Efficient Contracting in a Market for Life Insurance Agents with Asymmetric Information

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Abstract

The incentive conflict between the life insurance firm and its agents is examined. Conditions for first-best contracting in a symmetrically informed environment entail a fixed wage payment by the firm. In contrast, when the firm is constrained by both the uncertainty of consumer demand and the allocation of effort by the agent, a high commission rate for new policies sold and a low commission rate for policies renewed is an efficient contractual arrangement between the firm and its agents, if and only if an agent's effort is more productive when directed at increasing the expected flow of revenue from new rather than renewal customers. The prediction of the model is consistent with the contractual arrangements currently observed in the life insurance industry, where customers are "locked-in" by a renewal premium lower than the premium for a new customer who otherwise has the same characteristics.

A positive theory of the insurance firm based on the economic theory of agency was developed by Mayers and Smith (1981) who suggest that different contractual arrangements among owners, managers, agents, and policyholders arise as efficient outcomes when there are costs to controlling incentive conflicts among them. One component in the structure of the life insurance firm yet to be investigated rigorously is the incentive conflict between the life insurer and its sales representatives.[1] Of particular interest in this article is the solution reached between conflicting parties over the allocation of effort to alternative search tasks and the commission rates embodied in the incentive compensation agreement or commission contract offered to agents by insurers.

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[1] Kim, Mayers, and Smith (1990) develop and test a set of predictions based on agency theories of contracting between insurance firms and their policy writers. Our analysis formalizes some aspects of their discussion, which focuses on the property-liability industry.

Commission contracts in the life insurance industry compensate agents for their efforts by a high commission rate for new policies sold and a relatively low commission rate for policies renewed by present policyholders.[2] The literature, however, does not offer a complete explanation for this disparity in commission rates between new and renewal policies. The traditional argument holds that consumers are more hesitant to demand life insurance than other kinds of insurance. Consequently, life insurance agents are believed to need extra incentive to serve their more reluctant buyers. However, the incentive contracts faced by insurance agents must depend on the relative effectiveness of an agent's search activity within a given line of insurance, not across alternative lines. Thus, the traditional argument neglects an important dimension of the problem.

It is shown that the observed characteristics of commission contracts in life insurance are efficient for a firm confronting moral hazard with its agents under conditions such that an agent's effort is more productive when allocated to enhancing the flow of net revenue from new rather than renewal customers. In the life insurance market, a renewal customer faces a premium that is more favorable than the premium for a new policy. Thus, searching for new customers is more cost effective than searching for renewal customers because of this "lock-in" effect which is absent from other kinds of insurance.

The following section sets out the economic environment from which a model of contracting between the life insurance firm and its agents is constructed. A proposition for first-best contracting under symmetric information is expressed and examination of the moral hazard problem confronted by the life insurance firm under asymmetric information is undertaken. In the third section conditions for efficient contracting are derived and the more general applicability of our model to the property-liability industry is discussed.

The Model

The levels of search activity for new and renewal customers are denoted by k_1 and k_2, respectively. The new and renewal premium flows, net of expected death claims, resulting from the agent's choice of k_1 and k_2 are random and given by $F(\theta,k_1)$ and $\hat{F}(\hat{\theta},\alpha k_1,\beta k_2)$, respectively, where θ and $\hat{\theta}$ indicate the intensity of demand for life insurance by new and renewal customers. Increases in k_1 and k_2 cause first-order stochastic dominance shifts in the revenue distributions. The term αk_1 captures any indirect effect that search for new customers might have on the renewal premium flow. The parameter β indicates the productivity of k_2 relative to k_1 in enhancing revenue flows. The parameters α and β are assumed to satisfy $0 \leq \alpha < 1$ and $0 < \beta \leq 1$. The

[2] Dorfman (1976) provides a discussion of life insurance compensation plans, and more recent data on life insurance agent compensation is contained in the *Handbook of Agents Ordinary Life and Health Contracts* published by the Life Insurance Marketing and Research Association (LIMRA).

demand intensities θ and $\hat{\theta}$ are random variables for both the risk averse agent and the risk neutral life insurer.

A moral hazard problem arises in this environment when the levels of search chosen by the agent can be neither observed nor inferred by the insurer. Since the search activity of the agent affects the welfare of both the insurer and the agent, a conflict of interest arises between them if the agent's utility maximizing levels of search activity are not the same as those which maximize the value of the insurer. Thus, of interest is the optimal commission contract between the life insurer and the insurance agent when the level of search activity employed by the agent is unobservable by the insurer and uncertainty about the consumer demand for insurance precludes its being inferable *ex post*.

Symmetric Information and First-Best Contracting

As a standard of reference for gauging the moral hazard problem, suppose that an insurer could costlessly observe the levels of search activity, k_1 and k_2, employed by the agent. In that event, commission contracts that depend solely on θ and $\hat{\theta}$ are feasible. An efficient contractual arrangement can be characterized as a pair of commission contracts and a pair of search activity levels that maximize expected profits for the insurer, subject to the agent receiving a minimum expected utility. A first-best commission contract provides an optimal trade-off between the benefits of risk sharing between the insurer and its agents and the costs of providing an incentive to the agent to undertake costly search activity.

More formally, assume that the first-year and renewal commissions are functions of the net premium flows, i.e., $r_1(F(\theta,k_1))$ and $r_2(\hat{F}(\hat{\theta}, \alpha k_1, \beta k_2))$, respectively. The optimal commission contract $[r_1^*(\cdot),k_1^*;\ r_2^*(\cdot),k_2^*]$ maximizes the insurer's expected profits for a given level of the agent's expected utility. Since k_1 and k_2 are chosen before the respective demand intensities are known, k_1^* and k_2^* do not depend on θ and $\hat{\theta}$. With a risk neutral insurer and a risk averse agent, optimal risk sharing entails a fixed wage for the agent while the insurer bears all the risk. Thus, the first-best efficiency program calls for the insurer to choose k_1, k_2, and wages w to maximize expected profits subject to the agent's participation constraint:

$$\max E[\Pi] = \int\int \{F(\hat{\theta},k_1) + \hat{F}(\hat{\theta},\alpha k_1, \beta k_2)\}\, g(\theta)\hat{g}(\hat{\theta})d\theta d\hat{\theta} - w$$

s.t.

$$u(w) - C(k_1,k_2) \geq u^\circ$$

where $g(\cdot)$ and $\hat{g}(\cdot)$ denote the probability density functions for demand intensities, and $C(\cdot)$ is the agent's cost function for search activities. The agent's utility is assumed to be separable in search costs, while the utility of wealth function, $u(\cdot)$, is assumed to be strictly concave, reflecting risk aversion.

The first-order necessary conditions for an interior optimum imply that the ratio of marginal benefits of search activity for the insurer equals the corresponding ratio of the marginal costs of search activity for the agent,

$$\frac{EF_k(\theta,k_1^*) + \alpha E\hat{F}_k(\hat{\theta},\alpha k_1^*,\beta k_2^*)}{\beta E\hat{F}_k(\hat{\theta},\alpha k_1,\beta k_2^*)} = \frac{C_1(k_1^*,k_2^*)}{C_2(k_1^*,k_2^*)} \tag{1}$$

where $F_k = \partial F/\partial k$ and $C_i = \partial C/\partial k_i$. For the case in which an increase in k_i induces an additive shift of the net revenue functions and the intensity distributions are identical so that $g(\cdot) = \hat{g}(\cdot)$, the marginal condition in (1) implies that the ratio of marginal costs equals $\beta/(1+\alpha)$, or

$$C_2/\beta = C_1/(1+\alpha). \tag{2}$$

Thus, if $\alpha = 0$ and $\beta = 1$, then the optimal allocation of effort equates the marginal costs of search. When the cost function is separable and quadratic, k_1 exceeds k_2 if and only if $C_{22} < \beta C_{11}$ when $\alpha = 0$. Since units of new and renewal search activity have the same effect on their respective revenue flows, the condition $C_{22} > \beta C_{11}$ means that k_1 is more cost effective than k_2 in enhancing these flows because either $C_{22} > C_{11}$ or $\beta < 1$. In general, the marginal cost of k_2 is optimally equated to the marginal cost of k_1, deflated by the relative productivity of k_1 as a substitute for k_2 in producing renewal revenue. As a result, under first-best contracting, k_1 exceeding k_2 can be explained by k_1 being more productive than k_2 either directly or through its effect on renewal revenues.

A solution to the first-best efficiency problem entails levels of search activity, k_1^* and k_2^*, that are optimal from the point of view of the agent given the optimal commission functions, $r_1^*(\cdot)$ and $r_2^*(\cdot)$, that generate the appropriate wages,

$$r_1^*(F(\theta,k_1^*)) + r_2^*(\hat{F}(\hat{\theta},\alpha k_1^*, \beta k_2^*) = w^*. \tag{3}$$

Any first-best contract between a life insurer and its agents specifies this commission contract in exchange for the agent choosing k_1^* and k_2^*. Since the agent receives fixed wages, this contract between the life insurer and the agent provides an incentive for the agent to choose $k_1 < k_1^*$ and $k_2 < k_2^*$. However, under the assumption of symmetric information, the life insurer may observe the levels k_1 and k_2 chosen by the agent, so that any commission contract can have an effective forcing clause under which the life insurer would pay some $r_1(\cdot) < r_1^*(\cdot)$ and $r_2(\cdot) < r_2^*(\cdot)$ *ex post* that is not preferred by the agent.

Asymmetric Information and a Moral Hazard Problem

When the insurer can neither observe the agent's level of search nor the demand intensities of customers, a moral hazard problem arises since the agent will not choose in a manner consistent with the insurer's best interest. This is seen by examining the agent's choice of k_1 and k_2 to solve the following expected utility maximization problem:

$$\max E[u(w)] - C(k_1,k_2)$$

where

$$w = r_1{}^*(F(\theta,k_1)) + r_2{}^*(\hat{F}(\hat{\theta},\alpha k_1, \beta k_2)). \tag{4}$$

The first-order necessary conditions for an interior optimum imply

$$E[u'w_1]/E[u'w_2] = C_1(k_1,k_2)/C_2(k_1, k_2) \tag{5}$$

where $w_i = \partial w/\partial k_i$. Condition (5) is inconsistent with the necessary condition for first-best given in equation (2). Specifically, $(k_1{}^*, k_2{}^*)$ cannot satisfy (5) since the left hand side is undefined at that point.[3] Hence, the agent is better off by choosing levels of search activity different from $(k_1{}^*, k_2{}^*)$ and the insurer confronts a moral hazard problem.

Asymmetric Information and Efficient Contracting

When the life insurer cannot observe either the level of search activity or the intensity of consumer demand, the commission contract offered to agents must be conditional on the net revenue flows since these are the only observable variables on which the contract can be made enforceably contingent. The general form of the second-best problem is to maximize the insurer's expected profit subject to the agent's participation constraint and the incentive constraint specified in equation (5) where the commission contract is a function of the net revenue flows. It is well known, however, that solutions to the second-best problem entail compensation schemes which are complex.

Attention is confined to a sub-class of the second-best problem wherein the levels of search activity result in additive shifts of the new and renewal net revenue functions by k_1 and $\alpha k_1 + \beta k_2$, respectively, and also assume that the insurer offers a piecewise linear incentive scheme.[4] Using the Mirrlees-Holmström transformation of variables procedure discussed in Holmström (1979), define $\phi(F_1)$ and $\hat{\phi}(F_2)$ as the probabilities that $F_1 = F(\theta,k_1)$ and $F_2 = \hat{F}(\hat{\theta},\alpha k_1,\beta k_2)$ as induced by the probabilities $g(\theta)$ and $\hat{g}(\hat{\theta})$, respectively. Then, the constrained efficiency program for the life insurer is

$$\begin{aligned} \max \{ E[\Pi] = {} & (1-r_1) \int (F_1+k_1)\, \phi(F_1)\, dF_1 \\ & + (1-r_2) \int (F_2+\alpha k_1+\beta k_2)\, \hat{\phi}(F_2)\, dF_2 \} - w \end{aligned}$$

s.t.

$$\begin{aligned} (r_1+\alpha r_2)\cdot \bar{u}' - C_1 &= 0 \\ \beta r_2 \cdot \bar{u}' - C_2 &= 0 \\ \bar{u} - C(k_1,k_2) &\geq u^\circ \end{aligned} \tag{6}$$

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[3] Since $r_1{}^*(\cdot)$ and $r_2{}^*(\cdot)$ satisfy (3), w is non-random when the agent chooses at $(k_1{}^*, k_2{}^*)$ and $\partial r_2{}^*(\hat{F}(\hat{\theta}, \alpha k_1{}^*, \beta k_2{}^*))/\partial k_2 = 0$ and $\partial r_1{}^*(F(\theta, k_1{}^*))/\partial k_1 = -\alpha \cdot \partial r_2{}^*(\hat{F}(\hat{\theta}, \alpha k_1{}^*, \beta k_2{}^*))/\partial k_1$ for all θ and $\hat{\theta}$. Hence, $E[u'w_1]/E[u'w_2] = E[w_1]/E[w_2] = \{E[\partial(r_1{}^*(F)]/\partial k_1\}/\{E[\partial(r_2{}^*(\hat{F})]/\partial k_2\} = -\alpha \cdot \{E[\partial(r_Z{}^* \cdot \hat{F})]\partial/k_1/0$, which is undefined.

[4] Restricting attention to a piecewise linear function is not unwarranted in the present context since such a function describes commission contracts in the life insurance industry as discussed by Dorfman (1976). Linear contracting may be a reaction to the administrative costs associated with more complicated non-linear contracts.

where,

$$\bar{u} = \int\int u(w+(F_1+k_1)\cdot r_1+(F_2+\alpha k_1+\beta k_2)\cdot r_2)\ \phi(F_1)\ \hat{\phi}(F_2)\ dF_1\ dF_2$$
$$\bar{u}' = \int\int u'\ \phi(F_1)\ \hat{\phi}(F_2)\ dF_1\ dF_2$$

for $i=1,2$. The first two constraints on the problem are the incentive constraints, which are the first-order conditions for the solution to the agent's maximization problem when an increase in k_i induces an additive shift of the net revenue function. The third constraint is the agent's participation constraint. Associating the multipliers λ, μ, and γ respectively with these constraints, the first-order conditions for the choice variables k_1, k_2, r_1, r_2, and w yield, respectively,

$$\lambda[(r_1+\alpha r_2)^2\bar{u}'' - C_{11}] + \mu[(r_1+\alpha r_2)\beta r_2\bar{u}'' - C_{12}] + \gamma[(r_1+\alpha r_2)\bar{u}' - C_1] = r_1 - 1 - \alpha(1-r_2) \tag{7}$$

$$\lambda[(r_1+\alpha r_2)\beta r_2\bar{u}'' - C_{12}] + \mu[\beta^2 r_2^2\bar{u}'' - C_{22}] + \gamma[\beta r_2\bar{u}' - C_2] = \beta(r_2-1) \tag{8}$$

$$-\bar{F}_1 + A\tilde{u}_1'' + \gamma\tilde{u}_1' + \lambda\bar{u}' + k_1[-1+A\bar{u}''+\gamma\bar{u}'] = 0 \tag{9}$$

$$-\bar{F}_2 + A\tilde{u}_2'' + \gamma\tilde{u}_2'' + \mu\beta\bar{u}' + \lambda\alpha\bar{u}' + (\beta k_2+\alpha k_1)[-1+A\bar{u}''+\gamma\bar{u}'] = 0 \tag{10}$$

$$-1 + A\cdot\bar{u}'' + \gamma\cdot\bar{u}' = 0 \tag{11}$$

where $C_{ij} = \partial^2C/\partial k_i\partial k_j$ for all $i,j = 1,2$, $\bar{F}_i = EF_i$ for $i = 1,2$, $\bar{u}''$ is the second derivative of the agent's expected utility function, $A = \lambda(r_1+\alpha r_2) + \mu\beta r_2$, and

$$\tilde{u}_i' = \int\int u'F_i\ \phi(F_1)\ \hat{\phi}(F_2)\ dF_1\ dF_2$$

$$\tilde{u}''_i = \int\int u''F_i\ \phi(F_1)\ \hat{\phi}(F_2)\ dF_1\ dF_2$$

for $i = 1,2$.

Using condition (11), the relations in (9) and (10) can be rearranged to obtain

$$\frac{EF_1(-1+Au''+\gamma u')}{EF_2(-1+Au''+\gamma u')} = \frac{\lambda}{\beta\mu+\alpha\lambda}. \tag{12}$$

Under the assumption that the distribution of ϕ differs from $\hat{\phi}$ by an additive shift, F_1 in equation (12) can be replaced with F_2 plus a constant and then (11) implies that the left hand side of (12) equals unity. As a result,

$$\mu\beta = \lambda\cdot(1-\alpha) \tag{13}$$

Thus, the shadow cost of the incentive constraint on k_1, discounted by its productivity as a gross substitute for k_2 in generating the renewal revenue flow, is equated to the shadow cost of the incentive constraint on k_2, discounted by its relative productivity.

Condition (13) for efficient contracting under moral hazard can be contrasted with the marginal condition given in equation (2) for first-best contracting. When $\alpha = 0$ and $\beta = 1$, the marginal costs of alternative search activities are equated under first-best contracting, while the constrained efficient, moral hazard contract equates the shadow costs of the incentive constraints which limit the insurer's control over the allocation of effort. When $\alpha > 0$ and/or $\beta < 1$, the marginal cost of search is discounted appropriately in the case of first-best contracting, while the shadow cost of the associated incentive constraint is correspondingly discounted under constrained efficient contracting.

The last term appearing on the left hand side of the first order conditions for optimal effort, equations (7) and (8), equals zero given the incentive constraints in equation (6). Combining equations (7) and (8) and substituting from (13), we obtain

$$\frac{1+\alpha-\lambda[C_{11}+C_{12}(1-\alpha)/\beta]}{\beta-\lambda[C_{12}+C_{22}(1-\alpha)/\beta]} = \frac{r_1}{\beta r_2} + \frac{\alpha}{\beta} \tag{14}$$

which reveals a fundamental result:

$$r_1 > r_2 \tag{15}$$

if and only if $(1-\alpha^2)C_{22}$ is greater than $\beta^2 C_{11}$. When $\alpha = 0$, the commission rate for new customers exceeds that for renewals if and only if C_{22} is greater than $\beta^2 C_{11}$.

Thus, ignoring the effect of α for the moment, it is concluded that it must be more cost effective, on average, for an insurer's agents to allocate their efforts toward enhancing the flow from new rather than from renewal customers. The market for life insurance is unique in this respect because of a particular intertemporal feature of the premium structure. Once insured, a customer faces a renewal premium that is (increasingly) more favorable than the premium for a new policy.[5] Whether the intertemporal sharing of risks or adverse selection better explains this premium structure, its effect is to create a precommitment by customers to renew.[6] For this reason, k_2 has a relatively small effect on renewal revenue flows.

To examine the effects of α, assume a quadratic cost function with k_1 and k_2 equally costly, so that $C_{11} = C_{22} =$ constant. In this event, equation (15) implies $r_1 > r_2$ if and only if $1-\alpha^2$ exceeds β^2. It follows that, when $\alpha > 0$ and $\beta = 1$, $r_1 < r_2$. Thus, the indirect effect of searching for new customers on renewal premium flow does not explain the observed structure of commission contracts in the life insurance industry.

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[5] see Kim, Mayers, and Smith (1990) for a discussion of this "lock- in" effect.

[6] The pool of new, older customers may contain a higher proportion of those who know they are high risk causing an adverse selection externality in the intertemporal sharing of risks. Notice that even if precommitment is perfect the agent's revenue flow is stochastic because of policyholder death risk. Therefore, to efficiently share this risk between the agent and the insurer, the insurer bears more of the risk by front-loading the commission contract.

Finally, the statement for efficient contracting in equation (14) is a useful interpretation of the relationship between property-liability firms and their agents where the "lock-in" effect is absent. In this case, $\alpha = 0$ and $\beta = 1$ implies $r_1 = r_2$ if and only if an agent's effort is equally costly whether the seeking new or renewal customers, as it is in the quadratic case with $C_{11} = C_{22}$. As observed by Kim, Mayers, and Smith (1990), a uniform commission rate structure is the typical underlying compensation scheme observed in the property-liability industry.[7]

Conclusion

Traditionally life insurance agents have been compensated by a substantially higher commission rate for new policies sold relative to the rate they receive when policies are renewed. This observation is paralleled by informational asymmetries confronting the life insurer concerning the intensity of consumer demand and the allocation of effort by the agent to enhancing new and renewal revenue flows. It has been shown that constrained efficient contracts reward an agent's performance at a higher rate when effort is directed at increasing the expected flow of revenue from new rather than renewal customers when effort directed toward the latter is less cost effective. It has also been shown that our model has a more general applicability to the property-liability industry. In sum, the results in this article support Mayers and Smith's (1981) general conjecture that differences in cost can explain the observed contractual control of incentive conflicts associated with the insurance firm.

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Mayers, David, and Clifford Smith, 1981, Contractual Provisions, Organizational Structure, and Conflict Control in Insurance Markets, *Journal of Business*, 54: 407–34.

[7] Kim, Mayers, and Smith (1990) argue that insurance agents selling non-life policies, who own the property rights to the expirations, force the insurer to provide the same compensation for new and renewal customers through the threat of policyholder switching.