is given by, 2G =. Note that this is the firm’s second period profit *conditional* on . Recall that  is essentially sales differences between New and Existing customers in period 1. The firm must eventually calculate the ex-ante *unconditional expected* second period profit as anticipated at the beginning (prior to observing Δ). Using the fact that Δ is distributed N(0, 2V), the expected second period variables anticipated at the beginning of period 1 are found in the second column of Table 2. The expected profit is

|  |  |  |
| --- | --- | --- |
|  | =. | ( |

 A larger value for V corresponds to more heterogeneous customers, but the firm can measure the level of demand via  before committing to effort, commission rate, prices and production. The adaptability of the generalist implies that it can magnify the good situations and mitigate the bad (as described in the numerical illustration on pages 6-8). Even though uncertainty hurts the risk-averse sales force, the adaptability overcomes this disadvantage.

**Proposition 2:** The firm’s expected second period profit (21) increases in the uncertainty about the customers’ attitude-toward-the-brand, var(tg)=V .

 While Proposition 1 demonstrates the abstract point that signals of random demand can be used to tailor prices in such a way that profit increases in uncertainty, Proposition 2 illustrates this insight in the specific practical situation of choosing between a generalist and specialist sales force in which such a signal occurs naturally.[[4]](#footnote-4)

 Proposition 2 is contrary to the well-known result of the standard principal agent model that profit decreases in uncertainty. The reason for the counter-intuitive finding lies in adaptable pricing and production. If the prices and  were predetermined then the expected second period profit would decrease in uncertainty. It can be shown that if variables do not adjust to the information , the maximum expected second period profit is  where

|  |  |  |
| --- | --- | --- |
|   |  | ( |

This profit clearly decreases in V. The generalist firm benefits because it can reflect information in its prices and quantities, and with higher uncertainty there is more information potential in the system for it to exploit.

At a broader level the firm benefits due to its flexibility in incorporating learnt information in its marketing mix. In the current section the marketing mix element is its price whereas in Section 4 the flexibility lies in its choosing not to serve unprofitable customers.

*3.3.2 First period with a generalist sales force*

The sales response functions in the first period are

|  |  |  |
| --- | --- | --- |
|  | = +++1- and= +++1-. | ( |

The first period salary and commission is . The firm’s profit in the first period is , and the firm will optimize its total profit over two periods, =+. The analysis of the first period is similar to that of the second period and we only report the optimal solution in Table 3.

**---Insert Table 3 here---**

Note that our analysis incorporates the dynamic behavior of the agent. In the first period the agent rationally anticipates that she will be held to her fixed reservation utility in the second period, as is standard in principal-agent models. Thus, the first period can be analyzed separately.

 The variance V represents both the *a priori* uncertainty about market potential and the amount of information that can be garnered from comparing the sales of New and Existing customers. How does the firm’s profits in the first period and the total profit respond to changes in the variance V in market potential?

**Proposition 3:** While the generalist firm’s first period expected profit decreases in V, the total expected profits over both periods,

|  |  |  |
| --- | --- | --- |
|  | , | ( |

increases in uncertainty about the customers’ attitude-toward-the-brand V when there are diseconomies of scope, ≥0.

 Proposition 3 is a broader result than Proposition 2 since it shows that the total two-period profit increases in uncertainty despite the agents’ risk-aversion. Also it is clear that it is the effect of V on the second-period profit that determines how the total profit changes with uncertainty. In the first period, the effect of uncertainty regarding the customer’s attitude towards the uncertainty is intuitive and consistent with standard principal-agent models: uncertainty negatively affects job evaluation of the risk-averse salesperson, and since the firm must pay more to keep the agent away from the second-best job, increased uncertainty hurts expected profits.

***3.4 Specialist Sales Force Selling to either New or Existing Customers***

 When the principal employs a specialist sales force, different agents sell to the New and Existing customers in each period. Since there is no multitask problem we assume that the cost to the specialist agent of serving just one of the two generations of customers is TC()=, for t=1,2 and g= E, N. Notice the absence of the term eEeN, which was used to capture the additional cost of the task interference when the generalist salesperson had to sell to both customer segments.

*3.4.1 Second period with specialist sales force*

Consider first the case of agent who specializes in existing customers. We assume that the firm

compensates the agent with a salary plus commission contract,

|  |  |  |
| --- | --- | --- |
|  |  | ( |

Consider the information available to the specialist firm. The first period sales are = 1+-++, = 1+-++. Since the prices and efforts are known, at the end of the first period, difference in sales between the New and Existing customers, -, allows the firm to infer the difference in the latent demands -+-, which will be denoted Γ. Notice the terms pertaining to the attitude-towards-salesperson, 1E and 1N, do not cancel as they did in  because they pertain to different specialist salespeople. That is, because two different sales people call on the two different customer segments, the difference in purchases by these segments confounds attitude-for-the brand with attitude-towards-salesperson.

Because the New customer of period 1 becomes the Existing customer of period 2 and carries with them the attitude toward the brand, 1N=2E, the firm may condition the distribution of  on sales difference from the previous period, Γ.

 **Lemma 2:** The conditional distribution of 2E given the sales difference Γ is

|  |  |  |
| --- | --- | --- |
|  |  | ( |

 A comparison of Lemmas 1 and 2 shows that has a higher variance than. This is because the sales difference is affected by attitudes toward different specialist salespeople as well as by market potential. The specialist sales force generates less information than the generalist sales force (see Hess 1983 for methods of measuring information).

 Since the analysis is similar to that of the second period with a generalist (given in Section 3.3.1), we only report the optimal values in Table 4, depending on aggregate parameters,

|  |  |  |
| --- | --- | --- |
|  |  | ( |

H is an increasing function of r and V and  is a random variable distributed 

**---Insert** **Table 4 here---**

 The profit from sales to the customers in the second period will of course depend on the value of Γ identified at the end of period 1. However, prior to the first period the expected second period profit must be computed (see the right column of Table 4). Using the fact that  is distributed , the expected profit in the second period is

|  |  |  |
| --- | --- | --- |
|  | =. | ( |

**Proposition 4:** The specialist firm’s expected second period profit (28) increases in the variance of the customers’ attitude toward the brand, var(tg)=V.

*3.4.2 First period with specialist sales force*

In the first period, the firm and salespeople have no prior information about random variables. As a result the decisions for either the specialists are identical and found in Table 5, where

|  |  |  |
| --- | --- | --- |
|  | . | ( |

**---Insert Table 5 here---**

As the uncertainty about the attitude toward the brand V increases, the profits from the new customers fall because the risk-averse agents demand compensating differentials.

 Total profit over both periods for a sales force organized as specialists is as follows.

**Proposition 5:** While the specialist firm’s first period expected profit decreases in uncertainty about the customers’ attitude-toward-the-brand, V, the total expected profits over both periods,

|  |  |  |
| --- | --- | --- |
|  | , | ( |

first decreases and then increases in uncertainty V. The slope at V=0 is  and the slope asymptotically approaches 1/8 as uncertainty grows.

Thus the increase in total profit with increased uncertainty holds also for the specialist, albeit for a smaller parameter range compared to the generalist (see also Figure 1 below). This is because the information extraction with the specialist is not as efficient as with the generalist, but the underlying economic forces remain the same as with a generalist.

***3.5. Generalist versus Specialist Sales Force***

 The total profits of the firms organizing their sales force as generalists or specialists are given in equations (24) and (30) which are expressed as a function of the uncertainty of market potential in Figure 1. The profit for the specialist firm at V at zero is 1+1/(2r+1) while the profit for the generalist firm is 1+1/(4(1+2r+2+1). It is easy to show that when V is small the profits of the specialist must exceed those of the generalist firm (assuming ≥1 and r≥0). The generalist firm has a cost and risk bearing disadvantage relative to the specialist.

 Compare the relative profitability of the specialist versus the generalist as sales uncertainty increases. As depicted in Figure 1, starting from low levels of uncertainty, the gap (πSP\* - πG\*) diminishes as uncertainty about the brand attitudes increases. This result follows directly from Propositions 3 and 5.

**Proposition 6:** An increase in uncertainty about the customers’ attitude-toward-the-brand V favors the generalist, and the gap (πSP\* - πG\*) between the specialist and the generalist decreases.

****

**Figure 1**: Generalist and Specialist Sales Force Profits versus V

There is a large literature in marketing that studies the role of sales uncertainty in various aspects of interest to a selling organization. Coughlan and Narasimhan (1992), Lal et al. (1994) and Joseph and Kalwani (1995) explore the role of uncertainty in the firm’s compensation decision whereas Anderson (1985) and Krafft et al. (2004) investigate the role of sales uncertainty in choosing between an outside agent and an employee. The outside agent/employee decision is an aspect of sales force structure much like the generalist/specialist decision that we investigate. Krafft et al. (2004) hypothesize that a higher uncertainty favors a direct sales force. Based on Proposition 6, we find that a higher uncertainty favors a generalist sales force.

The reason for our finding is that the generalist sales organization can deduce more precise information about the future demand and can adapt to this information in pricing, production and compensation. The specialist organization cannot completely segregate the customer’s attitude-towards-agent from her attitude-toward-brand. Can uncertainty entirely overcome the advantage of the specialist sales force? The answer, as shown below, is, “Yes”.

Taking Taylor series approximations one can show that the profit function for the specialist approaches the asymptotic line 1+V/8 while the profit function for the generalist firm approaches the asymptotic line 1 + 1/(242r) +V/8. So while both forms of sales force organization will eventually benefit from the ability to adapt to greater volatility, the rank order of profits reverses.

**Proposition 7**: For sufficiently large uncertainty about the customers’ attitude-toward-the-brand, the profit of a generalist sales force exceeds the profits of a specialist sales force, regardless of the cost of multitasking or the risk aversion of the salespeople.

 Some practitioners and academics have argued that customers may prefer a single point of contact and may be unhappy with situations where one agent wins their business and then hands them over to other agents for fulfillment (Sheth and Sharma 2008). It is also argued that salespeople need to move away from merely selling to being ‘consultants’ or ‘account managers’ who both sell and service the customer’s after-sales needs. This literature seems to argue for a generalist sales force but from a customer’s point of view (the customer’s psychological cost of dealing with two agents is higher than dealing with one), and does not tie this to firm profitability. We show that firms can also benefit from a generalist for because the extra information can be used to tailor the pricing decisions. The information can also be used to improve qualifying customer leads, as we will demonstrate next.

**4. Qualifying Sales Leads: Generalist versus Specialist**

 The added information gleaned by a salesperson who sells to two different customer segments may be applied in ways other than flexible pricing to the segments. In particular, it may be used to target one segment while disqualifying the other from future sales efforts. Not every customer lead is worth ongoing effort from a salesperson: the lead may not really need the product or service or may have loyalty to a different brand. As a result, an important sales task is to “qualify” customers so that sales efforts are directed toward segments that generate adequate sales volume and to “disqualify” those who do not respond to sales efforts. In this section, we will demonstrate that generalist salespeople will be more effective than specialists in qualifying and disqualifying customer leads.

Suppose there are two customers, whose demand for the brand sold by the salesperson depends (as above) on effort, brand attitude and attitude-to-the-salesperson as

|  |  |  |
| --- | --- | --- |
|  |  | ( |

Suppose that customer i=1 is a lead that may or may not be a qualified customer while i=2 is a customer who buys regularly. Specifically, we will assume that 2’s attitude toward the brand is known from previous periods to take on the specific value  The customer 1 may have a positive or negative attitude toward the brand and 1 is assumed to be normally distributed with a mean 0 and variance V. The salesperson will make a tentative effort to sell to 1 and if resulting sales volume is large enough will judge the lead to be qualified. However, if sales volume is low, the lead will be disqualified (DQ) and will not be targeted for future effort, as will now be developed.

Consider first a generalist salesperson who has been assigned these two customers. Because the two customers see the identical salesperson, we assume that 1 and 2 are identical and their common value denoted  (mean zero and variance 1). In the initial period the sales (net of effort) reveals the latent attitudes  and  to generalist salesperson. Because the brand attitude of i=2 was previously known, this information is sufficient to precisely identify prospect 1’s brand attitude, .

 Second, suppose that initially the two customers were sold by different specialists, so that sales net of effort reveals  and . Because the attitudes-to-the-salesperson are different, sales information does not precisely pin-point the brand attitude of the prospect i=1. What can be inferred is that .

 Now, suppose that given the information deduced from the initial sales, the customers are targeted for new effort. Details of the analysis are provided in an online appendix and only the reduced form solutions are laid out here. If the generalist qualifies both customers, the maximized expected profit conditional upon prior information  is

|  |  |  |
| --- | --- | --- |
|  | . | ( |

On the other hand, if the customer 1 is disqualified, the salesperson will sell only to i=2 and expected profits will be

|  |  |  |
| --- | --- | --- |
|  | .  | ( |

It is more profitable to qualify the prospect 1 than to disqualify them if (32) exceeds (33). This is equivalent to

|  |  |  |
| --- | --- | --- |
|  | . | ( |

Because the generalist provides perfect information about the prospects brand attitude, this is the efficient criteria for qualifying a lead.

 On the other hand, if the specialist sells to customer 1 the expected profit conditional upon the perceived attitude toward brand and salesperson, , is

|  |  |  |
| --- | --- | --- |
|  | . | ( |

This is better than the zero profits if and only if

|  |  |  |
| --- | --- | --- |
|  | . | ( |

 In Figure 2, the disqualification of the prospective customer 1 by a generalist salesperson is based upon the dashed forty five degree defined by (34). The disqualification by a specialist is based upon the solid vertical line defined by (36). In the quadrants labeled II and IV, the specialist properly disqualifies and qualifies customer 1, respectively. However, in quadrant I, the generalist would correctly disqualify customer 1 while the specialist would continue to exert effort on a poor lead.

Why does this happen? The generalist has observed a relatively high value of , which implies that the sales has been generated by a very positive attitude toward the salesperson, . Simultaneously, the generalist observes a relatively low value of . Because the same salesperson sold to both customers, the positive attitude-towards-agent must imply that prospect 1 has a negative attitude-toward-brand, and hence should be disqualified. The specialist cannot infer that low sales is based upon negative attitude-towards-brand; it could just as likely have been negative attitude-toward-agent. Hence, the specialist finds it best to qualify customer 1, which is a mistake. By similar reasoning in quadrant III, the specialist mistakes low sales for poor brand attitude when it was really a problem with the salesperson.

D

Observed

Attitude of 1, 1

**Disqualification**

**With Generalist**

**Disqualification**

**With Specialist**

Observed

Attitude of 2, 2

**I**

**II**

**III**

**IV**

0

Legend: cross-hatched = DQ by Generalist

 shaded = DQ by Specialist

**Figure 2:** Disqualifying Prospect 1

The ex-ante profits of the generalist and specialist may be computed using the truncated normal distribution to account for disqualification of prospects if initial sales are disappointing. The profit formulas are as follows.

|  |  |  |
| --- | --- | --- |
|  |  | ( |

|  |  |  |
| --- | --- | --- |
|  |  | ( |

If one looks at these profits as a function of the degree of uncertainty about the market potential of customer 1, V, then the relationship looks qualitatively identical to Figure 1. Namely, the generalist is at a disadvantage because of task conflict when V is near zero, but the gap diminishes as V increases and for sufficiently large uncertainty, the generalist firm is more profitable than the specialist firm. Importantly, the profits of the firm increase in uncertainty in the context of lead qualifying as well. This is yet another illustration of the general result in Proposition 1.

 In summary, since the sales force that is organized with generalist salespeople can distinguish attitude-towards-brand from attitude-towards-agent better than specialists, this additional information allows generalists to more accurately predict which leads should be qualified customers.

**5. Conclusion**

 We have shown that contrary to the standard principal-agent model, the firm’s profit can increase in sales uncertainty when signals about random demand are properly exploited. The firm can exploit the learned information to tailor both its prices and production. Higher uncertainty has higher information potential, and this advantage of uncertainty can be enough to overcome the disadvantage of selling through risk-averse agents who dislike uncertainty. In sum, the firm can benefit from uncertainty.

This economic force has consequences for the firm’s sales force structure, namely the choice between a generalist and a specialist sales force. To underscore the diversity of contexts where the generalist versus specialist decision is impacted by uncertainty and information, we illustrate the tradeoff in two different contexts. We first ask whether the firm should have a generalist or specialist when serving new and existing customers. Next we ask whether the generalist or specialist is better for qualifying sales leads.

When a firm has both new and existing customers, when should it have a generalist sales force to sell to both customers types and when should it have a specialist sales force that sells to one or the other type? This question is important and has been widely debated in the managerial literature.

The novel insight that we offer in this paper is that a generalist sales force allows the firm to better infer, and hence exploit, information about the selling environment than a specialist sales force. With a generalist sales force the same agent sells to both new and existing customers, and so the agent-specific term can be filtered out and information about the uncertain market potential can be learnt. The known market potential can then be profitably used in the second period to better guide the firm’s pricing. Though the firm can make some inferences about the market potential even with a specialist sales force, this information is less precise (has more variance) than if it had a generalist sales force. Because different agents sell to the customers, the agent-specific term cannot be filtered out and show up as additional uncertainty. Our information-based rationale for having a generalist or a specialist sales force differs from the mostly cost-based reasons advanced in the literature. This result will not be overturned if we move to an infinite horizon model. Even if the advantage of the generalist shrinks over time, at every given point of time there is still an informational advantage of the generalist. Therefore, the *cumulative value* of generalist’s advantage grows rather than shrinks as the time horizon is lengthened.

It has been argued that a very important aspect of the salesperson’s job is to gather information that will increase selling effectiveness. Clearly, getting information that enables the firm and agent to qualify potential customers and not serve the unprofitable ones is profit enhancing. We show that the information extraction benefit of the generalist also makes it a better structure to correctly qualify sales leads. This link between lead qualification and sales force structure is also novel.

**References**

Anderson, E. (1985), “The Salesperson as Outside Agent or Employee: A Transaction Cost Analysis,” *Marketing Science*, 4, 234– 254.

Beatty, Sharon, Morris Mayer, James Coleman, Kristy Reynolds and Jungki Lee, (1996), “Customer-Sales Associate Retail Relationships,” *Journal of Retailing*, 72 (3), 223-247.

Bendapudi, Neeli and Robert Leone (2002), “Managing Business-to-Business Customer Relationships Following Key Contact Employee Turnover in a Vendor Firm,” *Journal of Marketing*, 66, 83-101.

Bhardwaj, Pradeep (2001), “Delegating Pricing Decisions,” *Marketing Science*, 20 (2), 143-169.

Bolton, Patrick and Mathias Dewatripont (2005), *Contract Theory*, The MIT Press, Cambridge, Massachusetts.

Coughlan, A. T., and Chakravarty Narasimhan (1992), “An empirical analysis of sales-force compensation plans,” *Journal of Business*, 65,93– 121.

Darmon, Rene (2002), “Salespeople’s Management of Customer Information: Impact on Optimal Territory and Sales Force Sizes,” *European Journal of Operations Research*, 137, 162-176.

Dubinsky, Alan, Lawrence Chonko, Eli Jones and James Roberts, (2003), “Development of a Relationship Selling Mindset: Organizational Influencers,” *Journal of Business-to-Business Marketing*, 10(1), 1-30.

Futrell, Charles, (2001), *Sales Management: Teamwork, Leadership and Technology*, 6th Ed., Harcourt.

Godes, David (2004), “Contracting under Endogenous Risk,” *Quantitative Marketing and Economics*, 2, 321-345.

Ham, Sung (2009), “Price Delegation: A Theoretical and Experimental Investigation,” Doctoral Dissertation, University of Houston, Houston, http://www.bauer.uh.edu/doctoral/marketing/

documents/PriceDelegationDissertationJuly92009.doc.

Hess, James D. (1983), *The Economics of Organization*, New York : North-Holland Publishing.

Holmstrom, Bengt and Paul Milgrom (1991), “Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership and Job Design,” *Journal of Law Economics and Organization*, 7, 24-52.

Johnston, Mark and Greg Marshall, (2006), *Sales Force Management*, 8th Ed., New York: McGraw-Hill/Irwin.

Joseph, Kissan (2001), “On the Optimality of Delegating Pricing Authority to the Sales Force,” *Journal of Marketing*, 65 (1), 62-70.

Joseph, Kissan and Alex Thevarajan (1998), “Monitoring and Incentives in Sales Organizations: An Agency Theoretic Perspective,” *Marketing Science*, 17(2), 107-123.

Joseph, K., & Manohar Kalwani (1995), “The Impact of Environmental Uncertainty on the Design of Salesforce Compensation Plans,” *Marketing Letters*, 6, 183–197.

Kalra, Ajay, Mengze Shi and Kannan Srinivasan (2003) “Sales force Compensation Schemes and Consumer Inferences,” *Management Science*, 49(May), 655-672.

Krafft, Manfred, Sonke Albers and Rajiv Lal (2004), “Relative Explanatory Power of Agency Theory and Transaction Cost Analysis in German Salesforces,” *International Journal of Research in Marketing*, 21, 265–283

Lal, R., Outland, D., and Richard Staelin (1994), “Salesforce Compensation Plans: An Individual-Level Analysis,” *Marketing Letters*, 5,117– 130.

Lodish, Leonard (1971), “CALLPLAN: An Interactive Salesman’s Call Planning System,” *Management Science*, 18 (2), 25-40.

Mantrala, Murali, Prabhakant Sinha and Andris Zoltners (1994), “Structuring a Multiproduct Sales Quota-Bonus Plan for a Heterogeneous Sales force: A Practical Model-Based Approach,” *Marketing Science*, 13(2), 121-144.

Mantrala, Murali, Sonke Albers, Fabio Calderaro, Ove Jensen, Kissan Joseph, Manfred Krafft, Chakravarthi Narasimhan, Srinath Gopalakrishnan, Andris Zoltners, Rajiv Lal and Leonard Lodish (2010), “Sales Force Modeling: State of the Field and Research Agenda,” *Marketing Letters*, 21, 255-272.

Misra, Sanjog, Anne Coughlan and Chakravarthi Narasimhan (2005), “ Salesforce Compensation: An Analytical and Empirical Examination of the Agency Theoretic Approach,” *Quantitative Marketing and Economics*, 3, 5–39.

Misra, Sanjog and Harikesh Nair (2011), “Structural Model of Sales-Force Compensation Dynamics: Estimation and Field Implementation,” *Quantitative Marketing and Economics*, 9(3) Sep. pp. 211-225.

Nalebuff, Barry and Joseph Stiglitz (1983), “Information, Competition and Markets,” *American Economic Review*, 73(2), 278-283.

Palmatier, Robert, Lisa Scheer and Jan-Benedict Steenkamp (2007), “Customer Loyalty to Whom? Managing the Benefits and Risks of Salesperson-Owned Loyalty,” *Journal of Marketing Research*, XLIV, 185-199.

Rangaswamy, Arvind, Prabhakant Sinha and Andris Zoltners (1990), “An Integrated Model-Based Approach to Sales Force Structuring,” *Marketing Science*, 9(4), 279-298.

Samuelson, Paul A. **(**1958), “An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money.” *Journal of Political Economy*, 66(6): 467–82.

Sheth, Jagdish and Arun Sharma (2008), “The Impact of the Product to Service Shift in Industrial Markets and the Evolution of the Sales Organization,” *Industrial Marketing Management*, 37, 260-269.

Singh, Nirvikar (1985), “The Marginal Value of Information in a Principal-Agent Model,” *Journal of Political Economy*, 93 (3), 599-609.

Sobel, Joel (1993), “Information Control in the Principal-Agent Problem,” *International Economic Review*, 34 (2), 259-269.

Tax, Stephen and Stephen Brown (1998), “Recovering and Learning from Service Failure,” *Sloan Management Review*, 40 (1), 75-88.

Walker, Orville, Gilbert Churchill and Neil Ford (1977), “Motivation and Performance in Industrial Selling: Present Knowledge and Needed Research,” *Journal of Marketing Research*, 14 (2), 146-168.

Weinberg, Charles B. (1975), “An Optimal Commission Plan for Salesmen’s Control Over Price,” *Management Science*, 21 (8), 937-943.

Weitz, Barton, Harish Sujan and Mita Sujan (1986), “Knowledge, Motivation and Adaptive Behavior: A Framework for Improving Selling Effectiveness,” *J. of Marketing*, 50, 174-191.

Willig, Robert D. (1979), “Multiproduct Technology and Market Structure,” *American Economic Review*, 69(May), 346-351.

Zoltners, Anders, Prabhakant Sinha (2005), “Sales Territory Design: Thirty Years of Modeling and Implementation,” *Marketing Science*, 24(3), 313-331.

Zoltners, Anders, Prabhakant Sinha and Sally Lorimer (2003), *Sales Force Design for Strategic Advantage*, Palgrave McMillan.

Zoltners, Anders, Prabhakant Sinha and Sally Lorimer (2008), “Sales Force Effectiveness: A Framework for Researchers and Practitioners,” *Journal of Personal Selling and Sales Management*, 28(2), 115-131.

**Table 2: Outcomes for Period 2 with Generalist Sales Force**

|  |  |  |
| --- | --- | --- |
| Variables | Contingent on Sales Difference  | Expected prior to learning  |
| Efforts,  |  |  |
| Commission rate, C2G |  |  |
| Salary, S2G |  |  |
| Prices, p2EG and p2NG | , | , |
| Sales, s2EG and s2NG | , | , |
| Expected profits, 2G |  |  |

1 

**Table 3: Outcomes for Period 1 with Generalist Sales Force**

|  |  |
| --- | --- |
| Variables | Value1 |
| Efforts,  |  |
| Commission rate, C1G |  |
| Salary, S1G |  |
| Prices, p1EG and p1NG | , |
| Sales, s1EG and s1NG | , |
| Expected profits, 1G |  |

 1 

**Table 4: Outcomes for Period 2 with Specialist in Existing Customers**

|  |  |  |
| --- | --- | --- |
| Variables | Contingent on Sales Difference  | Expected prior to learning  |
| Efforts,  |  |  |
| Com-missionrate,  |  |  |
| Salaries, , |  |  |
| Prices, , |  | , |
| Sales, , |  | , |
| Expected profits,  |  |  |

 1 ,

**Table 5: Outcomes for Period 1 with Specialists in Generation g**

|  |  |
| --- | --- |
| Variables | Value1 |
| Efforts,  |  |
| Commission rate,  |  |
| Salary,  |  |
| Price,  |  |
| Sales,  |  |
| Expected profits,  |  |

 1 

**Online Appendix**

**Proof of Lemma 1:**

First, if X1 and X2 are Normal random variables, , then the conditional distribution of X1 given X2 is . The joint distribution of the vector (1N, ≡1N-1E)’ is as follows. First, by assumption the means are both zero: E[β1N]=E[Δ]=0. Second, the variance of 1N is denoted V. Third, because we assume that β1E and β1N are independent, the variance of Δ equals var(β1N – β1E)=2V. Finally, the covariance of β1N and Δ equals E[β1N Δ] = E[β1N2 –β1Nβ1E] =V because β1E and β2E are independent. Putting these together:  The attitude toward value of 2E is identical to that of 1N so it follows directly that .

**Proof of Proposition 2:**

Differentiate (21) with respect to V and write the derivative as a multiple of quadratic function of risk aversion: .

Because ≥0, this must be positive at r=0. It is convex in r and has a positive slope at r=0 because the term in square brackets must exceed zero for all ≥0, V≥0. Hence, the derivative is positive for all r≥0.

**Proof of Proposition 3**:

 K is an increasing function of V, so first period profits decrease in V. From equation (24), compute the derivative with respect to V:

|  |  |  |
| --- | --- | --- |
|  |  | ( |

The worst case analysis of the first term with respect to risk aversion r is at

, so the first term cannot be below  and hence cannot be below -1/16 when ≥0. By similar reasoning, the fourth term of (1) cannot be below  and hence cannot be below -3/64. The sum of the first, second and fourth terms of (39) must exceed 1/64 and because the third term is positive, the derivative of total profits is positive.

**Proof of Lemma 2:**

Consider, Γ=+. We will determine the joint distribution of of (1N, )’. Since  and  have independent N(0,1) distributions and  and  have independent N(0, V) distributions, the mean, E[Γ]=0 and var(Γ)=var(+)=2(+V). Finally, the cov(β1N, Γ )=E[β1N Γ]. This gives cov(β1N, Γ )= V. Putting these together:

 Because 2E is identical to 1N, it follows directly that 

**Proof of Proposition 7:**

The profit for the specialist at 2 at zero, 1+1/(1+2r), is higher than the profit for the generalist firm, 1+1/(2+1+4(1+2r), if and only it 1+2r≤2+1+42r or 0≤2+2(2(1+2-1)r. Because ≥0 and r≥0, the right hand side of this inequality is non-negative. The specialist curve is diminishing at V=0 (derivative is -2r/(1+2r)2) while the generalist curve is increasing (derivative is  which is positive because ≥1). As V grows the curves cross over, for the following reason. Re-write the profit of the specialist firm (30) as

.

The terms in square brackets approach ½ as V→∞ and the terms 1/V approach zero. The profit therefore becomes very close to the asymptotic line .

Rewrite the profit function of the generalist firm (24) as

.

The two terms in square brackets approach 0 as V→∞. The term in angled brackets approaches 1/16 and the term in curly brackets approach 3/2 so the term in parentheses approaches 1/(24(1+)2r) as V→∞. Hence the generalist’s profit approaches the asymptotic line  which exceeds the asymptotic value of the specialist profit.

In summary, for V close to zero, the profit of the firm that has specialist sales people exceeds that with generalists, but as the information potential of the situation increases, eventually the firm is more profitable with a generalist sales force.

**Qualifying Leads**

 Suppose demand is We will assume that 2’s attitude toward the brand is known from previous periods to take on the specific value  The customer 1 may have a positive or negative attitude toward the brand and 1 is assumed to be normally distributed with a mean 0 and variance V while he attitudes-to-the-salesperson i is N(0,1).

**Generalist**: Because the two customers see the identical salesperson, we assume that 1 and 2 are identical and their common value denoted  (mean zero and variance 1). In the initial period the sales (net of effort) reveals the latent attitudes  and  to generalist salesperson. Because the brand attitude of i=2 was previously known, this information is sufficient to precisely identify prospect 1’s brand attitude, . In the current period we assume that a new  is drawn, but the is remain the same.

The constant risk averse utility function is U= -exp(r×Income). If the agent is paid salary and commission (different commission rates) then the expected utility given Normal random variables leads to certainty equivalent of (G superscripts are dropped for simplicity)



Maximizing this with respect to efforts to get . In the expected profits, the commission cancels since the salary must be set so that CE=0:



Maximizing this with respect to commission rates gives identical commission rates of

, and maximized expected profit is

.

 Now suppose that the generalist was told not to sell to customer 1. The certainty equivalent would then be  Notice that with zero effort for customer 1, the value of  is really irrelevant. Optimal effort is . The expected profit is Maximizing this with respect to commission rate gives  and maximized expected profit

.

 Qualifying is more profitable than disqualifying if

.

The profit given the disqualification rule is thus



Taking advantage of the fact that a truncated normal, N(,V) with the left tail truncated at , has a mean equal to  where  and  are the pdf and CDF of the standardized Normal, integrating across 1 gives the ex ante expected profit for the generalist



 **Specialists**: Suppose that initially the two customers were sold by different specialists, so that sales net of effort reveals  and . Because the attitudes-to-the-salesperson are different, sales information does not precisely pin-point the brand attitude of the prospect i=1. What can be inferred is that .

 If the generalist qualifies both customers, The certainty equivalent of the salesperson 1 is



The optimal effort is e1=C1. The expected profit for customer 1 is  The optimal commission rate is  and the maximized profit conditional upon prior information is

.

 Qualifying is more profitable than disqualifying if



Using the truncated normal, the total ex ante profit given the disqualification rule for the specialist ia



**Comparison of Generalist and Specialist**:

In the figure below, we have set risk aversion r=4, task conflict d=0.5, and brand attitude , and then graphed the profit relationships for the generalist and specialist.

Uncertainty about

Market Potential, V

Total Profit

Generalist

Specialist

Assumptions: =0.5, r=4, 2=0.1

 As with the pricing model, the task conflict gives the generalist a disadvantage when there is very little uncertainty. However, for sufficiently large uncertain, the informational advantage of the generalist makes it more profitable because of fewer mistakes in qualifying customers.

1. The significant change from the standard principal-agent model is the introduction of the random attitude-towards-agent term in addition to the usual random term in such models (we call this latter random term the attitude-towards-brand). As we already saw, our main theoretical insight in Proposition 1 holds even without the attitude-towards-agent term. [↑](#footnote-ref-1)
2. Though the agent’s effort is not observable, it is *inferable* ex post. It depends only on the commission rate, and the costs, all of which are known (see equation 16). In the standard one-shot principal-agent model this inferred effort plays no further role, whereas in our dynamic setup it reveals useful information. [↑](#footnote-ref-2)
3. We have also analyzed the case where the firm pays a separate commission for sales to new and existing customers. None of our results are sensitive to this, and it only adds algebraic complexity without providing any new insights. In fact, with separate commissions the key managerial comparisons in Propositions 6 and 7 are even stronger in favor of the generalist. [↑](#footnote-ref-3)
4. In fact we will show in Proposition 3 below that the *total profit* over both periods increases in V. Though we have proved the result for the generalist, we will see in Section 3.4 that the result is the same for the specialist as well since the same economic forces are at play. [↑](#footnote-ref-4)