Managing Conflicts between Marketing and Sales: Customer Acquisition in Business Markets

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ABSTRACT

Conflicts between marketing and sales functions in business-to-business firms hurt profits. Marketing claims that sales disregards qualified leads; sales questions lead quality. To address such conflicts and avoid threats to profits, we consider several fundamental, unexplored questions: Should marketers’ compensation depend on sales by sales reps, the leads marketers generate, or both? Should sales reps’ incentives depend on sales only, or should the volume of leads inform their compensation? How can B2B firms manage customer acquisition efficiently? When does a decentralized structure erode profits compared to a centralized structure? We propose a multi-agent principal-agent model to address these questions where agents receive performance-based incentives on both leads and sales. First, when the quality of leads is perfectly observed, we uncover that coordinating efficiently the marketing–sales interface requires firms to incentivize marketers only on the basis of the volume of qualified leads. Conversely, when the quality of leads is imperfectly observed, firms should incentivize marketers on both qualified leads and sales. In both cases, however, we discover that both qualified leads and sales should underlie incentives schemes for sales reps, even though reps do not influence lead generation. In contrast, we establish that alternative intuitive plans recommended by practitioners would fuel conflicts at the marketing and sales interface. Finally, we find that the proposed incentive schemes can, in certain conditions, mitigate inefficiencies at the marketing–sales interface and replicate equilibrium profits attained with a centralized structure, whether the qualification process is perfect or not.

Keywords: Agency Theory, Business Markets, Compensation, Customer Acquisition, Incentives, Marketing-Sales Interface, Multitasking.
1. Introduction

With an organizational imperative to acquire customers cost effectively (Quelch and McGovern 2005), business-to-business (B2B) firms generally do so using a two-stage process, with a qualification filter between stages (Sabnis et al. 2013). First, they must generate sales leads. Second, they follow up on the sales leads to acquire customers. The qualification filter typically involves some lead scoring method. In such firms, marketing and sales usually are distinct functions (Kotler et al. 2006), and in the initial, lead generation stage, the marketing function takes primary responsibility to generate prospects and oversee their tracking and management (Carroll 2006, p. 15). Sales might play a supporting role, by identifying customer needs and developing prospecting strategies (Zoltners et al. 2009). Both marketing and sales agree on the lead scoring methods and apply them to filter the leads generated by marketing; the resulting qualified leads then move on to sales (Patel 2017). In practice, lead qualification often relies on automated systems provided by vendors such as HubSpot or Marketo. Then in the follow-up stage, sales reps take primary responsibility to contact leads and close sales (Sabnis et al. 2013); marketers support them by implementing selling strategies (Zoltners et al. 2009). Thus, customer acquisition by B2B firms requires the concerted efforts of both marketing and sales functions (Oliva 2006).

The process often encounters hurdles in practice though (Homburg and Jensen 2007; Kotler et al. 2006). Conflicts at the marketing–sales interface can result in a sales lead black hole, such that marketing devotes resources (spending 65% of its budget, by some estimates) to generate qualified leads, but sales reps never follow up on 70% of these leads (Oliva 2012; Sabnis et al. 2013). According to an Aberdeen group study, firms waste nearly 80% of marketing expenditures used to generate leads, due to a lack of follow up by sales reps (Carroll 2006).¹ Such conflicts persist, despite a priori, independent lead qualification processes. Even though a majority of firms use automated

¹ Marketing–sales conflicts go beyond customer acquisition (e.g., Beverland et al. 2006; Biemans et al. 2010), but the loss of more than half of the marketing budget on ignored sales leads certainly hurts firms’ bottom lines.
lead scoring systems, only 40% of salespeople recognize the value of this process (Handova 2015), seemingly because rule-based lead scoring cannot guarantee a propensity to buy. Despite the promises of vendors like HubSpot and Marketo, such automated systems provide noisy signals on lead quality based on recognized heuristics (Dupre 2016). The underlying technologies also might fail to identify high quality leads, due to data inaccuracies or missing information (Teleark 2019).

Such issues can create conflicts between marketing and sales, so to address this lack of alignment, firms often rely on ex ante organizational designs (e.g., one agent for marketing and sales, which we refer to as centralized, or one agent for marketing and another one for sales, which we refer to as decentralized) and ex post incentives, which together aim to align agents (marketing and sales reps) with the firm’s interests (Besanko et al 2010; Milgrom and Roberts 1992). Cespedes (2012) cites various organizational configurations that aim to enhance coordination across marketing and sales productivity. For example, centralized and decentralized structures represent two design options to implement the two-stage customer acquisition process.

In a centralized structure, the firm confronts a sequential moral hazard agency problem, because a multitasking agent first exerts marketing efforts (lead generation) and then sales efforts (lead follow-up and customer acquisition). The firm (principal) must determine ex post (after the decision to centralize marketing and sales) the optimal level of incentives to offer this multitasking agent who produces intermediary (leads) and final (sales) outcomes. It anticipates that the multitasking agent’s effort in the first stage (lead generation) relates positively to outcomes in the second stage (sales closure). In response to the incentives, the agent chooses both effort levels sequentially.

In a decentralized structure, the firm confronts a sequential moral hazard agency problem in teams with two distinct agents, such that the first agent (marketer) engages in lead generation, and the second (sales rep) performs lead follow-up and customer acquisition. The firm must determine
ex post (after decentralizing marketing and sales functions) how to incentivize each agent, including which metrics to use (e.g., sales only or a combination of leads and sales), whether compensation plans should be symmetric or asymmetric between agents (e.g., same or different metrics), and the levels of incentives, again while taking into account the impact of leads on sales. Agents, in response to their own respective performance metrics and those of the other agent, determine their optimal effort level.

These organizational design and incentive structure issues for intermediate (leads) and final (sales) outcomes prompt relevant practice-oriented considerations (e.g., Carroll 2006; Young 2005). For example, sales reps often earn commissions, whereas marketers receive fixed salaries, but perhaps marketers should be able to earn variable compensation according to their performance too (Kotler et al. 2006; Zoltners et al. 2009). However, we lack clarity regarding which metrics provide accurate evaluations of the performance of marketing personnel. Kotler et al. (2006, p. 12) suggest that because sales metrics are easy to “define and measure” and strongly affect the firm’s bottom line, they could be used to compensate both marketers and sales personnel. Yet Zoltners et al. (2009, p. 422) caution that because marketing and sales “jobs are different in terms of the activities they require,” an intermediate outcome might serve as a better reward for marketing. Oliva (2006, p. 397) calls “lead generation … the key linkage between marketing and sales,” such that marketers might be compensated according to the estimated sales potential of the qualified leads they generate, and then sales reps would earn their compensation on the basis of sales from subsequently acquired customers. Suggestions of different performance metrics (leads for marketers, sales for sales reps) have not evoked universal support though. Whereas Kotler et al. (2006) argue that marketers’ compensation must depend on sales, as converted by sales reps, Zoltners et al. (2009, p. 422) insist it should depend on the volume of qualified leads that marketers generate, and only sales reps should be compensated according to their achieved sales.
To explore these managerial dilemmas, we propose an analytical, principal–agent model,² which acknowledges moral hazard, to understand how to better manage the marketing–sales interface. In a centralized structure, we argue that the incentives offered to a multitasking agent should depend on both leads and sales; incentivizing this agent only on sales would not be optimal, even if sales ultimately determine the firm’s bottom line. In contrast, in a decentralized structure, we assert that the design of optimal contracts for marketers and sales reps must reflect two different logics: the informativeness of metrics used to compensate agents and the team nature of the moral hazard. Our results show that when the lead qualification process is perfect, the principal should incentivize the marketer not with sales, but only on qualified leads, even though marketing efforts are necessary to achieve sales. This finding departs from an idea in the agency literature that “incentive contract[s] should be based on all variables that provide information about the agent’s actions” (Bolton and Dewatripont 2004, p. 169), also known as the informativeness principle. However, at the marketing–sales interface, sales do not provide additional information about the agent’s efforts, beyond lead metrics, as long as the qualification process is perfect. The combination of the two performance metrics in the marketer’s incentive plan thus is not necessary. If the qualification process is imperfect though, it is optimal to compensate marketers according to both sales and qualified leads, because both metrics now provide information about the marketer’s performance.

Although qualified leads are uninformative about the sales rep’s efforts, we find that the sales rep’s incentives should extend beyond sales conversions to account for the volume of qualified leads that the marketer generates, regardless of whether the qualification process is perfect or not. More precisely, the sales rep’s incentive plan should include both a positive commission on converted sales and a negative commission on lead volume, which approximates a quota-based

² Coughlan et al. (2010, p. 5) suggest that “good analytic models can contribute by permitting the analysis of a market or a problem where other tools simply do not (or do not yet) work.” For example, identifying which compensation scheme to use with realistic experiments would be expensive and difficult. Thus, an analytical approach seems apt to study these questions at the marketing–sales interface.
commission plan. The rationale for this finding does not follow from the informativeness principle, as in the marketer’s case, but from the team nature of the agency relationship at the lead conversion stage (Bolton and Dewatripont 2004). Due to the sequential nature of customer acquisition in B2B markets, sales uncertainty increases with lead uncertainty. Therefore, the principal should offer the sales rep a negative commission rate to filter out common shocks that affect both the marketer’s and the sales rep’s individual outputs, to prevent sales reps from free-riding on leads generated by the marketer. In turn, the principal offers the sales rep a higher commission on converted sales compared to a sales rep with a contract that ignores the volume of leads generated by the marketer. Thus, in a decentralized structure, managers should manage agency relationships that are different than the agency relationship in a centralized structure.

Furthermore, we find that alternative compensation plans, such as compensating all agents only on sales or excluding consideration of leads in defining the sales rep’s variable pay, create tensions at the marketing–sales interface, such that either one or both agents work less than they would under both a centralized structure and the decentralized structure with the proposed incentive plan. Finally, in some circumstances, the proposed plan for the decentralized structure can yield an equilibrium profit identical to the level earned with a centralized structure. Thus, we establish that properly designed incentive plans can mitigate the inefficiencies that arise at the marketing–sales interface.

We organize the remainder of this article as follows: In Section 2, we provide an overview of the agency theory literature in marketing. Section 3 characterizes optimal strategies for the principal and a multitasking agent in the centralized structure; Section 4 presents optimal strategies for a decentralized structure. Thus we compare profits earned under centralized and decentralized structures. In Section 5, we extend the model to accommodate noisy lead qualification processes.
We also confirm the robustness of our results by considering several generalizations. Finally, we conclude with a discussion of the implications of our findings.

2. **Principal–Agent Models in Marketing**

In principal–agent models that address the moral hazard problem, a risk-averse agent works for a risk-neutral principal that establishes a compensation plan composed of a fixed salary and performance-based incentives (Holmstrom 1982; Mirrlees 1976; Rees 1985a, 1985b). The principal and agent operate in an uncertain environment, and the principal cannot accurately observe the agent’s efforts. The agent’s risk aversion creates a desire to avoid penalty from adverse outcomes due to unfortunate circumstances, so some risk-sharing must exist between the principal and agent. The moral hazard problem requires the principal to design a contract to stimulate the agent to make appropriate efforts to maximize the principal’s rewards, while recognizing the agent’s risk aversion and the stochastic nature of the environment.

Existing models examine various marketing contexts, including contracting with an advertising agency (Zhao 2005), customer satisfaction (Hauser et al. 1994), and sales force management (Basu et al. 1985). The latter represents perhaps the most prominent application, and research in this area examines compensation for sales reps with heterogeneous abilities (Lal and Staelin 1986; Rao 1990), for sales reps selling multiple products (Lal and Srinivasan 1993; Raju and Srinivasan 1996), and selling situations in repeated environments (Mantrala et al. 1997; Rubel and Prasad 2016). Scholars also propose models to address both sales rep compensation schemes and strategic issues, such as eliciting market information from sales reps (Chen 2005; Mantrala and Raman 1990; Simester and Zhang 2014), delegating pricing responsibilities to them (Bhardwaj 2001; Mishra and Prasad 2004), monitoring (Joseph and Thevaranjan 1998), managing their self-control problems (Jain 2012), coordinating efforts of sales and operations (Jerath et al., 2007), and accounting for firms’ operational constraints (Dai and Jerath 2013). We add to the sales force
management literature by analyzing the two-stage customer acquisition process in B2B firms, which requires analyzing sequential moral hazard problems.

By doing so, we also contribute to the scant literature on sequential moral hazard problems in teams, which we summarize in Table 1. For example, Thevaranjan and Joseph (1999) propose a personal selling model in which the lead response function is deterministic, whereas the sales response function is stochastic, which makes the issue of incentive design for marketers moot. In contrast, we consider both the lead response function and the sales response function as stochastic and thus account for the dual risk of moral hazard by both the marketer and the sales rep, then characterize the optimal incentive structures for risk-averse agents in a sequential moral hazard problem in teams. Hemmer (1995, 1998) investigates a sequential moral hazard problem in a two-stage production process, analyzing the designs of unidimensional incentives for agents who share similar risk aversion levels. Such an approach (e.g., paying both marketers and sales reps on the basis of converted sales only for instance) is detrimental in B2B settings though, because, as we will demonstrate, this approach will fuel conflicts at the marketing–sales interface. Schmitz (2005, 2013) instead explores incentives in a sequential moral hazard problem for research and development (R&D) efforts, using binary-action models with risk-neutral agents to predict when firms should integrate or decentralize R&D activities, according to nonlinear incentives. We complement these studies by developing a continuous-action model with risk-averse agents to predict when the principal should centralize or decentralize lead generation and selling tasks, as well as by showing that simple linear incentives can be desirable in B2B settings. That is, despite the vast number of principal–agent models pertaining to sales force management, we know of no research that explores how to incentivize risk-averse marketers and sales reps simultaneously to ensure optimal customer acquisition in B2B firms, when both the lead and sales response functions are stochastic.

----- INSERT TABLE 1 ABOUT HERE----
3. Optimal Incentives in a Centralized Structure

We first consider a centralized structure. In a centralized structure, the firm (principal) tasks a multitasking agent with both marketing and sales efforts. In line with the customer acquisition process in B2B firms, we observe two performance metrics, qualified leads and sales, under the control of the same agent. In this and the next section, we assume that the qualification process is perfect, and the volume of qualified leads perfectly coincides with the volume of quality leads. We relax this assumption in Section 5 to explore how a noisy qualification process changes incentives, equilibrium efforts, and profits. Table 2 summarizes our notations.

--- INSERT TABLE 2 ABOUT HERE---

The response functions for qualified leads and sales are as follows. The agent first exerts effort \( u \) to generate qualified leads, i.e., \( x_1 \), such that:

\[
    x_1 = u + \varepsilon_1,
\]

where \( \varepsilon_1 \sim N(0; \sigma_1^2) \) captures uncertainty surrounding the generation of qualified leads. This response function comports with Thevaranjan and Joseph’s (1999) specification of the lead production function. After observing the number of qualified leads, the agent exerts selling efforts \( v \), and the sales response function is:

\[
    x_2 = f_s(x_1, v) + \varepsilon_2,
\]

where the response function \( f_s(x_1, v) \) implies that \( \frac{\partial f_s}{\partial x_1} > 0 \) and \( \frac{\partial f_s}{\partial v} > 0 \), and \( \varepsilon_2 \) captures the uncertainty that affects lead conversion, with \( \varepsilon_2 \sim N(0; \sigma_2^2) \). We posit that \( f_s(x_1, v) \) is additively separable, such that \( f_s(x_1, v) = x_1 + v \). Such a specification is common in the agency literature (e.g., Gibbons and Murphy 1992; Holmstrom 1999; Dewatripont et al. 1999), where the intercept \( x_1 \) in our case indicates the ability or effectiveness of the agent (thus, the higher \( x_1 \), the more
effective the agent is). In Section 6, we relax this assumption; our main results hold under a multiplicative specification too.

### 3.1. Compensation Contract and Expected Utility

Consistent with extant research (e.g., Chen 2005; Lal and Srinivasan 1993) and common practice in many industries (e.g., Joseph and Thevaranjan 1998), the compensation plan for the agent consists of a fixed salary and performance-based incentives. We focus on the design of a compensation plan that is linear in the observed performance metrics; we relax this assumption in Section 6. Linear plans are robust and optimal in several environments (e.g., Holmstrom and Milgrom 1987), as well as popular in practice and easily implementable. Specifically, the contract for the multitasking agent is:

\[
S_c(x_1, x_2) = y_0 + y_1 x_1 + y_2 x_2,
\]

where \(y_0\) is the agent’s fixed salary, \(y_1\) quantifies the sensitivity of the compensation plan to generated qualified leads, and \(y_2\) is the sales commission awarded to the agent for the ultimately generated sales.

Consistent with the sequential nature of customer acquisition in B2B markets, we consider the following game sequence:

1. The principal offers the contract, \(S_c(x_1, x_2)\) to the agent.
2. The agent accepts/rejects the contract.
3. The agent exerts marketing effort (\(u\)) and generates \(x_1\) qualified leads.
4. The agent then exerts effort (\(v\)), and \(x_2\) sales are realized.
5. Payment is made.

Stage 3 corresponds to the lead generation phase, and Stage 4 corresponds to the lead conversion stage. The agent’s decision to accept or reject the contract is based on expected utility, which
depends on the compensation plan and any disutilities for efforts, or $C_c(u)$ and $C_c(v)$, respectively, such that:

$$C_c(u)' > 0, C_c(u)'' > 0 \text{ and } C_c(v)' > 0, C_c(v)'' > 0.$$ 

Following the extant sales force compensation literature (e.g., Hauser et al. 1994; Joseph and Thevaranjan 1998), we depict the disutility functions of effort as $C_c(u) = u^2/2$ and $C_c(v) = v^2/2$, for analytical tractability. Such specifications are prevalent in empirical and experimental research on sales force compensation design (e.g., Chung et al. 2014; Chen and Lim 2017). Given these response functions, the quadratic cost structures imply that marketing and selling efforts exhibit marginal decreasing returns.

Furthermore and consistent with previous studies (e.g., Hauser et al. 1994; Lal and Srinivasan 1993), we assume that the agent is risk averse and behaves according to a negative exponential utility function. The total utility enjoyed by the agent in the centralized structure $U_c$ can be written as:

$$U_c = 1 - \exp \left[ -\rho_c \left( S_c(x_1, x_2) - \frac{u^2}{2} - \frac{v^2}{2} \right) \right],$$ 

where $\rho_c$ is the risk aversion coefficient of the agent.

Finally, we assume $U_c^0$ is the agent’s utility for doing alternative work (e.g., realizing sales from existing customers, working for another firm). Acceptable contracts must generate utilities that are no worse than $U_c^0$ to ensure the agent’s participation, which we formally implement as

$$\mathbb{E}(U_c) \geq U_c^0.$$ 

### 3.2. Objective Function and the Firm

Using the preceding specifications and constraints, the firm writes the agent’s contract to maximize its profits from customer acquisition, as determined by sales to newly acquired customers, the constant marginal cost of production $c$, and compensation for the agent. Following Lal and
Staelin (1986), and without loss of generality, we normalize \( c \) to 0 and note that our results hold true for a general unit margin. Mathematically, the objective function of the firm is:

\[
E(\Pi_c) = E\left(x_2 - S_c(x_1, x_2)\right). \tag{4}
\]

The principal then chooses contract parameters to maximize the firm’s expected profit, subject to the agents’ incentive compatibility constraint and individual rationality conditions, IC and IR, respectively:

\[
\Omega_c^* = \arg\max_{\Omega_c} E(\Pi),
\]

with \( \Omega_c = \{\gamma_1, \gamma_2\} \), subject to

\[
u^* = \arg\max_u E(U_c), \quad (\text{agent’s IC condition regarding marketing efforts}),
\]

\[
v^* = \arg\max_v E(U_c), \quad (\text{agent’s IC condition regarding selling efforts}), \quad \text{and}
\]

\[E(U_c) \geq U_c^0 \quad (\text{IR condition}).
\]

### 3.3. Optimal Strategies and Equilibrium Profits

We solve the game backward, starting from the lead conversion stage. At this stage, the agent decides the level of effort to exert \( v \), taking into account the volume of qualified leads generated \( x_1 \), which is no longer a random variable. In the lead conversion stage, the only source of uncertainty comes from \( \epsilon_2 \). Because of the LEN structure of the game (referring to a Linear compensation plan, Exponential utility, and Normally distributed errors), the agent’s utility certainty equivalent at this stage is:

\[
v^* = \arg\max_v \gamma_0 + \gamma_1 x_1 + \gamma_2 (x_1 + v) - \frac{v^2}{2} - \frac{\rho_c}{2} (\gamma_2 \sigma_2)^2, \tag{5}
\]

which gives us \( v^* = \gamma_2 \), which in turn is a maximum because \( \frac{\partial^2 E(U_c)}{\partial v^2} < 0 \).

At the lead generation stage, the agent determines the optimal effort level to generate qualified leads, such that

\[
u^* = \arg\max_u \gamma_0 + \gamma_1 u + \gamma_2 (u + v^*) - \frac{u^2}{2} - \frac{v^2}{2} - \frac{\rho_c}{2} \left(\left((\gamma_1 + \gamma_2)\sigma_1\right)^2 + (\gamma_2 \sigma_2)^2\right). \tag{6}
\]
where \( (\gamma_1 + \gamma_2)\sigma_1^2 + (\gamma_2 \sigma_2)^2 = \text{Var}(S_c(x_1, x_2)) \) is the compensation risk faced by the agent at this stage of the game, which is composed of two terms. The first term is the agent’s compensation risk that comes from \( \epsilon_1 \) (at this stage, \( x_1 \) is a random variable), and the second term is the agent’s compensation risk that comes from \( \epsilon_2 \). Differentiating Equation (6) with respect to \( u \) and equating the resulting equation with 0 yields \( u^* = \gamma_1 + \gamma_2 \), a maximum based on the second-order condition \( \frac{\partial^2 \mathbb{E}(U_c)}{\partial u^2} < 0 \).

We then replace the optimal effort strategies in the agent’s utility certainty equivalent and solve for the fixed salary \( \gamma_0 \) that satisfies the agent’s IR condition (Bolton and Dewatripont 2004). It needs to be taken into account together with the agent’s IC conditions, \( v^* = \gamma_2 \) and \( u^* = \gamma_1 + \gamma_2 \), so that the principal can choose the commission rates that maximize the firm’s expected profit, or formally:

\[
\{\gamma_1^*, \gamma_2^*\} = \text{ArgMax}_{\{\gamma_1, \gamma_2\}} u + v - (\gamma_0 + \gamma_1(u) + \gamma_2(u + v)).
\]

(7)

As a result, we obtain the following proposition (proofs for all propositions are in Appendix A):

**Proposition 1:** The optimal incentive parameters and equilibrium profit under the centralized structure are

\[
\{\gamma_1^*, \gamma_2^*\} = \left( \frac{\rho_c \times (\sigma_2^2 - \sigma_1^2)}{(1 + \rho_c \sigma_1^2) \times (1 + \rho_c \sigma_2^2)}; \frac{1}{1 + \rho_c \sigma_1^2} \right)
\]

and

\[
\mathbb{E}(II_c) = \frac{1}{2} \left( \frac{1}{1 + \rho_c \sigma_1^2} + \frac{1}{1 + \rho_c \sigma_2^2} \right) - U_c^0,
\]

respectively.

Proposition 1 furnishes three main insights. First, the agent always exerts positive lead generation and lead conversion efforts, because after replacing the optimal commission rates in the agent’s effort strategies,

\[
(u^*; v^*) = \left( \frac{1}{1 + \rho_c \sigma_1^2}; \frac{1}{1 + \rho_c \sigma_2^2} \right).
\]
Second, in line with the extant agency literature, the value of the agent’s outside effort does not affect the determination of the optimal commission rates, but it does determine the equilibrium profit. Third, the optimal incentive scheme depends on which activity, lead generation or lead conversion, is riskier. When $\sigma_2^2 > \sigma_1^2$, the sales conversion process is the more uncertain activity and as a result it is more desirable for the principal to incentivize lead generation efforts, by setting $\gamma_1^* > 0$, as it is the less risky one, i.e., $\sigma_2^2 > \sigma_1^2 \Rightarrow u^* > v^*$. Alternatively, when $\sigma_2^2 < \sigma_1^2$, lead generation is the more uncertain activity and it is then desirable for the principal to encourage the agent to be more aggressive and to not coast on his (past) lead generation efforts. Consequently it is optimal for the principal to implement $\gamma_1 < 0$, which, together with $\gamma_2 > 0$ can approximate a quota-based commission plan (see, e.g., Bhargava and Rubel 2019 for a similar interpretation). In this case, the agent starts receiving commissions on sales when $x_2 \geq q$, where $q = -\frac{y_1}{y_2} x_1$. As a result, the agent works more at converting leads into sales, i.e., $u^* < v^*$.

In summary, the analysis of the centralized structure reveals that in a centralized structure, the principal must design a compensation plan to manage a multitasking agent to account for both metrics influenced by the agent, not sales only. In equilibrium, the agent always exerts positive effort levels for both tasks. Although the optimal commission rate on sales is always positive, the optimal commission rates for leads can be positive or negative.

4. Optimal Incentives in a Decentralized Structure

With a decentralized structure, the principal must design incentives to orchestrate efforts by two different agents: the marketer, responsible for initial lead generation, and the sales rep, who is responsible for lead follow-up and closure (Zoltners et al. 2009). Just as in a centralized structure, we observe two performance metrics, qualified leads and sales. However, the design of optimal incentives in a decentralized structure raises two novel strategic considerations. First, rather than a multitasking agent, the principal must account for the team nature of the agency relationship
between the marketer and the sales rep. Thus, the incentive–insurance balance that the principal strikes to incentivize agents is different. Second, the issue of which metrics to use to incentivize the two agents becomes central and includes the further question of whether the same or different metrics should apply to the marketer and the sales rep. This question is particularly important because of the possible conflicts that may arise at the marketing–sales interface, e.g., marketers can blame sales reps for not following up enough on generated leads (Kotler et al. 2006) or sales reps can blame marketers for not generating enough quality leads (Hyam 2018).

To compare equilibrium strategies and profits between the centralized and decentralized structures, we assume that the response functions remain the same. However, the firm’s expected profit differs, because it needs to hire and compensate two agents. The marketer controls $u$, while the sales rep controls $v$. We assume that the contract for the marketer is:

$$S_m(x_1,x_2) = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2,$$

where $\alpha_0$ is the marketer’s fixed salary, $\alpha_1$ quantifies the sensitivity of the marketer’s compensation plan to generated qualified leads, and $\alpha_2$ is the sales commission awarded to the marketer for sales converted by the sales rep. Then the contract for the sales rep is:

$$S_s(x_1,x_2) = \beta_0 + \beta_1 x_1 + \beta_2 x_2,$$

where $\beta_0$ is the sales rep’s fixed salary, $\beta_1$ quantifies the sensitivity of the sales rep’s compensation plan to the number of qualified leads generated by the marketer, and $\beta_2$ is the sales commission awarded to the sales rep for closed deals. The game then follows a sequence:

1. The principal offers different contracts to the marketer, $S_m(x_1,x_2)$, and the sales rep, $S_s(x_1,x_2)$, where $x_1$ is the number of qualified leads generated by the marketer and $x_2$ is the level of sales generated by the sales rep.
2. The marketer and sales rep simultaneously accept/reject the contracts according to their own expected utilities.
3. The marketer exerts effort \( (u) \), and the number of qualified leads \( x_1 \) can be observed.
4. The sales rep exerts effort \( (v) \), and sales \( x_2 \) are realized.
5. Payments are made.

4.1. Utility Functions and Profit

The decisions to accept or reject contracts by the marketer and the sales rep depend on their own expected utilities, which in turn reflect their respective compensation plans and effort disutilities, \( C_m(u) \) and \( C_s(v) \), respectively, such that \( C_m(u)' > 0, C_m(u)'' > 0 \), and \( C_s(v)' > 0, C_s(v)'' > 0 \), and furthermore, \( C_m(u) = u^2/2 \) and \( C_s(v) = v^2/2 \). The total utilities enjoyed by the marketer \( U_m \) and the sales rep \( U_s \) can be written, respectively, as:

\[
U_m = 1 - \exp \left[ -\rho_m \left( S_m(\alpha_1, x_2) - \frac{u^2}{2} \right) \right]
\]  
\[
U_s = 1 - \exp \left[ -\rho_s \left( S_s(x_1, x_2) - \frac{v^2}{2} \right) \right],
\]

where \( \rho_m \) is the risk aversion coefficient of the marketer, and \( \rho_s \) is the risk aversion coefficient of the sales rep, both of which could be lower, higher, or equal to the risk aversion coefficient of the agent in the centralized structure \( \rho_c \). Finally, \( U^0_m \) is the value of the marketer’s outside option, and \( U^0_s \) is the value of the sales rep’s outside option. Acceptable contracts for both the marketer and the sales rep must generate utilities that are no worse than \( U^0_m \) and \( U^0_s \), such that the agents’ participation constraints are \( \mathbb{E}(U_m) \geq U^0_m \) and \( \mathbb{E}(U_s) \geq U^0_s \).

The principal chooses contract parameters to maximize the firm’s expected profit:

\[
\mathbb{E}(\Pi) = \mathbb{E}\left( x_2 - S_m(x_1, x_2) - S_s(x_1, x_2) \right),
\]

subject to the agents’ IC constraints and IR conditions, \( \Omega^* = \text{ArgMax}_{\Omega} \mathbb{E}(\Pi) \), with \( \Omega = \{\alpha_1, \alpha_2, \beta_1, \beta_2\} \), subject to \( u^* = \text{ArgMax}_{u} \mathbb{E}(U_m) \) (marketer’s IC), \( v^* = \text{ArgMax}_{v} \mathbb{E}(U_s) \) (sales rep’s IC), \( \mathbb{E}(U_m) \geq U^0_m \), and \( \mathbb{E}(U_s) \geq U^0_s \) (IR).
Similar to the centralized structure, we proceed backward and start by characterizing the sales rep’s optimal effort strategy after observing $x_1$. At the lead conversion stage, the sales rep’s utility certainty equivalent is:

$$v^* = \operatorname{ArgMax}_v \beta_0 + \beta_1 x_1 + \beta_2 (x_1 + v) - \frac{v^2}{2} - \frac{\rho}{2} \left( \beta_2 \sigma_2 \right)^2,$$  \hspace{1cm} (9)

which yields $v^* = \beta_2$ with $\frac{\partial^2 E(u)}{\partial v^2} < 0$. Similarly, at the lead generation stage, the marketer determines the optimal effort level, while taking into account both the sales rep’s selling effort strategy $v = v^*$ and the lead response function $x_1 = u + \varepsilon$. Then,

$$u^* = \operatorname{ArgMax}_u \alpha_0 + \alpha_1 u + \alpha_2 (\beta_2 + u) - \frac{u^2}{2} - \frac{\rho_m}{2} \left( (\alpha_1 + \alpha_2) \sigma_1 \right)^2 + (\alpha_2 \sigma_2)^2,$$  \hspace{1cm} (10)

where $((\alpha_1 + \alpha_2) \sigma_1)^2 + (\alpha_2 \sigma_2)^2 = \text{Var}(S_m(x_1, x_2))$ is the compensation risk faced by the marketer at this stage. The first- and second-order conditions for the marketer’s optimization problem are $u^* = \alpha_1 + \alpha_2$ and $\frac{\partial^2 E(u_m)}{\partial u^2} < 0$, respectively, characterizing a maximum. The agents’ fixed salaries are then determined such that their respective IR conditions bind. Using the agents’ IC and IR conditions, the principal chooses the optimal commission rates to maximize the firm’s expected profit, as in Equation (8).

As we have noted, opposing views exist regarding the best choice of incentive metrics. Kotler et al. (2006) suggest compensating both marketers and sales reps according to only converted sales. Using the specifications of the compensation plans and the sequence of the game, it would be equivalent to setting $\alpha_1 = \beta_1 = 0$ at Stage 1 of the game and optimizing the profit function with respect to $\alpha_2$ and $\beta_2$. We call this approach the “Kotler” plan. Zoltners et al. (2009) instead argue for basing the marketer’s compensation on the volume of leads only and the sales rep’s compensation on converted sales only, to represent their distinct roles. Formally, it would be
equivalent to setting $\alpha_2 = \beta_1 = 0$ at Stage 1 of the game and optimizing the firm’s expected profit with respect to $\alpha_1$ and $\beta_2$. We call this approach the “ZS” (Zoltner-Sinha) plan.

4.2. Equilibrium under a Decentralized Structure

**Proposition 2a:** Under the Kotler plan, the optimal commission rates and expected profit are

$$ (\alpha_2^K; \beta_2^K) = \left( \frac{1}{1 + \rho_m (\sigma_1^2 + \sigma_2^2)}; \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)} \right) $$

and

$$ \mathbb{E}(\Pi_K) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_m (\sigma_1^2 + \sigma_2^2)} + \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)} \right) - U_m^0 - U_s^0, $$

respectively. Under the ZS plan, the optimal commission rates and expected profit are

$$ (\alpha_1^{ZS}; \beta_2^{ZS}) = \left( \frac{1}{1 + \rho_m \sigma_1^2}; \frac{1}{1 + \rho_s \sigma_2^2} \right) $$

and

$$ \mathbb{E}(\Pi_{ZS}) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_m \sigma_1^2} + \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)} \right) - U_m^0 - U_s^0, $$

respectively.

**Proposition 2b:** The optimal commission rates are

$$ (\alpha_1^*, \alpha_2^*) = \left( \frac{1}{1 + \rho_m \sigma_1^2}; 0 \right) $$

and

$$ (\beta_1^*, \beta_2^*) = \left( \frac{1}{1 + \rho_s \sigma_2^2}; \frac{1}{1 + \rho_s \sigma_2^2} \right), $$

and the resulting equilibrium profit is

$$ \mathbb{E}(\Pi_D) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_m \sigma_1^2} + \frac{1}{1 + \rho_s \sigma_2^2} \right) - U_m^0 - U_s^0. $$

Propositions 2a and 2b reveal several important managerial insights. First, the proposed optimal compensation plan (Proposition 2b) generates more profit than the Kotler or ZS approaches, i.e.,

$$ \mathbb{E}(\Pi_D) > \mathbb{E}(\Pi_{ZS}) > \mathbb{E}(\Pi_K). $$

The rationale for this finding comes from the fact that we do not restrict any contract parameter to be 0 at Stage 1 of the game, so our proposed method allows for more degrees of freedom to identify
the optimal commission rates. As a result, in equilibrium and even though we did not restrict the marketer’s commission on sales to be 0 ex ante, it is optimal to set $\alpha_2^*$ to 0. This result implies that no optimal linear contract exists whereby the firm incentivizes the marketer through both leads and sales. It is somewhat surprising; marketing efforts affect $x_1$ directly and $x_2$ indirectly. Thus, according to the informativeness principle (e.g., Bolton and Dewatripont 2004), we might expect the principal to use both metrics to incentivize the marketer. Yet the informativeness principle does not apply here, because realized sales do not convey any new information about the marketer’s efforts, beyond the information provided by the generated volume of qualified leads. Including converted sales in the marketer’s incentive schemes would result in suboptimal risk sharing between the firm and its marketer, which explains why $E(\Pi_D) > E(\Pi_K)$.

Conversely, we find that $\beta_1 \neq 0$, even though this parameter has no direct impact on the sales rep’s effort strategy, in that $\frac{\partial v^*}{\partial \beta_1} = 0$. In particular, it is optimal for the principal to set $\beta_1 < 0$. The intuition follows from the literature on multi-agent moral hazard problems in teams with observable individual outputs (e.g., Bolton and Dewatripont 2004, pp. 314-315), which indicates that a negative commission rate imposed on the sales rep reduces the rep’s exposure to the common shock affecting both agents (i.e., $\epsilon_1$). Everything else equal, setting $\beta_1 < 0$ decreases the variance of the sales rep’s compensation $Var(S_s(x_1, x_2)) = \left((\beta_1 + \beta_2)\sigma_1\right)^2 + (\beta_2\sigma_2)^2$, such that for any given $\beta_2$, $Var(S_s(x_1, x_2))\big|_{\beta_1<0} < Var(S_s(x_1, x_2))\big|_{\beta_1>0}$, since $\beta_1 + \beta_2 < \beta_2$ in such a case. As a result, and in line with Proposition 2, the principal can set the sales rep’s commission rate on sales higher when $\beta_1 \neq 0$ than when $\beta_1 = 0$, such that

$\beta_2^*|_{\beta_1 \neq 0} > \beta_2^*|_{\beta_1 = 0},$
since $\beta^*_2|_{\beta_1=0} = \frac{1}{1+\rho_3(\sigma^2_1+\sigma^2_2)}$, while $\beta^*_2|_{\beta_1 \neq 0} = \frac{1}{1+\rho_3\sigma^2_2}$. Consequently, the sales rep works more when $\beta_1 < 0$. A manager can filter out common shocks that affect individual outputs, while also increasing the sales rep’s commission on sales. In terms of managerial implementation, we suggest that the compensation plan offered to the sales rep can be approximated by a quota-based commission plan such that the compensation received by the sales rep, i.e., $\max \{\beta_0, \beta_0 + \beta_1x_1 + \beta_2x_2\}$, can be re-written as:

$$S(x_1, x_2) = \begin{cases} 
\beta_0 \text{ if } x_2 < q \\
\beta_0 + \beta_1x_1 + \beta_2x_2 \text{ if } x_2 \geq q
\end{cases}$$

where $q = -\frac{\beta_1}{\beta_2} x_1$. Hence, as the volume of qualified leads generated by the marketer increases, so should the quota of the rep.

To summarize, the two findings $\alpha^*_2 = 0$ and $\beta^*_1 < 0$, manifest because decentralizing the marketing and sales functions creates agency relationships that differ from the multitasking agency problem created by a centralized structure.

### 4.3. Conflicts at the Marketing–Sales Interface

Propositions 2a and 2b also shed light on conflicts at the marketing–sales interface, relative to the optimal plan in a decentralized structure and the optimal effort levels in a centralized structure. Recall that marketers tend to complain that sales reps do not follow through on the leads they generate, while sales reps blame marketers for not generating enough high quality leads. We seek analytical support for these claims by replacing the optimal commission rates in the optimal effort strategies for both decentralized and centralized structures. We report the findings in Table 3.

---INSERT TABLE 3 ABOUT HERE---

In a decentralized structure, both Kotler and ZS plans induce the sales rep to work less in converting sales than the proposed plan does, because:
\[ v_d^* > v_d^K = v_d^{ZS}, \]
as indicated in marketers’ complaints that sales reps do not work hard enough to follow up on the leads they generate. This observation holds when we compare equilibrium sales conversion efforts under both centralized and decentralized structures, assuming that \( \rho_c \leq \rho_s \), because

\[ v_c^* > v_d^K = v_d^{ZS}, \]

which means that both the Kotler and ZS approaches generate conflict. The sales rep again works less than would result from the proposed plan or in a centralized structure. When \( \rho_c = \rho_s \), the sales rep’s level of effort under a decentralized structure that applies our proposed plan instead yields:

\[ v_d^* = v_c^*. \]

Turning to lead generation efforts, in a decentralized structure, the Kotler plan induces the marketer to work less at generating leads than does the proposed plan, because:

\[ u_d^* > u_d^K, \]

but the ZS plan does not have this negative influence, because \( u_d^* = u_d^{ZS} \). Parallel conclusions result when we compare equilibrium lead generation effort levels under a decentralized structure with lead generation efforts under a centralized structure. For example, when \( \rho_c = \rho_m \), both the ZS plan and the proposed plan in a decentralized structure induce the marketer to work optimally, as defined by the equilibrium effort level obtained under the centralized structure,

\[ u_d^* = u_c^*. \]

The rationales for these findings follow from two logics. First, converted sales are not informative about the marketer’s effort, so setting \( \alpha_2 > 0 \), as in the Kotler plan, exposes the marketer to stochastic shocks that are not directly congruent with the lead generation process, which influences the optimal level of compensation risk that the principal transfers to the marketer. As a consequence, the principal is constrained in terms of reducing performance-based incentives, so the
marketer exhibits less effort. Second, forcing $\beta_1$ to be 0 prevents the principal from accounting for the team nature of the agency problem that arises at the marketing-sales interface, whereas setting $\beta_1 < 0$ allows the principal to incentivize the sales rep to induce more effort, as explained.

Therefore, decentralizing marketing and sales functions can generate conflicts when the choice of incentives does not reflect the different natures of their agency relationships. The Kotler approach to compensate both agents only on sales, despite appearing intuitive, induces equilibrium efforts that are less than the efforts prompted by the centralized structure. Conversely, the ZS approach only induces the marketer to work optimally, not the sales rep. Our proposed approach mitigates these conflicts by incentivizing both agents to work at higher levels; in particular, when $\rho_c = \rho_m = \rho_s$, they exert the same amount of effort as induced by the centralized structure, because this structure optimally allocates risk between the agents.

4.4. Value Destruction and Value Creation at the Marketing–Sales Interface

From these results, we explore when the decentralized structure might destroy or create value. We summarize the equilibrium profits earned under all scenarios in Table 4.

---INSERT TABLE 4 ABOUT HERE---

As we have mentioned, a decentralized structure achieves the highest value creation under the proposed plan (cf. Kotler and ZS approaches), by enabling the principal to manage the different types of agency relationships created by decentralization. Depending on the values of the agents’ outside options and their risk aversion coefficients though, the expected profit earned with the proposed plan in a decentralized structure might be lower, equal, or even higher than the equilibrium profit under a centralized structure. Assuming $U_c^0 = U_m^0 = U_s^0 = 0$, we find that centralization yields more profit than decentralization,

$$\mathbb{E}(\Pi_C) > \mathbb{E}(\Pi_D),$$

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when \( \rho_c < \rho_m \) and/or \( \rho_c < \rho_s \), that is, when agents under a decentralized structure are more risk averse than those under a centralized structure. This finding mostly arises because hiring more risk-averse agents in a decentralized structure constrains the principal to providing fewer incentives. On the contrary, if \( \rho_c > \rho_m \) and/or \( \rho_c > \rho_s \), the decentralized structure might create more profit than the centralized structure,

\[
\mathbb{E}(\Pi_C) < \mathbb{E}(\Pi_D),
\]

mainly because the principal provides more incentives to the agents, due to lower risk aversion coefficients. Finally, when \( \rho_c = \rho_m = \rho_s = \rho \), and assuming \( U^0_c = U^0_m = U^0_s = 0 \), the proposed plan in a decentralized or centralized structure yields the same profit:

\[
\mathbb{E}(\Pi_C) = \mathbb{E}(\Pi_D) = \frac{1}{2} \times \left( \frac{1}{1 + \rho \sigma^2_1} + \frac{1}{1 + \rho \sigma^2_2} \right).
\]

This finding is important; all else being equal, decentralization does not de facto generate inefficiencies, conditional on whether the manager properly incentivizes agents by recognizing the different types of agency relationships. In turn, we offer two insights into the commonly documented feud between marketing and sales. First, the proposed asymmetric compensation plans encourage the marketer and sales rep to choose, independently and non-cooperatively, equilibrium effort levels that coincide with those for a centralized structure. Incentives alone thus can help coordinate marketing and selling efforts, as long as the contracts properly reflect the different agency relationships induced by decentralization. Second, we show that the equilibrium profit level attained in a decentralized structure under the proposed compensation plan, assuming some circumstances (e.g., values of outside options normalized to zero, similar risk aversion coefficients), can replicate the profit level attained by a centralized structure, such that it fully mitigates inefficiencies at the marketing–sales interface that can result from decentralization.
5. Optimal Incentives When Lead Quality Is Not Perfectly Observed

We have thus far relied on the assumption that the volume of quality leads is perfectly revealed by the qualification process. By relaxing this assumption, we acknowledge that the volume of quality leads $x_1$ might not be perfectly observed and rather quantified by a lead scoring model. This qualification process is noisy, identifying $y$ qualified leads among the $x_1$ leads generated. In turn,

$$y = x_1 + \epsilon_y,$$

where $\epsilon_y \sim N(0, \sigma_y^2)$ is the noise in the qualification process that prevents a direct assessment of how many quality leads $x_1$ have been generated. In the parlance of statistical filtering (e.g., Kalman filtering), $x_1$ is the latent state equation, while $y$ is the observation equation. The principal offers the following compensation plans to agents:

$$S_m = \alpha_0 + \alpha_1 \times y + \alpha_2 \times x_2$$

and

$$S_s = \beta_0 + \beta_1 \times y + \beta_2 \times x_2.$$  

After observing $y$ from the scoring model, the sales rep’s estimation of quality leads is (Ljungqvist and Sargent 2004):

$$\hat{x}_{1s} = \hat{u} + \frac{\sigma^2}{\sigma^2_x + \sigma^2_y} \times (y - \hat{u}),$$

(12)

where $\hat{u}$ is the sales rep’s assessment of the marketer’s effort. Similarly, after observing $y$ from the qualification process, the marketer estimates that $\hat{x}_{1M}$ have been generated, such that:

$$\hat{x}_{1M} = u^* + \frac{\sigma^2}{\sigma^2_x + \sigma^2_y} \times (y - u^*),$$

(13)

where $u^*$ is the actual level effort exerted by the marketer, who knows how much work s/he has performed. The marketer and sales rep develop different estimates of the volume of true quality leads generated, because only the marketer has perfect information about actual effort, so $\hat{x}_{1s} \neq \hat{x}_{1M}$. The sequence of the game is:
1. The principal offers different contracts to the marketer, $S_m(y, x_2)$, and sales rep, $S_s(y, x_2)$, where $y$ is the volume of qualified leads revealed by the imperfect qualification process, and $x_2$ is the level of sales generated by the sales rep.

2. The marketer and the sales rep simultaneously accept/reject the contracts according to their own expected utilities.

3. The marketer exerts effort $u$.

4. The sales rep estimates $x_1$ and, on the basis of this estimate, exerts effort $(v)$. Sales are realized.

5. Payments are made.

Solving for the optimal effort levels and commission rates with an imperfect qualification process leads to the following proposition:

**Proposition 3:** When the qualification process is imperfect, the optimal commission rates for the marketer and sales rep in the decentralized structure are

$$\left(\alpha_0^*, \alpha_1^*\right) = \left(\frac{\sigma_2^2 \sigma_y^2 + \sigma_1^2 \left(\sigma_2^2 - \sigma_y^2\right)}{z} ; \frac{\sigma_y^2 \left(\sigma_1^2 + \sigma_2^2\right)}{z}\right)$$

and

$$\left(\beta_1^*, \beta_2^*\right) = \left(-\frac{\sigma_1^2}{\left(1 + \rho_3 \sigma_2^2\right) \left(\sigma_1^2 + \sigma_2^2\right)} ; \frac{1}{1 + \rho_3 \sigma_2^2}\right)$$

respectively, where $z = \sigma_2^2 \left(\sigma_1^2 (1 + \rho_m \sigma_1^2) + \sigma_y^2 (1 + 2 \rho_m \sigma_1^2)\right) + \sigma_y^2 (1 + \rho_m \sigma_1^2)$. As a result, the firm’s expected profit under a decentralized structure with an imperfect qualification process is

$$\mathbb{E}(\Pi_D) = \frac{\left(\sigma_1^2 + \sigma_y^2\right) \sigma_2^2 (2 + \rho_m \sigma_1^2 + \rho_3 \sigma_2^2) + \sigma_y^2 (2 + \left(\rho_m + \rho_3\right) \sigma_2^2)}{2(1 + \rho_3 \sigma_2^2) z}.$$  

The main distinction that Proposition 3 makes is that when the qualification process is noisy, it is optimal for the manager to offer the marketer a non-zero commission rate on sales, i.e., $\alpha_0^* = \frac{\sigma_y^2 \left(\sigma_1^2 + \sigma_2^2\right)}{z}$. In line with the informativeness principle, converted sales now provide additional
information about lead generation efforts, so it becomes optimal to include this metric in the
marketer’s compensation. Conversely, and as we established previously, when the qualification
process is perfect and not corrupted by noise, $\sigma_y = 0$, we retrieve the optimal commission rates and
profit from Proposition 2b.

Finally, we compute (see Appendix A for the computations), the difference between the
expected profit obtained under the decentralized structure and the expected profit obtained under
the centralized structure when $\sigma_y \neq 0$, i.e., $\mathbb{E}(\Pi_D) - \mathbb{E}(\Pi_C)$, to analyze whether and when the
centralized structure necessarily creates more value than the decentralized one when the qualification
process is noisy. The analysis reveals, assuming that $\rho_c = \rho_m = \rho_s$ and $U^0_c = U^0_m = U^0_s = 0$, that
$\mathbb{E}(\Pi_D) > \mathbb{E}(\Pi_C)$ when $0 < \sigma^2 < \frac{-\eta_1 + \sqrt{\eta_1^2 + 4\eta_2}}{\eta_3}$, where $\eta_1$, $\eta_2$ and $\eta_3$ are reported in Appendix A. Thus,
even when the qualification process is imperfect, the decentralized structure will not necessarily
destroy value compared to the centralized structure, which comports with our earlier results.

6. Generalizations

We consider two extensions to the core model, such that we analyze multiplicative sales response
functions and non-linear incentives.

6.1. Multiplicative Sales Response Function

We explore the robustness of our results to multiplicative sales response functions, in which:

$$x_2 = x_1^\varphi v + \varepsilon_2,$$$$

(14)$

and $\varepsilon_2$ captures the uncertainty that affects lead conversion, with $\varepsilon_2 \sim N(0; \sigma^2_2)$, and $0 < \varphi < 1$.

This specification implies that the sales production function is a Cobb-Douglas function with two
inputs, leads and selling efforts. To perceive this point, it suffices to make the change of variable
$V = v^2$, which implies that $\sqrt{V} = v$ and thus that $x_1^\varphi v = x_1^\varphi \sqrt{V} = x_1^\varphi V^{1/2}$. Consequently, when
$\varphi = 1/2$, the Cobb-Douglas function displays constant returns to scale ($\varphi + \frac{1}{2} = 1$ in this case);
when \( \varphi < 1/2 \), it displays decreasing returns to scale (\( \varphi + \frac{1}{2} < 1 \) in this case); and when \( \varphi > 1/2 \), it displays increasing returns to scale (\( \varphi + \frac{1}{2} > 1 \) in this case).

Following the game sequences from Sections 3 and 4, we obtain the following results for \( \varphi = 1/2 \) for analytical tractability and for \( \rho_c = \rho_s = \rho_m = \rho \) for parsimony. In a decentralized structure, the optimal commission rates for the marketer are:

\[
(\alpha_1^*; \alpha_2^*) = \left( \frac{1}{1 + \rho \sigma_1^2} \times \frac{(2 - \beta_2^*) \beta_2^*}{2}; 0 \right),
\]

whereas the optimal contract parameters for the sales rep are:

\[
(\beta_1^*; \beta_2^*) = \left( -\frac{\beta_2^*}{2}, \frac{3 - \Delta}{2} \right),
\]

with \( \Delta = \sqrt{1 + 8\rho(1 + \rho \sigma_1^2)\sigma_2^2} \). Similarly, in a centralized structure, the optimal commission rates for the multitasking agent are \( (\gamma_1^*, \gamma_2^*) \) = \( \left( \frac{1}{1 + \rho \sigma_1^2} \times \frac{\gamma_2^* (2 - \gamma_2^* (2 + \rho \sigma_2^2))}{2}, \frac{3 - \Delta}{2} \right) \). From these commission rates, we can make three observations. First, even with a multiplicative sales response function, the optimal commission rate on sales that should be offered to the marketer is 0, and the sensitivity of the sales rep’s compensation plan to qualified leads is negative, such that \( \alpha_2^* = 0 \) and \( \beta_1^* < 0 \). We thus confirm the robustness of our earlier results, as well as the intuitions underlying them. Second, we note that \( \alpha_1^* \) depends on \( \beta_2^* \) and, as a consequence, on \( \sigma_2^2 \), due to the multiplicative nature of the sales response function. Third, with these results we can compute the expected profits obtained under both centralized and decentralized structures; even when the sales response function is multiplicative, the profit level obtained for a decentralized structure under the optimal contract is equal to the profit level obtained in a centralized structure, such that \( E(\Pi^*) = \frac{1 + \Delta}{16(1 + \rho \sigma_1^2)^2} + \)
\[ \frac{\sigma_1^2}{2} \left( \Delta - \frac{5}{2} - \rho (1 + \rho \sigma_2^2) \sigma_2^2 \right). \]

In Appendix A, we offer proofs, and in Appendix B, we furnish numerical analyses for \( \varphi \neq 1/2 \) that confirm these findings.

### 6.2. Non-Linear Incentives

When we relax the assumption of linear compensation plans, we characterize the equilibria obtained under centralized and decentralized structures when compensation plans are quadratic. Under a centralized structure, we derive the optimal strategies and profit when the agent’s compensation plan is:

\[ S_c(x_1, x_2) = \gamma_0 + \gamma_{11} x_1 + \gamma_{12} x_1^2 + \gamma_{21} x_2 + \gamma_{22} x_2^2. \]

Similarly, under a decentralized structure, we obtain the optimal strategies and equilibrium profit when the marketer’s compensation plan is:

\[ S_m(x_1, x_2) = \alpha_0 + \alpha_{11} x_1 + \alpha_{12} x_1^2 + \alpha_{21} x_2 + \alpha_{22} x_2^2, \]

and the sales rep’s compensation plan is:

\[ S_s(x_1, x_2) = \beta_0 + \beta_{11} x_1 + \beta_{12} x_1^2 + \beta_{21} x_2 + \beta_{22} x_2^2. \]

For these new structures, we resort to numerical analyses and report two sets of results, assuming that \( \rho_s = \rho_m = \rho_c = \rho = 1/2 \) and that \( U_c^0 = U_m^0 = U_s^0 = 0 \).

The ratio of the equilibrium profit under a decentralized structure when agents’ compensation plans are quadratic, relative to the equilibrium profit under a decentralized structure when agents’ compensation plans are linear, indicates the profit gains due to non-linear plans, as in Table 5.

---INSERT TABLE 5 ABOUT HERE---

Table 5 thus offers three insights. First, the quadratic plan generates higher profits than the linear plan, which seems intuitive; it provides greater flexibility to the principal to incentivize the agents. Second, depending on parameter values, the gains obtained by the non-linear plan are less than 4% and in most cases less than 1%. From an implementation perspective, managers thus need to trade
off the profit gains achieved with non-linear plans against the simplicity of linear plans. Third, profit gains provided by non-linear plans appear more substantial (greater than 1% but less than 4%) in situations marked by more uncertainty, such that $\sigma^2 = 1$.

We also explore how much profit gain results from a centralized structure, relative to a decentralized structure, when the firm implements optimized non-linear plans. Specifically, we report the ratio of equilibrium profit under a centralized structure when agents’ compensation plans are quadratic relative to the equilibrium profit under a decentralized structure when agents’ compensation plans are quadratic. Thus we can assess the profit gains obtained with a centralized structure over a decentralized structure.

---INSERT TABLE 6 ABOUT HERE---

As we show in Table 6, and in line with the preceding results, the firm does not have to lose profit if it chooses to decentralize its marketing and sales functions. Conditional on the implementation of appropriate incentives, the firm can mitigate profit losses induced by decentralization. However, the loss of inefficiency due to decentralization increases with uncertainty.

Taken collectively, the results in Tables 5 and 6 furnish evidence that linear plans are not “too” bad and that properly optimized incentives can mitigate profit losses due to the decentralization of marketing and sales functions.

7. Discussion and Conclusion

Customer acquisition in B2B firms typically involves efforts by marketers and sales reps; however, as has been well documented in practice (e.g., Kotler et al. 2006) and academia (e.g., Smith et al. 2006), the marketing–sales interface is rarely smooth. It suffers a persistent sales lead black hole (Sabnis et al. 2013). Conflicts between marketing and sales and the ensuing customer acquisition challenges thus affect most firms in business markets; as Cespedes (2014, p. vi) articulates it, “for most firms, the largest, most difficult, and most expensive part of strategy implementation is aligning
sales and go-to-market efforts with the company’s espoused strategies and goals.” To address this issue and investigate the efficacy of the emerging practice of granting variable compensation to marketers (Kotler et al. 2006; Zoltners et al. 2009), we analyze the optimal design of incentives schemes for both marketers and sales reps.

Substantively, we add to the extant compensation literature (e.g., Basu et al. 1985; Coughlan and Joseph 2012) by proposing a novel multi-agent theoretical model that we apply to investigate the joint roles of the marketer and the sales rep in firms’ customer acquisition efforts. We also present distinct compensation structures that firms can use to coordinate the customer acquisition efforts of both marketers and sales reps. In particular, qualified leads, not sales, should determine marketers’ compensation when the qualification process is perfect, while both qualified leads and sales should determine marketers’ compensation when the qualification process is imperfect. In contrast, both sales and leads should inform the sales rep’s compensation, even though leads metric is not under the control of the sales rep, to reflect the team nature of the agency problem at the sales conversion stage. The optimal sales rep compensation plan should mimic a quota-based approach, such that the commission on sales gets paid only after sales exceed a quota determined by the volume of qualified leads generated by the marketer. Finally, we find that the proposed asymmetric compensation schemes can mitigate inefficiencies and prevent conflicts at the marketing and sales interface when incentives properly reflect the different agency relationships.

We close by noting that it is difficult to overstate the importance of customer acquisition for B2B firms. Inspired by several influential contributions (e.g., Cespedes 2014; Kotler et al. 2006; Zoltner et al. 2009), we show that compensation structures for marketers and sales reps can be designed and implemented profitably, to manage customer acquisition by the marketing and sales functions effectively.
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<td>Schmitz (2013)</td>
</tr>
<tr>
<td>This Study</td>
</tr>
<tr>
<td>Symbol</td>
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<tr>
<td>--------</td>
</tr>
<tr>
<td>$x_1$</td>
</tr>
<tr>
<td>$x_2$</td>
</tr>
<tr>
<td>$u$</td>
</tr>
<tr>
<td>$v$</td>
</tr>
<tr>
<td>$\varepsilon_1$ ($\varepsilon_2$)</td>
</tr>
<tr>
<td>$\sigma_1^2$ ($\sigma_2^2$)</td>
</tr>
<tr>
<td>$\alpha_0$ ($\beta_0$)</td>
</tr>
<tr>
<td>$\alpha_1$ ($\beta_1$)</td>
</tr>
<tr>
<td>$\alpha_2$ ($\beta_2$)</td>
</tr>
<tr>
<td>$S_m(x_1, x_2)$ ($S_s(x_1, x_2)$)</td>
</tr>
<tr>
<td>$\rho_c$</td>
</tr>
<tr>
<td>$\rho_m$ ($\rho_s$)</td>
</tr>
<tr>
<td>$C_m(u)$ ($C_s(v)$)</td>
</tr>
<tr>
<td>$U_m(u)$ ($U_s(v)$)</td>
</tr>
<tr>
<td>$V_m(u^0)$ ($V_s(v^0)$)</td>
</tr>
<tr>
<td>$\Pi$</td>
</tr>
<tr>
<td>$S_c(x_1, x_2)$</td>
</tr>
<tr>
<td>$\gamma_0$</td>
</tr>
<tr>
<td>$\gamma_1$ ($\gamma_2$)</td>
</tr>
</tbody>
</table>
Table 3: Optimal Effort Strategies

<table>
<thead>
<tr>
<th>Structure</th>
<th>Lead Generation Effort ($u$)</th>
<th>Lead Conversion Effort ($v$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralized</td>
<td>$u_c^* = \frac{1}{1 + \rho_c \sigma_1^2}$</td>
<td>$v_c^* = \frac{1}{1 + \rho_c \sigma_2^2}$</td>
</tr>
<tr>
<td>Decentralized</td>
<td>$u_d^K = \frac{1}{1 + \rho_m (\sigma_1^2 + \sigma_2^2)}$</td>
<td>$v_d^K = \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)}$</td>
</tr>
<tr>
<td>Decentralized</td>
<td>$u_d^{zs} = \frac{1}{1 + \rho_m \sigma_1^2}$</td>
<td>$v_d^{zs} = \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)}$</td>
</tr>
<tr>
<td>Proposed Plan</td>
<td>$u_d^* = \frac{1}{1 + \rho_m \sigma_1^2}$</td>
<td>$v_d^* = \frac{1}{1 + \rho_s \sigma_2^2}$</td>
</tr>
</tbody>
</table>

Table 4: Expected Profits

<table>
<thead>
<tr>
<th>Structure</th>
<th>Expected Profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralized</td>
<td>$\mathbb{E}(\Pi_C) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_c \sigma_1^2} + \frac{1}{1 + \rho_c \sigma_2^2} \right) - U_c^0$</td>
</tr>
<tr>
<td>Decentralized under</td>
<td>$\mathbb{E}(\Pi_K) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_m (\sigma_1^2 + \sigma_2^2)} + \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)} \right) - U_m^0 - U_s^0$</td>
</tr>
<tr>
<td>the Kotler Plan</td>
<td></td>
</tr>
<tr>
<td>Decentralized under</td>
<td>$\mathbb{E}(\Pi_{ZS}) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_m \sigma_1^2} + \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)} \right) - U_m^0 - U_s^0$</td>
</tr>
<tr>
<td>the ZS Plan</td>
<td></td>
</tr>
<tr>
<td>Decentralized under</td>
<td>$\mathbb{E}(\Pi_D) = \frac{1}{2} \times \left( \frac{1}{1 + \rho_m \sigma_1^2} + \frac{1}{1 + \rho_s \sigma_2^2} \right) - U_m^0 - U_s^0$</td>
</tr>
<tr>
<td>the Proposed Plan</td>
<td></td>
</tr>
</tbody>
</table>
Table 5: Ratio of Profit with Quadratic Plans over Profit with Linear Plans, under Decentralization

<table>
<thead>
<tr>
<th>$\sigma^2_i$</th>
<th>$\frac{\mathbb{E}(\Pi^\text{Quadratic})}{\mathbb{E}(\Pi^\text{Linear})}$</th>
<th>$\sigma^2_i = 1/5$</th>
<th>$\sigma^2_i = 1/4$</th>
<th>$\sigma^2_i = 1/3$</th>
<th>$\sigma^2_i = 1/2$</th>
<th>$\sigma^2_i = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2_i = 1/5$</td>
<td>1.00018</td>
<td>1.00041</td>
<td>1.00114</td>
<td>1.00424</td>
<td>1.0224</td>
<td></td>
</tr>
<tr>
<td>$\sigma^2_i = 1/4$</td>
<td>1.00019</td>
<td>1.00042</td>
<td>1.00115</td>
<td>1.00426</td>
<td>1.02255</td>
<td></td>
</tr>
<tr>
<td>$\sigma^2_i = 1/3$</td>
<td>1.00028</td>
<td>1.00048</td>
<td>1.00119</td>
<td>1.00433</td>
<td>1.02287</td>
<td></td>
</tr>
<tr>
<td>$\sigma^2_i = 1/2$</td>
<td>1.00187</td>
<td>1.00158</td>
<td>1.00186</td>
<td>1.00476</td>
<td>1.02381</td>
<td></td>
</tr>
<tr>
<td>$\sigma^2_i = 1$</td>
<td>1.02017</td>
<td>1.01934</td>
<td>1.01813</td>
<td>1.01764</td>
<td>1.03308</td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Ratios of Profit from Centralized Structure over Profit from Decentralized Structure

<table>
<thead>
<tr>
<th>$\frac{\mathbb{E}(\Pi^\text{Quadratic})}{\mathbb{E}(\Pi^\text{Central})}$</th>
<th>$\sigma^2_i = 1/5$</th>
<th>$\sigma^2_i = 1/4$</th>
<th>$\sigma^2_i = 1/3$</th>
<th>$\sigma^2_i = 1/2$</th>
<th>$\sigma^2_i = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2_i = 1/5$</td>
<td>1.00001</td>
<td>1.00001</td>
<td>1.00001</td>
<td>1.00001</td>
<td>1.00002</td>
</tr>
<tr>
<td>$\sigma^2_i = 1/4$</td>
<td>1.00002</td>
<td>1.00002</td>
<td>1.00002</td>
<td>1.00003</td>
<td>1.00005</td>
</tr>
<tr>
<td>$\sigma^2_i = 1/3$</td>
<td>1.00008</td>
<td>1.00009</td>
<td>1.00009</td>
<td>1.00011</td>
<td>1.00016</td>
</tr>
<tr>
<td>$\sigma^2_i = 1/2$</td>
<td>1.00051</td>
<td>1.0006</td>
<td>1.00067</td>
<td>1.00074</td>
<td>1.0009</td>
</tr>
<tr>
<td>$\sigma^2_i = 1$</td>
<td>1.00156</td>
<td>1.00233</td>
<td>1.00375</td>
<td>1.00649</td>
<td>1.01069</td>
</tr>
</tbody>
</table>
REFERENCES


Appendix A: Proofs

Proof of Proposition 1: We solve the game backward, starting from the lead conversion stage. Due to the LEN structure of the game, the agent’s utility certainty equivalent at this stage is such that the optimal effort is determined by:

\[ v^* = \text{ArgMax}_v \ y_0 + \gamma_1 x_1 + \gamma_2 (x_1 + v) - \frac{v^2}{2} - \frac{\rho_c}{2} (\gamma_2 \sigma_2)^2 \]  \hspace{1cm} (A1)

The first-order condition yields \( v^* = \gamma_2 \), which is a maximum, because \( \frac{\partial E(v)}{\partial v^2} < 0 \). We then replace the optimal lead conversion effort strategy in the agent’s utility certainty equivalent at the lead generation stage such that

\[ u^* = \text{ArgMax}_u \ y_0 + \gamma_1 (u) + \gamma_2 (u + v^*) - \frac{u^2}{2} - \frac{\rho_c}{2} ((\gamma_1 + \gamma_2)\sigma_1 + (\gamma_2 \sigma_2)^2), \]  \hspace{1cm} (A2)

and we find that \( u^* = \gamma_1 + \gamma_2 \), which is a maximum, because \( \frac{\partial E(u)}{\partial u^2} < 0 \). We replace the optimal effort strategies in the agent’s utility certainty equivalent at Stage 2 of the game (when the agent accepts or rejects the contract) and solve for the fixed salary \( y_0 \) that satisfies the agent’s individual rationality (IR) condition. It yields:

\[ y_0^* = U_c^0 + \frac{1}{2} \times (\gamma_1 (\gamma_1 + 2\gamma_2) (-1 + \rho_c \sigma_1^2) + \gamma_2^2 (-2 + \rho_c (\sigma_1^2 + \sigma_2^2))). \]  \hspace{1cm} (A3)

To obtain the optimal commission rates, we replace the agent’s optimal effort strategies, \( v^* = \gamma_2 \) and \( u^* = \gamma_1 + \gamma_2 \), as well as \( y_0^* \), in the expression of the firm’s expected profit at Stage 1, and then we optimize the resulting expression with respect to \( y_1^* \) and \( y_2^* \), such that

\[ \{y_1^*, y_2^*\} = \text{ArgMax}_{(y_1,y_2)} u^* + v^* - (y_0^* + \gamma_1 (u^*) + \gamma_2 (u^* + v^*)). \]  \hspace{1cm} (A4)

We find that \( (y_1^*, y_2^*) = \left( \frac{\rho_c \times (\sigma_2^2 - \sigma_1^2)}{(1 + \rho_c \sigma_1^2) \times (1 + \rho_c \sigma_2^2)}, \frac{1}{1 + \rho_c \sigma_2^2} \right) \), which is a maximum, because \( \frac{\partial^2 E(H)}{\partial y_1^2} = -(1 + \rho_c \sigma_1^2) < 0 \) and \( \frac{\partial^2 E(H)}{\partial y_1^2} \frac{\partial^2 E(H)}{\partial y_2^2} - \frac{\partial^2 E(H)}{\partial y_2^2} \frac{\partial^2 E(H)}{\partial y_1^2} \frac{\partial^2 E(H)}{\partial y_1^2} = (1 + \rho_c \sigma_1^2)(1 + \rho_c \sigma_2^2) > 0 \). Replacing the optimal commission rates in the firm’s expected profit, we find that in equilibrium, \( E(H_c) = \frac{1}{2} \left( \frac{1}{1 + \rho_c \sigma_1^2} + \frac{1}{1 + \rho_c \sigma_2^2} \right) - U_c^0 \).

Proof of Proposition 2: Similar to the proof of Proposition 1, we proceed backward and first characterize the optimal effort strategy of the sales rep at the lead conversion stage, such that

\[ v^* = \text{ArgMax}_v \ \beta_0 + \beta_1 x_1 + \beta_2 (x_1 + v) - \frac{v^2}{2} - \frac{\rho_c}{2} (\beta_2 \sigma_2)^2, \]  \hspace{1cm} (A5)
which yields $\nu^* = \beta_2$ with $\frac{\partial^2 E(\nu)}{\partial \nu^2} < 0$. We then replace $\nu$ by $\nu^*$ in the marketer’s utility function certainty equivalent to obtain the optimal lead generation effort strategy:

$$u^* = \arg\max_u \alpha_0 + \alpha_1 u + \alpha_2 (\beta_2 + u) - \frac{u^2}{2} - \frac{\rho_m}{2} \left((\alpha_1 + \alpha_2)^2 + (\alpha_2 \sigma_2)^2\right), \quad (A6)$$

and we obtain $u^* = \alpha_1 + \alpha_2$ with $\frac{\partial^2 E(u_m)}{\partial u^2} < 0$. We replace the optimal effort strategies in the agents’ expected utilities at Stage 2 of the game and solve for the fixed salaries, $\alpha_0$ and $\beta_0$, that guarantee the agents’ participation:

$$\alpha_0^* = U_m^0 + \frac{(\alpha_1 (\alpha_1 + 2 \alpha_2) (-1 + \rho_m \sigma_1^2) + \alpha_2 (-1 + \rho_m (\sigma_1^2 + \sigma_2^2) - 2 \beta_2))}{2}, \quad (A7)$$

and

$$\beta_0^* = U_s^0 + \frac{(-2 (\alpha_1 + \alpha_2) (\beta_1 + \beta_2) + \beta_1 (\beta_1 + 2 \beta_2) \rho_s \sigma_1^2 + \beta_2^2 (-1 + \rho_s) (\sigma_1^2 + \sigma_2^2))}{2}. \quad (A8)$$

Next, we replace the optimal effort strategies, as well as the agents’ fixed salaries in the firm’s expected profit at Stage 1, such that

$$E(II) = -\alpha_0^* - \beta_0^* + (\alpha_1 + \alpha_2)(1 - \alpha_1 - \beta_1 - \alpha_2 - \beta_2) + \beta_2 (1 - \alpha_2 - \beta_2). \quad (A9)$$

To obtain the results for the Kotler plan, we set $\alpha_1 = \beta_1 = 0$ in Equation (A9), then optimize the resulting expression with respect to $\alpha_2$ and $\beta_2$, such that

$$(\alpha_2^K; \beta_2^K) = \left(\frac{1}{1 + \rho_m (\sigma_1^2 + \sigma_2^2)}; \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)}\right), \quad (A10)$$

which is a maximum, because $\frac{\partial^2 E(II)}{\partial \alpha_2^2} = -(1 + \rho_m (\sigma_1^2 + \sigma_2^2)) < 0$ and

$$\frac{\partial^2 E(II)}{\partial \alpha_2^2} \frac{\partial^2 E(II)}{\partial \beta_2^2} - \frac{\partial^2 E(II)}{\partial \alpha_2 \partial \beta_2} \frac{\partial^2 E(II)}{\partial \alpha_2 \partial \beta_2} = (1 + \rho_m (\sigma_1^2 + \sigma_2^2))(1 + \rho_s (\sigma_1^2 + \sigma_2^2)) > 0.$$

Replacing the optimal commission rates in the firm’s expected profit yields $E(II_K) = \frac{1}{2} \times \left(\frac{1}{1 + \rho_m (\sigma_1^2 + \sigma_2^2)} + \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)}\right) - U_m^0 - U_s^0$. Similarly, under the ZS plan, the optimal commission rates result from setting $\alpha_2 = \beta_1 = 0$ in Equation (A9) and then optimizing the resulting expression with respect to $\alpha_1$ and $\beta_2$:

$$(\alpha_1^{ZS}; \beta_2^{ZS}) = \left(\frac{1}{1 + \rho_m \sigma_1^2}; \frac{1}{1 + \rho_s (\sigma_1^2 + \sigma_2^2)}\right), \quad (A11)$$

which is a maximum, because $\frac{\partial^2 E(II)}{\partial \alpha_1^2} = -(1 + \rho_m \sigma_1^2) < 0$ and

$$\frac{\partial^2 E(II)}{\partial \alpha_1^2} \frac{\partial^2 E(II)}{\partial \beta_2^2} - \frac{\partial^2 E(II)}{\partial \alpha_1 \partial \beta_2} \frac{\partial^2 E(II)}{\partial \beta_2 \partial \alpha_1} = (1 + \rho_m \sigma_1^2)(1 + \rho_s (\sigma_1^2 + \sigma_2^2)) > 0.$$
expected profit yields $\mathbb{E}(\Pi_{2S}) = \frac{1}{2} \times \left( \frac{1}{1+\rho_m \sigma_1^2} + \frac{1}{1+\rho_s (\sigma_1^2 + \sigma_2^2)} \right) - U_m^0 - U_s^0$. Finally, for the optimal commission rates under the proposed plan, we do not restrict any commission rate to be 0 and optimize the firm’s expected profit with respect to $\alpha_1, \alpha_2, \beta_1$ and $\beta_2$. As a result,

$$
(\alpha_1^*, \alpha_2^*) = \left( \frac{1}{1+\rho_m \sigma_1^2} ; 0 \right)
$$

and

$$
(\beta_1^*, \beta_2^*) = \left( -\frac{1}{1+\rho_s \sigma_2^2} ; \frac{1}{1+\rho_s \sigma_2^2} \right),
$$

which characterizes a maximum because the Hessian has three negative eigenvalues and one 0 eigenvalue. Replacing the optimal commission rates in the expected profit yields the optimal profit for the decentralized structure, or $\mathbb{E}(\Pi_D) = \frac{1}{2} \times \left( \frac{1}{1+\rho_m \sigma_1^2} + \frac{1}{1+\rho_s \sigma_2^2} \right) - U_m^0 - U_s^0$.

**Proofs Section 5:** To characterize the equilibrium under the decentralized structure when the quality of leads is noisy, we proceed backward and start with the characterization of the sales rep’s optimal effort strategy. At this stage, the only information that the sales rep has with respect to the volume of quality leads is the result of the noisy scoring model, $y = x_1 + \epsilon_y$, and $\epsilon_y \sim \mathcal{N}(0, \sigma_y^2)$ is the noise corrupting the qualification process. With this information, the sales rep estimates the volume of quality leads. Specifically, before observing $y$, the sales rep’s prior is $x_1 \sim \mathcal{N}(u, \sigma_1^2)$, and $u$ is the sales rep’s conjecture about the marketer’s effort. After observing the signal $y$ and before expending effort, the sales rep derives an estimate of $x_1$, or $\hat{x}_{1,s} = u + \frac{\sigma_1^2}{\sigma_1^2 + \sigma_y^2} \times (y - u)$ (e.g., Ljungqvist and Sargent 2004, p.161). Then the sales rep chooses an optimal effort strategy,

$$
\nu^* = \text{ArgMax}_\nu \quad \beta_0 + \beta_1 x_1 + \beta_2 (\hat{x}_{1,s} + \nu) - \frac{\nu^2}{2} - \frac{\rho_s}{2} (\beta_2 \sigma_2)^2,
$$

which yields $\nu^* = \beta_2$ with $\frac{\partial^2 \mathbb{E}(U)}{\partial \nu^2} < 0$. We replace $\nu$ by $\nu^*$ in the marketer’s utility function certainty equivalent to obtain the optimal lead generation effort strategy. To this end, we note that before observing $y$, the marketer’s prior about the volume of quality leads is $x_1 \sim \mathcal{N}(u^*, \sigma_1^2)$, and $u^*$ is the actual choice of the marketer. After observing $y$, the marketer’s estimation of the volume of quality leads is $\hat{x}_{1,M} = u^* + \frac{\sigma_1^2}{\sigma_1^2 + \sigma_y^2} \times (y - u^*)$. Thus, at the lead generation stage, the marketer’s optimal effort strategy is characterized by

$$
u^* = \text{ArgMax}_u \quad a_0 + a_1 u + a_2 (\nu^* + u) - \frac{u^2}{2} \frac{\rho_m}{2} \text{Var}(S_m(y, x_2)),
$$

41
where the compensation risk is $\text{Var}(S_m(y, x_2)) = \left(\alpha_1 + \alpha_2 \frac{\sigma^2_1}{\sigma^2_1 + \sigma^2_2} \right)^2 \left(\sigma^2_1 + \sigma^2_2\right) + \alpha_2^2 \sigma^2_2$. As a result, we obtain $u^* = \alpha_1 + \alpha_2$, which is a maximum. Replacing the optimal strategies in the marketer’s expected utility function at the time of contracting, we find that the fixed salary that guarantees participation is:

$$
\alpha^*_0 = u^0_m - \frac{(\alpha_1 + \alpha_2)^2}{2} - \alpha_2 \beta_2 + \frac{\rho_m}{2} \left(2\alpha_1\alpha_2\sigma^2_1 + \alpha_2^2 (\sigma^2_1 + \sigma^2_2) + \alpha_2^2 \left(\sigma^2_2 + \frac{\sigma^4_1}{\sigma^4_1 + \sigma^4_2}\right)\right),
$$

To determine the sales rep’s fixed salary at Stage 2, and given the information structure of the game, we assume that the sales rep perfectly anticipates the marketer’s optimal effort strategy, such that $\bar{u} = u^* = \alpha_1 + \alpha_2$. As a result,

$$
\beta^*_0 = u^0_s - \frac{\beta^2_2}{2} - (\alpha_1 + \alpha_2) (\beta_1 + \beta_2) + \frac{\rho_s}{2} \left(2\beta_1\beta_2\sigma^2_1 + \beta_2^2 (\sigma^2_1 + \sigma^2_2) + \beta_2^2 \left(\sigma^2_2 + \frac{\sigma^4_1}{\sigma^4_1 + \sigma^4_2}\right)\right).
$$

Next, we replace the optimal effort strategies and fixed salaries in the firm’s expected profit and optimize the resulting expression with respect to the commission rates, so

$$
(\alpha^*_1; \alpha^*_2) = \left(\frac{\sigma^2_2 \sigma^2_1 (\sigma^2_2 - \sigma^2_1)}{z}; \frac{\sigma^2_1 (\sigma^2_1 + \sigma^2_2)}{z}\right),
$$

and

$$
(\beta^*_1; \beta^*_2) = \left(-\frac{\sigma^2_1}{(1 + \rho_s \sigma^2_1)(\sigma^2_1 + \sigma^2_2)}; \frac{1}{(1 + \rho_s \sigma^2_2)}\right),
$$

respectively, where $z = \sigma^2_2 \left(\sigma^2_1 (1 + \rho_m \sigma^2_1) + \sigma^2_2 (1 + 2 \rho_m \sigma^2_1)\right) + \sigma^4_1 (1 + \rho_m \sigma^2_1)$. It again characterizes a maximum, because the Hessian has three negative eigenvalues and one 0 eigenvalue. Replacing the optimal effort strategies and commission rates in the firm’s expected profit, we find that at the equilibrium, the optimal expected profit under a decentralized structure with a noisy qualification process is $\mathbb{E}(P_D | \sigma_y \neq 0) = \frac{(\sigma^2_1 + \sigma^2_2) \sigma^2_1 (2 + \rho_m \sigma^2_1 + \rho_s \sigma^2_2) + \sigma^2_1 (2 + \rho_m \sigma^2_1) \sigma^2_2}{2(1 + \rho_s \sigma^2_2)}$.

The characterization of the equilibrium under a centralized structure when the volume of quality leads is not perfectly observed proceeds in a similar fashion. Assuming that the agent’s compensation plan is $S_c(y, x_2) = \gamma_0 + \gamma_1 y + \gamma_2 x_2$, the optimal lead generation and lead conversion efforts by the agent are $u^* = \gamma_1 + \gamma_2$ and $v^* = \gamma_2$, respectively. The salary level that ensures the agent’s participation is:

$$
\gamma^*_0 = \frac{1}{2} \left(-\gamma_1 + \gamma_2\right)^2 + \gamma_2^2 + \rho_c \left(2\gamma_1 \gamma_2 \sigma^2_1 + \gamma_1^2 (\sigma^2_1 + \sigma^2_2) + \gamma_2^2 \left(\sigma^2_2 + \frac{\sigma^4_1}{\sigma^4_1 + \sigma^4_2}\right)\right).
$$

As a result, the maximization of the firm’s expected profit is:
\[
\gamma_1^* = \frac{\rho_c \left( \sigma_2^2 - 2 \sigma_1^2 + \frac{\sigma_1^4}{\sigma_1^2 + \sigma_2^2} \right)}{1 + \rho_c \left( 2 \sigma_2^2 + \frac{\sigma_1^4}{\sigma_1^2 + \sigma_2^2} + \sigma_2^2 \left( 1 + \rho_c (\sigma_1^2 + \sigma_2^2) \right) \right)}
\]

and

\[
\gamma_2^* = \frac{\left( \sigma_1^2 + \sigma_2^2 \right) \left( 1 + \rho_c (\sigma_1^2 + \sigma_2^2) \right)}{\sigma_1^2 (1 + \rho_c \sigma_1^2)(1 + \rho_c \sigma_2^2) + (1 + 2\rho_c \sigma_1^2)(1 + \rho_c \sigma_2^2) \sigma_2^2 + \rho_c (2 + \rho_c \sigma_2^2) \sigma_1^4}
\]

Replacing the optimal commission rates in the firm’s expected profit, we obtain the equilibrium expected profit under a centralized structure when the volume of quality leads is not perfectly observed:

\[
\mathbb{E}(\Pi_c | \sigma_y \neq 0) = \frac{\sigma_1^2 (2 + \rho_c (\sigma_1^2 + \sigma_2^2)) + (2 + \rho_c (4\sigma_1^2 + \sigma_2^2)) \sigma_2^2 + 4\rho_c \sigma_2^4}{2(\sigma_1^2 (1 + \rho_c \sigma_1^2)(1 + \rho_c \sigma_2^2) + (1 + 2\rho_c \sigma_1^2)(1 + \rho_c \sigma_2^2) \sigma_2^2 + \rho_c (2 + \rho_c \sigma_2^2) \sigma_1^4})
\]

Let define \( Q = \mathbb{E}(\Pi_D | \sigma_y \neq 0) - \mathbb{E}(\Pi_c | \sigma_y \neq 0), \) with \( \rho_c = \rho_m = \rho_s = \rho \) and \( U_c^0 = U_m^0 = U_s^0 = 0. \)

\( Q > 0 \) when \( 0 < \sigma_2^2 < \frac{-\eta_1 + \sqrt{\eta_1^2 + \eta_3}}{\eta_3}, \) where \( \eta_1 = \sigma_2^2 + 2 \left( \rho (\sigma_1^4 + \sigma_2^4) + \sigma_1^2 (1 + \rho \sigma_2^2) \right), \eta_2 = 4\rho^2 \sigma_1^8 + 8\rho \sigma_1^6 (1 + 2\rho \sigma_2^2) + \sigma_1^4 (1 + 2\rho \sigma_2^2)^2 + 4\sigma_1^2 \sigma_2^2 (1 + 3\rho \sigma_2^2 + 2\rho^2 \sigma_3^2) + 4\sigma_1^4 (1 + 5\rho \sigma_2^2) \) and \( \eta_3 = 4\rho (\sigma_1^2 + \sigma_2^2) \left( 1 + \rho (\sigma_1^2 + \sigma_2^2) \right). \)

**Proof for Section 6.1:** We first analyze the decentralized structure. Starting with the lead conversion stage and given the LEN structure of the game, the sales rep’s utility certainty equivalent at this stage is such that the optimal effort is determined by

\[
v^* = \text{ArgMax}_v \beta_0 + \beta_1 x_1 + \beta_2 v \sqrt{x_1} - \frac{v^2}{2} - \frac{\rho}{2} (\beta_2 \sigma_2)^2,
\]

which gives \( v^* = \beta_2 \sqrt{x_1} \) with \( \frac{\partial^2 U_s}{\partial v^2} = -1 < 0. \) For parsimony, we assume \( \rho_M = \rho_S = \rho_C = \rho. \)

When we replace the sales rep’s optimal effort strategy in the marketer’s utility certainty equivalent at the lead generation stage,

\[
u^* = \text{ArgMax}_u \alpha_0 + \alpha_1 u + \alpha_2 \beta_2 u - \frac{u^2}{2} - \frac{\rho}{2} \left( (\alpha_1 + \alpha_2 \beta_2) \sigma_1 \right)^2 + (\alpha_2 \sigma_2)^2.
\]
At this stage, $x_1$ is treated as a random variable, so the marketer treats $v$ as $v^* = \beta_2 \sqrt{u + \epsilon_1}$.

Differentiating Equation (A21) with respect to $u$ indicates that $u^* = \alpha_1 + \alpha_2 \beta_2$, which is a maximum, because $\frac{\partial^2 u_m}{\partial u^2} = -1 < 0$. We then replace $v^* = \beta_2 \sqrt{u^* + \epsilon_1}$ and $u^* = \alpha_1 + \alpha_2 \beta_2$ in the marketer’s utility certainty equivalent and solve for $\alpha_0$, such that $\alpha_0 + \alpha_1 u^* + \alpha_2 \beta_2 u^* - \frac{u^2}{2} - \frac{\rho}{2} \left( (\alpha_1 + \alpha_2 \beta_2) \sigma_1 \right)^2 + (\alpha_2 \sigma_2)^2 = 0$, which gives:

$$\alpha_0 = -\frac{(1 - \rho \sigma_1^2)(\alpha_1 + \alpha_2 \beta_2)^2 + \rho (\alpha_2 \sigma_2)^2)}{2}. \quad (A22)$$

To obtain the sales rep’s salary ($\beta_0$) that meets the IR condition, we note that $\text{Var}(S_0(x_1, x_2)) = (\beta_1 + \frac{\beta_2^2}{2}) \sigma_1^2 + (\beta_2 \sigma_2)^2$, and at this stage, the sales rep’s utility certainty equivalent $U_s^{CE}$ is:

$$\beta_0 + (\beta_1 + \alpha_2 \beta_2)(\alpha_1 + \alpha_2 \beta_2) - \frac{\beta_2^2}{2}(\alpha_1 + \alpha_2 \beta_2)^2 - \frac{\rho}{2} \left( (\beta_1 + \frac{\beta_2^2}{2}) \sigma_1 \right)^2 + (\beta_2 \sigma_2)^2 \right)^2, \quad (A23)$$

so the sales rep’s salary should be:

$$\beta_0 = \left(2 \beta_1 + \beta_2^2\right)(-4(\alpha_1 + \alpha_2 \beta_2) + (2 \beta_1 + \beta_2^2) \rho \sigma_1^2) + 4 \rho (\beta_2 \sigma_2)^2) / 8. \quad (A24)$$

Taking the agents’ IC and IR conditions, the principal chooses optimal commission rates to maximize the firm’s expected profit, which yields two possible equilibria: $(\alpha_1; \alpha_2; \beta_1; \beta_2) = \left(\frac{1}{1 + \rho \sigma_1^2} \times \frac{(2 - \beta_2) \beta_1}{2} \times 0; -\frac{\beta_2^2}{2}; \frac{3 + \Delta}{2}\right)$ and $(\alpha_1^*; \alpha_2^*; \beta_1^*; \beta_2^*) = \left(\frac{1}{1 + \rho \sigma_1^2} \times \frac{(2 - \beta_2) \beta_1}{2} \times 0; -\frac{\beta_2^2}{2}; \frac{3 - \Delta}{2}\right)$, with $\Delta = \sqrt{1 + 8 \rho (1 + \rho \sigma_1^2) \sigma_2^2}$. The second candidate point satisfies $\beta_2 < 1$ and is an optimum. As a result, in equilibrium, $(u^*, v^*) = \left(\frac{1}{1 + \rho \sigma_1^2} \times \frac{(2 - \beta_2) \beta_1}{2} \times \beta_2^* \sqrt{x_1}\right), \mathbb{E}(x_1) = u^*$, and $\mathbb{E}(x_2) = \beta_2^* u^* = \frac{1}{1 + \rho \sigma_1^2} \times \frac{(2 - \beta_2) \beta_1^*}{2} \frac{2}{2} + \frac{\rho \sigma_1^2}{2} \left(\frac{A - \frac{5}{2} - \rho (1 + \rho \sigma_1^2) \sigma_2^2}{2}\right)$.

Finally, $\mathbb{E}(\Pi^*) = \frac{1 + \Delta}{16(1 + \rho \sigma_1^2)} + \frac{\rho \sigma_1^2}{2} \left(\frac{A - \frac{5}{2} - \rho (1 + \rho \sigma_1^2) \sigma_2^2}{2}\right)$.

Next, we characterize the equilibrium under a centralized structure. The agent’s optimal effort strategy is determined by

$$v^* = \text{ArgMax}_v \gamma_0 + \gamma_1 x_1 + \gamma_2 v \sqrt{x_1} - \frac{v^2}{2} - \frac{\rho}{2} (\gamma_2 \sigma_2)^2, \quad (A25)$$

so $v^* = \gamma_2 \sqrt{x_1}$, which is a maximum, because the second derivative of the agent’s utility certainty equivalent with respect to $v$ equals -1. We replace $v$ by $v^* = \gamma_2 \sqrt{u + \epsilon_1}$ in the agent’s utility certainty equivalent at the lead generation stage, such that $\gamma_0 + \gamma_1 u + \gamma_2^2 u - \frac{u^2}{2} - \frac{v^2}{2} = \gamma_2 \sqrt{x_1}.$
\[ \frac{\rho}{2} \left( \left( y_1 + \frac{y_2}{2} \right)^2 + (y_2 \sigma_2)^2 \right), \]

which we differentiate once to obtain the first-order condition,

\[ u^* = y_1 + \frac{y_2^2}{2}, \]

and twice to obtain the second-order condition that confirms \( u^* = y_1 + \frac{y_2^2}{2} \) is a maximum. We replace the optimal strategies of the agent in the utility function certainty equivalent, which we equate to 0 by solving for \( y_0 \) to obtain the salary that guarantees the IR condition,

\[ y_0 = \frac{(4\rho - (1 - \rho \sigma_1^2)(2y_1 + y_2^2))^2}{8}. \]

Next, we replace the agent’s optimal effort strategies and fixed salary in the firm’s expected profit, which we optimize with respect to \( y_1 \) and \( y_2 \). The result of these efforts is three candidate points, \((y_1, y_2) = (0, 0), (y_1, y_2) = \left( \frac{1}{1 + \rho \sigma_1^2} \times \frac{y_2(2 - y_2(2 + \rho \sigma_1^2))}{2}, \frac{3 - \Delta}{2} \right), \)

and \((y_1, y_2) = \left( \frac{1}{1 + \rho \sigma_1^2} \times \frac{y_2(2 - y_2(2 + \rho \sigma_1^2))}{2}, \frac{3 - \Delta}{2} \right). \)

The first candidate point is not feasible, because it would imply zero effort; neither is the second candidate point, which would yield a sales commission greater than 1. Only the last candidate point is feasible, in that it ensures the sales commission is less than 1 and is an optimum. As a result, in equilibrium,

\[ (u^*, v^*) = \left( \frac{1}{1 + \rho \sigma_1^2} \times \frac{(2 - y_2^2)\rho \sigma_1^2}{2}, y_2^* \sqrt{\gamma_1} \right). \] (A26)

Finally, by replacing the optimal strategies in the firm’s expected profits under both structures, we find that under the multiplicative sales response function,

\[ \mathbb{E}(\Pi_D^*) = \mathbb{E}(\Pi_C^*) = \frac{1 + \Delta}{16(1 + \rho \sigma_1^2)} + \frac{\rho \sigma_1^2}{2} \left( \Delta - \frac{5}{2} - \rho (1 + \rho \sigma_1^2) \sigma_2^2 \right). \] (A27)
Appendix B: Multiplicative Sales Response Function

We detail the numerical analyses conducted to investigate the optimal strategies, for which

\[ x_2 = x_1^\varphi v + \varepsilon_2, \]

where \(0 < \varphi < 1\). We proceed backward and first characterize the sales rep’s optimal effort strategy under this specification, \(v^* = \beta_2 x_1^\varphi\), which is an optimum given the second-order condition. We need to replace \(v^*\) in the marketer’s utility function certainty equivalent, which requires evaluating the mean, the variance, and \((u + \varepsilon_1)^2\varphi\). Therefore, we apply a Taylor’s expansion of \((u + \varepsilon_1)^2\varphi\) around \(\mathbb{E}(\varepsilon_1)\) to obtain \((u + \varepsilon_1)^2\varphi \approx u^{2\varphi} + 2u^{-1+2\varphi} \varphi \varepsilon_1\). In turn, \(\mathbb{E}((u + \varepsilon_1)^2\varphi) \approx u^{2\varphi}\), and \(\text{Var}(u^{2\varphi}) \approx 4u^{-2+4\varphi} \varphi^2 \sigma_1^2\). We solve for the marketer’s optimal effort strategies, the IR conditions of both agents, and the firm’s optimal commission rate numerically. When \(\varphi = 1/2\), the numerical results are identical to the analytical results, as it should be. In Table B1, we report the optimal commission rates obtained under the decentralized structure with \(\sigma_1 = 1/4\), \(\sigma_2 = 1/4\), \(\rho = 1/2\) as examples.

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Table B1: Optimal Commission Rates for Different Values of \(\varphi\)

These numerical analyses confirm that \(\alpha_1^* > 0\), \(\alpha_2^* \approx 0\), \(\beta_1^* < 0\), and \(\beta_2^* > 0\). Furthermore, we find that \(\mathbb{E}(\Pi_D) > 0\) and \(\mathbb{E}(\Pi_C) = \mathbb{E}(\Pi_D)\). Similar findings result with different parameter values.