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INFORMATION, SEARCH, AND PRICE VARIABILITY OF INDIVIDUAL LIFE INSURANCE CONTRACTS

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I. INTRODUCTION

The objective of this paper is to explain the observed price variability of individual life insurance contracts. This market holds special interest because of the alleged strong informational asymmetries that favour life insurance firms over insurance consumers (Consumer's Union [4] and Federal Trade Commission [6]). Estimates indicate that the price variability of individual life insurance is substantial, so that the pay-off from additional consumer search is equally large. For example, term insurance contracts renewable to a specific age constitute a relatively simple and homogeneous class of products. Yet, a sample of 12 insurance firms issuing in 1979 to Canadian males aged 25, $100,000 term policies yearly renewable to age 70, indicates an annual price spread of $89 with an approximate 1979 present value price spread of $890 (using a 10% discount rate). A sample of 49 insurance firms issuing in 1977 to males in New York State aged 20, $50,000 term policies renewable every 5 years to age 70, indicates an annual price spread of $150 with an approximate 1979 present value price spread of $1500 (again using a 10% discount rate).[1]

There is more than one candidate explanation for retail price variability in any market. Pure price shopping models, where products are homogeneous, buyers and sellers are many, buyers with identical search costs search for sellers, and sellers with identical advertising costs advertise price to locate buyers, are sufficient to generate an equilibrium distribution of prices. However, such models do not appear to offer a consistent empirical explanation for the observed price variability in individual life insurance contracts.[2] The question is why not?

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[1] These prices are taken from (respectively) Consumers' Association of Canada [3] and New York State Department of Insurance [5].

[2] Butters [2] provides a thorough analysis of such a pure price shopping, model. We take the Butters calculation for the equilibrium price variance and, for a set of Canadian life insurance prices for 1977, calculate the optimal consumer search for each category of insurance policy (where a category is defined by type of policy, age at which the policy is issued, sex of the purchaser, coverage in the policy) that yields the observed variance of prices. The implied optimal consumer search is not consistently reasonable. For example, if we estimate the per unit cost of life insurance firm advertising (including agents' fees) at 30% of the lowest-priced

(continued on p. 132)

There are several institutional features that differentiate the market for individual life insurance contracts from the markets that prevail in pure price-shopping models. First, life insurance contracts are not homogeneous products. There are important differences across contract types. Contracts are typically either term insurance (insurance of some specified amount renewable over a relatively short horizon (yearly or every five years)), or permanent insurance (insurance of some specified amount where there is an annual premium but the horizon for the contract is longer and the contract has savings and perhaps business investment (participating) components to it). Optional riders such as double indemnity, waiver of premium benefits, and guaranteed insurability are other possible contract features but these are usually restricted to permanent insurance.

Second, there are differences amongst underwriting insurance firms for any given contract type. For example, firms may have different medical criteria for additional benefits that are included in guaranteed insurability options, different loan rates where a cash value policy is used as collateral, different ages of consumers at which renewable term policies terminate, different service on policies, different dividend records or differing abilities to screen accurately consumer insurance risk.

Third, there are differences across insurance consumers in either the marginal cost of search or equivalently, the productivity of their search efforts. Commentators on the life insurance industry (e.g., Consumer's Union [4], Federal Trade Commission [6]) maintain that many (most?) consumers perceive only with error the real value of alternative contracts and, while consumers are aware of differences across underwriting firms, many (most?) can identify these firms only after extremely costly search. According to this view, this market is characterized by significant price distribution in equilibrium due to variability of consumer knowledge on the true value of life insurance contracts underwritten by alternative life insurance firms.

Finally, individual insurance contracts involve a negotiated bilateral exchange between the consumer and the life insurance agent where the agent identifies and "sells" the policy to the consumer and where the agent knows the educational and financial characteristics of the household, revealed by the consumer to facilitate a risk rating and a policy recommendation by the agent. Such knowledge on consumers plus information on the

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firm in each category of insurance policy (an assumption which favours easy consumer search), 25 year old males buying $10,000 yearly renewable (to age 70) term insurance must find it optimal to search 6 hours over 7 underwriting firms. Fifty-five year-old women buying $50,000 of non-participating whole life insurance must find it optimal to search 110 hours over 29 under-writing firms. Obtaining price quotes over the telephone is *not* a particularly time-consuming activity per quote. If all consumers exhaustively search all possibilities, they are fully informed and the distribution of prices should collapse to a single competitive price. Therefore, 25 year old males and 55 year old females in the above example must be sufficiently unproductive in searching prices that in 6 and 110 hours respectively, they do not sample exhaustively. This is an unreasonable restriction.

true value of insurance contracts places the agent in a dominant informational position.

Ultimately, our objective is to estimate a reduced-form equation that explains and interprets those factors affecting the prices of individual life insurance contracts. To do this, we need to sketch a model of buyer choice and life insurance sales which incorporates the institutional features of this market. Our explanation of price levels and variability turns on the ability of life insurance firms through their agents to price discriminate against consumers who hold varying price elasticities of demand with respect to coverage from each contract underwritten by each life insurance firm. Therefore, our demand story is cast at the brand level and focuses on consumer ignorance. Variation in consumer price elasticities on brands of life insurance reflects variation in marginal search costs for rational but not fully informed consumers who, consequently, hold varying stocks of knowledge on alternative life insurance contracts and underwriting firms. Price discrimination across consumers by firms is possible as each individual contract sale is a negotiated bilateral exchange between a consumer and life insurance agent, and agents know consumer price elasticities through personal and financial information revealed by potential consumers to agents. Therefore, individual life insurance sales are a strong example of markets examined by Porter [12] where the institutional retail arrangements favour producers over consumers. Porter argues that similar explanations of price variability generalize to other markets characterized by retailer power due to asymmetric information between buyers and sellers, e.g., nonconvenience goods such as automobiles.

Section II sketches our model of buyer behaviour and retail sales of individual life insurance contracts. While the misperception and search specification is, by now, routine in the economics literature, its novelty lies in the empirical application to this industry. Section III tests the model over a wide collection of U.S. and Canadian data. The empirical results offer support to the model and lend themselves to reasonable interpretations. Finally, Section IV offers some summary comments and conclusions.

II. AN EQUILIBRIUM MODEL OF INSURANCE PRICES

Previous papers on insurance focus on the implication of adverse selection for a competitive equilibrium in insurance markets (Rothschild and Stiglitz [14]). Insurance firms cannot sort high and low risk consumers so that firms cannot sell more expensive coverage to high risk consumers. Information asymmetries favour consumers against firms. The result is that a zero-profit equilibrium does not exist. In this paper, our emphasis is on consumer misperception so that the information asymmetries are just the reverse.

Here, consumers are rational and engage in search across life insurance firms and policies. None of the basic uncertainty ideas in this paper is new. Based on research across policies, consumers form expectations on the value of competing forms of insurance. These expectations may involve misperceptions. They select the policy that maximizes expected surplus and prepare to search across agents representing alternative suppliers of the product. This search takes the form of a minimally acceptable value (reservation value) to the insurance package which consumers are prepared to seek. Different marginal opportunity costs of search for consumers leads to different reservation values for consumers. The assumption of zero marginal costs for at least some consumers means that these consumers are fully-informed.[3]

As Rothschild [13] points out, it is important that the supply side of search models guarantees that price dispersion is an equilibrium condition. In this model, it is the firms through their agents that locate consumers. Life insurance firms are assumed to know the attributes of their products and are capable of locating and differentiating consumers according not only to risk but, by assumption, the information held by consumers on the relative value of alternative life insurance schemes. Therefore, as life insurance sales are on an individual basis where resale is impossible, firms can price discriminate against consumers. The key to price discrimination is the life insurance agent. Successful agents have the capacity to find consumers and read perfectly the level of information on product quality held by these consumers by virtue of the complete personal and financial history of each household which is at the agent's disposal for purposes of risk rating and policy selection. The result is that the reservation values on product quality formulated by consumers in the definition of their optimal search rules are self-fulfilling. Life insurance firms through their agents are assumed to segment the retail market in individual life insurance contracts and to offer consumers in each segment a price-quality product package that they will just accept. Typically, agents identify appropriate consumers and then "sell" their insurance packages to these consumers. This identification of target consumer groups by firms and their agents facilitates market segmentation. Equilibrium prices emerge from the bilateral exchange between consumers and price discriminating life insurance firms. Out ultimate objective is to subject the set of equilibrium prices generated by our model to an empirical test.

[3] Butters [2] points out that strictly positive marginal search costs for all consumers in the context of Cournot-Nash reactive assumptions means that the only equilibrium price is the monopoly price as it always pays the lowest-price firm(s) to raise their price by an amount less than the marginal search cost.

II.1 *Consumer Model*

Consumers in our model are differentiated by the probability of death (risk), the marginal opportunity cost of search and their subjective evaluation of the alternative life insurance policies available. Within each risk class of consumers, we assume that there is an equal representation of consumers by search costs (which we treat as a continuum where convenient). Without loss of generality, but with a considerable reduction in the notational burden, this means that we may focus on the determination of equilibrium prices for a representative risk class of consumers. We impute to each consumer within this typical risk class a specific expected utility function linear in expected income and the perceived net benefits from holding life insurance policies. (This specific utility function eases the analytical burden.)

$$EU^j \equiv y + \sum_i \sum_l b^{ilj} \tag{1}$$

where $y \equiv Y - \Gamma L$; Y is the (common) income in the absence of death; Γ is the probability of death for consumers in this risk class; L is the (common) known loss of family income should death occur for the insurance; therefore, y is the expected income; b^{ilj} is the perceived expected benefits that accrue to the family (bequest motive) from holding insurance policy type l purchased from company i by the consumer j where consumers differ by search costs. All search and purchase decisions are assumed to be *ex-ante* for the consumer. We use perceived net benefits to measure expected utility as it is the perception of benefits that influences the decision to purchase.

The net benefits from the purchase of life insurance are equal to the gross benefits (defined as B^{ilj}) less all purchase and search costs. Gross benefits are assumed to be additively separable in three components of the contract. First, there are the death benefits of the policy, measured in multiple thousands of dollars as μ, that accrue to the heirs on death. The magnitude and circumstances for collection of these death benefits are known with certainty. The benefits accruing to the consumer from the policy are assumed to be diminishing in the payments to the beneficiaries upon the death of the insured. In other words, the rate of exchange for the family between income dollars while living and payments of the policy upon the death of the insured is less than one. This reflects the psychic loss to the household from the death of a family member. For subsequent empirical purposes, it is convenient to assume an iso-elastic evaluation of the face value of the contract.

The final two components reflect each consumer's evaluation of the relative merits of different insurance policies (policy evaluation) and competing suppliers of life insurance (firm evaluation). Policy evaluation is subject to possible consumer misperception; firm evaluation is characterized by consumer search without misperception. In our static model, consumer j's best estimate of the value of policy-specific attributes per dollar of death benefits is represented by a scalar u_l, policy "quality". As the data at our disposal do not afford tests on the nature of consumer research across contract types, we specify u_l as the consumer's best estimate of the value of contract l *after* policy-specific research net of any research expenses. Therefore, u_l for each consumer may contain evaluation errors in perceiving the quality of each policy. We assume that there is some distribution of u_l's across the set of consumers purchasing individual life insurance contracts.

h_i represents the value per dollar of death benefits to consumer j from a policy underwritten by firm i which we label as firm "quality". Differences in firm quality in the face of differing marginal costs of consumers search yield differing equilibrium prices for any policy. Consumers derive utility from these policy and firm attributes aside from death benefits even if they continue to survive. With this specification, gross insurance benefits in our model, net of policy-specific research costs, may be written as:

$$(2) \qquad B^{ilj} \equiv \Gamma\mu^{\eta} + (h_i + u_l)\mu$$

where $\eta < 1$ because of our assumption that insurance benefits are diminishing in payments to beneficiaries upon the death of the insured.

We impute a simple search procedure to the selection of a firm by each consumer. We assume that consumers do know costlessly and perfectly the premium price for each policy underwritten by each firm but not the levels of policy or firm quality. Define P^{li} as the price per thousands of dollars of death benefits of policy l from firm i to consumer j. We assume that P^{li} is decomposable by all consumers into a policy component P^l and a firm component, P^i, i.e., $P^{li} \equiv P^l + P^i$. Therefore, consumers know the P^i's and P^l's but not the policy or firm quality level represented by alternative prices. For each policy l, each consumer knows that there is a distribution of firm quality described by $F(h_i;\ N)$ where N is the number of firms offering the contract of interest to the consumer. We define n as the number of searches for a typical consumer and α_j as the marginal opportunity cost of search for consumer j. σ_{α}^2 defines the variance of σ, assumed identical for each risk class of consumers. Variability of α across consumers reflects either varying opportunity costs to search or varying productivity in the search process.

Based on these assumptions and definitions, we may rewrite the expected utility for a typical consumer j in any risk class as:

$$(3) \qquad EU^j \equiv y + \sum_i \sum_l \left[\Gamma\mu^{\eta} + (h_i + u_l)\mu - \alpha_j n - (P^l + P^i)\mu\right]$$

By assumption, consumer j has already carried out any research on the optimal contract to purchase. Therefore, consumers in our model must choose (i) the optimal contract l^*, (ii) the appropriate search rule over firms h^*, (iii) the optimal coverage μ^*.

As expected utility is linear in this choice of policy types, consumer j chooses l^* so that $(u_l - P^l)$ is maximized. By this, we mean that with knowledge on prices each consumer chooses to purchase the contract that maximizes expected surplus for quality dimensions related specifically to the contract based on the perception of policy quality gleaned from the research of this consumer across substitute contracts. Given the linearity of contract choice in the model, u_l and P^l may be defined to be net of the true value of the contract class. (Then, $u_l(>0, =0, <0)$ indicates that the consumer (over-values, exactly values, under-values respectively) these policy-specific elements of life insurance choice.) This characterization of contract choice facilitates our subsequent empirical analysis by permitting an identification of the variability of prices across firms within each class of contracts. We define u^* to be the level of consumer misperception for the chosen policy.

Within the chosen class of contracts, the appropriate rule for consumers to search across alternative suppliers is to define a reservation value h^* within the relevant distribution so that if the consumer encounters a firm whose quality level is $h_i \geq h^*$, then the consumer buys from firm i. Otherwise, the consumer continues to search. In a similar setting, Lippman and McCall [8] show that the solution to this standard search problem occurs when the expected marginal benefits from search equal the marginal cost of search for consumer j.

$$\mu H(h^*; N) = \alpha_j \tag{4}$$

where $H(h^*; n) = \int_{h^*}^{\infty} (h_i - h^*)\, dF(h_i; N)$ is a convex, non-negative strictly decreasing function with $\partial H/\partial h^* \equiv H_h = F(h^*; N) - 1$.

Lippman and McCall show that the expected quality gain from pursuing the optimal search strategy defined by (4) is the reservation search quality. Therefore, the optimal coverage for the best policy evaluated at the expected level of firm-specific quality net of search costs is given by:

$$\Gamma\eta\mu^{\eta-1} + h^*(\mu) + u^* = P^{li} \tag{5}$$

where, as we have defined it, P^{li} is the premium price per thousands of dollars of death benefits for consumer j from the perceived best policy and firm, net of true policy-quality values and $\mu < L$ (for reasons of moral hazard). This last constraint is assumed to be non-binding.[4]

Solving (4) and (5) for reservation values of firm quality as a function of price and other variables exogenous to these decisions for consumers is useful

[4] This specification yields sensible properties for the demand for individual insurance. From (5), $\partial\mu/\partial h^* = -1/[\Gamma\eta(\eta-1)\mu^{\eta-2}] > 0$, so that increased search across firms shifts the consumer's demand function for death benefits to the right, i.e., the identification of a better deal increases the desired coverage at a constant price. Further, if we define ε_P^{μ} to measure the price elasticity of coverage, then at a constant level of death benefits $(\hat{\mu})$, $\partial\varepsilon_P^{\mu}\,\partial h^*_{|\hat{\mu}} = \partial\varepsilon_P^{\mu}/\partial u^*_{|\hat{\mu}} = 1/[\Gamma\eta(\eta-1)\mu^{\eta-2}] < 0$. This says that increased search and an increased perception of the policy's quality at a given level of death benefits make consumers more price elastic. This result is consistent with the view that better-informed consumers are more price-elastic consumers.

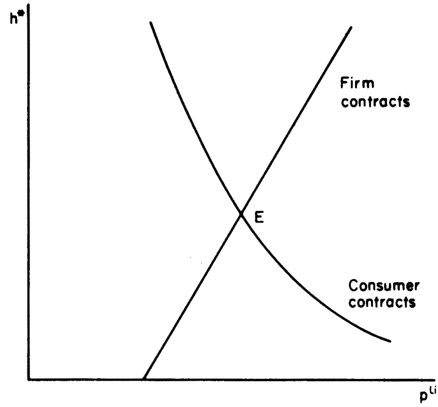

FIGURE 1
Consumer/Firm price—quality equilibrium for one policy and one segment of the life insurance retail market.

for our subsequent empirical analysis and yields:

(6) $h^* = \xi_j(\alpha_j, \Gamma, N, P^{li}, u^*)$

where by conventional comparative static techniques $\partial h^*/\partial P^j = -H/D < 0$ where $D \equiv \Gamma\eta(\eta - 1)\mu^{\eta-1}H_h - H > 0$ (by virtue of the concavity of the consumer's decision problem). (6) is illustrated in Figure 1. Therefore, as prices rise and consumers reduce their coverage, they reduce their search efforts. In a similar fashion, $\partial h^*/\partial\Gamma < 0$, $\partial h^*/\partial\alpha_j > 0$, $\partial h^*/\partial u^* 0$, $\partial h^*/\partial N < ? > 0$. At a given price, consumers facing either a greater risk of death, having a lower marginal opportunity cost of search (a higher marginal product of search) or imputing a larger value to the selected contract engage in greater research. The impact of additional firms on optimal search is uncertain, as we cannot forecast in general the effect of more sellers on the distribution of firm-specific quality.[5] These are intuitively reasonable results. These comparative static results will be interpreted further once the model is complete.

II.2 *Life Insurance Firm Model*

Define M to be the number of consumers in our typical risk class. Then, by assuming that firms servicing each risk class are alike, we may define

[5] More firms selling in any segment of the retail market may alter the optimal search patterns for rational consumers. This may shift the locus of optimal consumer contracts in Figure 1 but the direction of the change is unclear. The uncertainty stems from the uncertain impact on consumer search equilibrium of general changes in the distribution of offers from firms. For example, with a constant marginal cost of search, if more sellers shift the distribution to yield a higher marginal benefit to search at the old equilibrium, then both search and price are increased. This result turns on the sign of $H_N \equiv \int_{h^*}^{\infty} (h_i - h^*) f_N \, dh_i$ which, in general, is *not* known.

$m \equiv M/N$ as the number of contracts underwritten by each firm. This is our measure of a firm's output. We focus exclusively here on individual life insurance contracts. Further, we consider complete separability across contract classes (i.e., we view each firm as a single-product life insurance firm). Such separability eases the analytics by avoiding the difficulties in packaging that would emerge from multi-output firms.

Agents in our model discriminate across consumers in each risk class to measure with accuracy the reservation quality that this consumer would just accept. Given the extensive personal and financial information solicited in advance of a policy proposal by agents that would facilitate such discrimination, this is a reasonable assumption. Here, we assume that each life insurance firm underwrites only one level of quality in its contracts. Therefore, firms look across consumers in each risk and policy class and in the face of open entry, enter a segment of the retail market characterized by excess profits for existing firms and consumers with a common evaluation of the policy and a common cost to search (i.e., a common reservation value of firm quality).

Firm through their agents face each consumer in a bilateral exchange knowing they face a downward-sloping demand curve for death benefits, and knowing h^*, the consumer's reservation value on firm quality. For convenience, we permit firms to select coverage as a decision variable and use the inverse of the demand function. Therefore, (5) defines the individual demand curve faced by firms in their exchange with consumers.

Associated with each individual contract are certain expected costs: the expected death benefits and the costs of providing policy and firm quality known to the underwriting insurance firm. The cost of firm quality is the reservation value for consumers in that segment of the retail market serviced by each firm or h^*. (Here, there is uncertainty only on the location of firm quality not its value.) With the linearity of our model, the joint assumptions that life insurance salesmen measure h^* with accuracy and that the marginal costs of supplying h^* are constant and equal to one mean that the expected profits of the firm (and therefore its decision variables) are independent of h^*. As policy quality measures have been scaled as deviations from their true measures, the corresponding costs to the firm of misperceptions by consumers on the value of any contract are zero.

Next, there are the commissions to agents. Each agent screens consumers to select those appropriate for the policies underwritten by the agent's company.[6] Each sale requires a fixed number of hours of the agent's time which we define as $\bar{s}$. Although agents are paid a commission that is a portion of gross premium revenues, we assume an equilibrium number of salesmen. Therefore, in the face of open entry into the ranks of life

[6] In fact, agents not only screen consumers but by offering advice seek to affect consumer evaluations of alternative contracts. An examination of the welfare effects of this activity may be found in Mathewson [10].

insurance agents, and a homogeneous labour force, agents earn a competitive wage rate w.

As well, we assume that capital markets for the investment of each insurance firm's investment portfolio are competitive and in equilibrium. By this, we mean that life insurance firms neither outperform nor underperform either each other or other financial intermediaries in the construction of optimal investment portfolios. Therefore, expected revenues from investment just offset the opportunity costs for investment for each firm and may be ignored.

Finally, there are all other head-office and branch expenses for the firm which vary with the volume of contracts handled by the firm, the measure of the output of each firm.[7]

As all costs are now defined, they may be assembled into total costs: $(\Gamma + h^*)m$ represents expected pay-out and firm quality costs; agents' expenses are $wm\bar{s}$ which may be aggregated with all other expenses as $G(m, w) + C$ where $G', G'' > 0$, $G' > G(m, w)/m$ for all m and C is a positive constant.[8]

Given the exclusivity of choices of policy types by each consumer plus our cost specification of each firm with competitive capital markets in equilibrium, expected profits for each policy type (type of life insurance, risk category, firm specific quality) may be considered independently and, under Chamberlinian assumptions, are defined as:

$$E\Pi \equiv (\Gamma\eta\mu^{\eta} + u^*\mu - \Gamma\mu)m - G(m, w) - C$$

Expected profits for each firm are maximized with respect to insurance coverage (μ) and the number of policies underwritten (m). Expected profits are assumed to be concave in these decision variables. A firm equilibrium is given by:

$$\Gamma\eta^2\mu^{-1} + u^* = \Gamma \tag{7}$$

$$\mu[\Gamma(\eta\mu^{\eta-1} - 1) + u^*] = G' \tag{8}$$

Equations (7) and (8) are similar to the usual marginal conditions.[9] As each firm has the ability to discriminate across consumers, (7) and the average revenue from the sale of each contract in (8) are independent of firm size. These features facilitate our subsequent empirical tests. As well, as

[7] It is reasonable to expect that all head-office expenses should vary directly with the number of contracts underwritten, the physical volume of output. Fixed costs C arise as the set-up costs of establishing a head office and agency system for each policy type sold by each firm. These assumptions guarantee a unique firm size in an insurance industry equilibrium.

[8] Kellner and Mathewson [7] find no evidence of equilibrium scale economies for life insurance firms.

[9] The assumption that all M consumers buy a policy characterized by strictly positive coverage constrains the distribution of u^* across consumers to guarantee that the left-hand sides of (7) and (8) are strictly positive.

we indicated, our specification leaves (7) and (8) independent of h^*. Therefore, search decisions by consumers across firms do *not* affect the death benefit size of contract nor the number of contracts sold. This means that subject only to sufficient density of consumers to guarantee that $E\Pi \geq 0$ (in an industry equilibrium $E\Pi = 0$), life insurance firms are willing to supply any firm quality demanded. However, premium prices do depend on h^*. Using (5), we may define the optimal premium price per dollar of death benefits (corrected for true product quality) as:

$$P^{li} = [\Gamma - u^*(1 - \eta)]/\eta + h^* \tag{9}$$

where $\partial P^{li}/\partial h^* = 1$ (if h^* is treated as a parameter, then increases in h^* leave μ^*, defined by (7), unchanged but are passed along to consumers directly through increases in premium prices), $\partial P^{li}/\partial \Gamma > 0$, $\partial P^{li}/\partial u^* < 0$ and $P^{li} > 0$ requires $\Gamma + \eta h^* > u^*(1 - \eta)$. Increases in risk and decreases in policy evaluation because they reduce price elasticities, increase the premium price.

Equilibrium levels of premium price and firm-specific quality are determined by the simultaneous satisfaction of (6) and (9), the respective price/quality trade-offs for consumers and firm. Figure 1 illustrates such an equilibrium. The effects of changes in parameters on the equilibrium levels of h^* and P^{li} are essential for any empirical test. These are summarized as: $\partial h^*/\partial \alpha = \partial P^{li}/\partial \alpha < 0$; $\partial h^*/\partial \Gamma$, $\partial P^{li}/\partial \Gamma > 0$; $\partial h^*/\partial u^* > 0$; $\partial P^{li}/\partial u^* < ? > 0$; $\partial h^*/\partial N$, $\partial P^{li}/\partial N < ? > 0$. To illustrate these comparative statics, consider a change in the opportunity cost of search for the consumer (α) on the equilibrium in Figure 1. Changes in α leave the firm's contract locus unaffected. However, an increase in α means that the consumer will search less assiduously across competing firms at each price level so that the consumer's locus of equilibrium contract falls. Consequently, the observed equilibrium levels of both price and firm quality are reduced. Consumers are less willing to search and demand a lower minimum level of firm quality; firms supplying consumers with higher α's offer lower quality and require a lower price to cover the costs of such quality.

For any given risk category and price level, the distribution of firm-specific quality levels is determined by the joint distribution of the costs of search and policy evaluations across consumers. These are the firm-quality variations observed by consumers for each alternative type of policy.

III. EMPIRICAL ESTIMATION OF EQUILIBRIUM PRICE DISTRIBUTION

The test of our equilibrium model of information asymmetries in the life insurance industry is whether or not it is capable of explaining the observed variation and levels of prices of different life insurance companies for individual life insurance contracts. Specifically, we test the predictions generated by the model for the effects on relative price variability of changes in the age of the consumers group purchasing the contract, the number of companies underwriting the particular policy,[10] the sex of the consumer group, where the data include policies issued to both men and women and a set of variables that capture the characteristics of the policy.

The data available to test the model consist of five cross-sectional samples of life insurance prices from different geographical areas. Samples 1 and 2 are taken from the Consumers' Association of Canada, *Shopper's Guide to Canadian Life Insurance*, [3]. Sample 3 is from the New York State Department of Insurance, *Consumer's Shopping Guide for Life Insurance*, [5]. Sample 4 is from the State of Pennsylvania, Department of Insurance, *Shopper's Guide for Life Insurance*, pooled over 1972 and 1973 (in [17]). Sample 5 is from Belth, *Life Insurance; A Consumer's Handbook*, [1].

All samples except New York report interest-adjusted net-cost data over a horizon of 20 years, a standard method of price comparison in the insurance industry. This New York sample is interest-adjusted net-cost data over a horizon of 10 years.[11] This method of calculating the protection content of premium prices assumes that consumers of life insurance live with probability one for 20 years and then cash in the policy for the cash surrender value with probability one. For participating policies, dividends are forecasted over the period. Finally, all policies are evaluated at the end of the 20 year period by subtracting from the accumulated premiums, the cash-surrender value of the policy and the accumulated (forecasted) dividends. The result is present-valued as the pure insurance cost. The reported price is the pure insurance cost per thousand of dollars of coverage. Undoubtedly, the arbitrary assumptions on life expectancy, the horizon for holding the policy and the likelihood of surrender introduce biases but a systematic statement on the direction of the bias does not appear to be possible.[12]

Our data do not contain information on the search or income characteristics or insurance purchase decisions of individual households. The test of the model takes the form of explaining the relative price variability of individual life insurance contracts across firms for each contract type.

[10] We do not assume that the observation period for these measured prices is characterized by an industry equilibrium. Therefore, the number of underwriting companies is treated as an exogenous variable.

[11] For the New York Sample, policies are reported by ages 20, 35, 50 for issuing the contract. Many life insurance companies do not renew term insurance beyond 65 so that the sample of firms is greatly reduced for 20 year interest-adjusted cost data for policies issued to 50 year olds.

[12] For example, the Canadian data use interest rates of 6 per cent. These rates seem unduly low given inflationary expectations in excess of 6 per cent. This may overvalue savings and dividend elements and, therefore, underprice the cost of insurance elements. As well, the postponement of dividends involves a mortality factor as well as an interest factor as dividends are not paid when the insured dies and the death benefits are collected. Further, forecasted dividends policies are based on historical dividends. For these reasons, our attention is restricted to price variation across firms within each type of life insurance policy.

We use the comparative static predictions generated by the consumer and firm bilateral exchange equilibrium model under our assumptions. To develop the appropriate reduced-form equation from our model, we take logarithms of the firm's price-quality path, linearize the consumer's price-quality path, and calculate the corresponding relative price variances that arise due to variation in search costs for each category of policies.[13] Then, we derive

$$(10) \qquad [d \ln P^{il}]^2 = C[d\alpha_j]^2$$

where $C \equiv [\eta h^*_\alpha/(\Gamma + \eta h^* - u^*(1-\eta) - \eta h^*_{\ln P}]^2$.

Equation (10) may be re-interpreted with an error term as:

$$(11) \qquad \sigma^2_{\ln P} \simeq C\sigma^2_\alpha + \varepsilon_P$$

A linearization of C over the measurable variables (Γ, N, u^*) and substitution into (11) yields

$$(12) \qquad \sigma^2_{\ln P} \simeq (C^0 + C_\Gamma \Gamma + C_N N + C_u u^*)\sigma^2_\alpha + \varepsilon_P$$

Equation (12) is a reduced-form equation that tells us that the larger is the variance of consumer search costs, the greater is the observed variance of relative prices as discriminating life insurance firms accommodate perfectly the search patterns of consumers. Changes in the probability of death, the number of underwriting firms and misperceptions on product quality alter the relationship of relative price variability to search cost variability in either a predictable or an interpretable fashion *given our model*. For the equilibrium

[13] Taking logarithms of the firm's price-quality path permits us to evaluate relative price variability, a measure that is directly affected by the impact of the consumer insurance risk, the number of insurance firms and attributes of the products on price levels. Under these conditions, the firm and consumer paths become (respectively):

$$\text{(i)} \qquad \ln P^{il} = \ln[\Gamma + \eta h^* - u^*(1-\eta)] - \ln \eta$$

$$\text{(ii)} \qquad h^* = h^*_\alpha \alpha_j + h^*_\Gamma \Gamma + h^*_N N + h^*_u u + h^*_P P^{il}$$

(where $h^*_\alpha \equiv \partial h^*/\partial\alpha$ and so on).
For empirical purposes, we assume that u^* varies only across policies. Therefore, price variability is due to variability in consumer search costs so that (i) and (ii) yield:

$$\text{(iii)} \qquad d \ln P^{il} = \eta\, dh^*/[\Gamma + \eta h^* - u^*(1-\eta)]$$

$$\text{(iv)} \qquad dh^* = h^*_\alpha\, d\alpha + h^*_{\ln P}\, d \ln P^{il}$$

(where $h^*_P\, dP^{il} \equiv h^*_{\ln P} \cdot \partial \ln P^{il}/\partial P^{il} \cdot dP^{il}/d \ln P^{il} \cdot d \ln P^{il} \equiv h^*_{\ln P}\, d \ln P^{il}$).
Substituting (iv) into (iii), solving for $d \ln P^{il}$ and squaring both sides permits us to write (10) in the text. If logs were not used, (11) in the text would become:

$$\sigma^2_P \simeq c\sigma^2_\alpha + \varepsilon_P \qquad \text{where} \qquad c \equiv [h_\alpha/(1 - h_P)]^2$$

Given our linearization, c is independent of (Γ, N, u^*) so that our model forecasts an approximately constant variance of prices across policy categories.

consumer-firm model developed here:

$C_\Gamma < 0$ as $\partial h^*/\partial\Gamma > 0$ from the consumer-firm equilibrium.[14]

$C_N < ? > 0$ as sign $C_N = -$sign H_N and the sign of H_N cannot be predicted uniquely from the consumer-firm equilibrium.

$C_u < ? > 0$ as sign $C_u = -$sign $\partial P^{li}/\partial u^*$ and the sign of C_u cannot be predicted uniquely from the consumer-firm equilibrium.

In the absence of differentials in consumer search costs and firm and policy quality, $\sigma_\alpha^2 = 0$ and $C_\Gamma = C_N = C_u = 0$. These differentials lie at the heart of the model in this paper.

Our price data do not include income information on consumers purchasing insurance contracts. Therefore, in our specification the consumer choice model leaves insurance demand independent of income. However, our empirical sense is that life insurance is a normal good so that we correct for the omission of incomes by calculating relative price variability for groups defined not only by risk and policy type but by the size of death benefits as well.

The measured characteristics of life insurance policies and their predicted effects are as follows:

(1) Age: Age is a measure of the probability of death. Therefore, based on our model, age should have a negative coefficient.
(2) Number of Companies Writing the Policies: For the Canadian data, the companies voluntarily reporting their prices to the Canadian Consumers Association do not constitute all companies underwriting the various policies in the Canadian market. As long as the sample of included companies is unbiased, there is no problem. The sign of C_N depends on the negative of the sign of $\partial h^*/\partial N$ which in the consumer-firm equilibrium depends on the sign of H_N. If C_N is positive (negative), then "on average" more sellers reduce (increase) the marginal benefit from search.

The next set of policy characteristics are measured by dummy variables. They do *not* measure the sign or magnitude of u^*, the value imputed to policy—specific quality iterms, but they do measure the relative values of u^*, i.e., they measure whether u^*'s held for one type of policy are higher or lower than u^*'s held for some reference type of policy. The discussion

[14] For example, C_Γ is defined as:

$$C_\Gamma \equiv -2[\eta h_\alpha^*]^2[1 + \eta h_\Gamma^*]/[\Gamma + \eta h^* - u^*(1-\eta) - h_{\ln P}^*]^3$$

As $h_{\ln P}^* < 0$, $P^{il} > 0$ (i.e., $\Gamma + \eta h^* > u^*(1-\eta)$) and $h_\Gamma^* > 0$, we predict that $C_\Gamma > 0$.

that follows assumes that $\partial P^{il}/\partial u^* > 0$ (i.e., increased perceived policy quality increases price) and therefore, that $C_u < 0$.

(3) Sex (relevant where a sample includes policies underwritten for both men and women): Sex differences are measured by a variable set equal to 0 if female, 1 if male. We cannot predict whether men or women systematically over-value or under-value life insurance. The decision for women to buy insurance may or may not be made independent of insurance decisions made by a husband if one exists. If women over-value policies relative to men, perhaps due to inexperience, or if men purchasing insurance for their wife over-value insurance relative to their own, then $C_u < 0$. Some firms have prices for women set equal to the prices for younger men due to a lower risk of death for any one age group. Therefore this sex variable may pick up a risk or an age effect.

(4) Type of insurance: Insurance policies are typically either term, permanent non-participating, or permanent participating. The three-way characterization of relative over or under-valuation of policy types requires two dummy variables, one variable equal to one if permanent insurance, (zero otherwise), and one variable equal to one participating permanent insurance (zero otherwise). Conventional wisdom on the insurance industry suggests that consumers over-value permanent insurance relative to term insurance.[15] Permanent insurance is considered an inferior commodity due to the low (negative real) rate of return on the savings component. If this is the case, then the coefficient on the first dummy variable should be negative. Conventional wisdom on the insurance industry suggests that in times of falling mortalities and growth in the demand for insurance, participating policies are better deals than non-participating policies for permanent insurance.[16] If participating insurance is under-valued relative to non-participating insurance, then the coefficient on the second dummy variable should be positive. The sum of these two coefficients indicates whether permanent participating insurance is under or over-valued relative to term insurance. There is no prediction on this magnitude by industry commentators.

Table I reports the estimated coefficients for the fitted equation. In general, F statistics for each regression (which are not reported in Table I) are sufficient to reject the hypothesis of no differences in consumer search costs or product quality. We may interpret the coefficients for each variable. As our model predicts, relative price variability falls with age in all samples.

[15] For example, Consumer's Union [4] reports that "except for families that need forced savings or a tax shelter, CU judges term insurance to be more likely to meet those (the family's) needs".

[16] For example, Consumer's Union [4] reports that "on balance, CU favours participating policies for those people buying cash value life insurance".

TABLE I

ESTIMATED REDUCED-FORM EQUATION FOR A MODEL OF CONSUMER SEARCH AND MISPERCEPTION FOR INDIVIDUAL LIFE INSURANCE CONTRACTS

Sample	*Constant*	*Age*	*No. of Companies*	*Sex Variable*	*Permanent Insurance Variable*	*Participating Variable*	*Permanent Participating Variable*	*Observations*	R^2
1	3.06*E*-02	−0.04*E*-02	0.03*E*-02	−0.85*E*-02	−0.74*E*-02	2.32*E*-02	1.58*E*-02	152	0.63
	(10.66)*	(−6.75)	(3.60)	(−6.33)	(−3.95)	(11.77)	(8.40)		
2	4.49*E*-02	−0.06*E*-02	0.03*E*-02	−1.19*E*-02	−0.24*E*-02	3.03*E*-02	2.79*E*-02	152	0.52
	(8.56)	(−5.32)	(2.07)	(−4.83)	(−0.68)	(7.99)	(5.57)		
3	−4.36*E*-02	−0.05*E*-02	0.20*E*-02	−1.44*E*-02	−0.52*E*-02	1.78*E*-02	1.26*E*-02	48	0.86
	(−3.26)	(−4.83)	(6.61)	(−5.21)	(−0.90)	(6.44)	(1.68)		
4	−1.30*E*-02	−0.05*E*-02	0.03*E*-02	—	−1.13*E*-02	1.86*E*-02	0.73*E*-02	24	0.82
	(−1.21)	(−5.83)	(3.02)		(−1.62)	(6.44)	(1.52)		
5	0.97*E*-02	−0.03*E*-02	0.04*E*-02	—	−0.05*E*-02	−0.65*E*-02	−0.70*E*-02	23	0.67
	(2.70)	(−2.90)	(3.59)		(−0.25)	(−3.09)	(−2.29)		

* *t*-statistics are reported in parentheses under each coefficient estimate.

Dependent Variable: Variance of the logarithms of the protection price of individual life insurance contracts by type of policy, coverage and age at which the policy is issued.

Our model traces this effect to both direct mortality effects and indirect search effects. More firms increase relative price dispersion. The interpretation of this result from our model is that more sellers by reducing the marginal benefit from search reduce the equilibrium search efforts and price for each consumer in each appropriate class. A reduction in price lowers relative price dispersion. In those samples which include policies underwritten for both men and women, women face greater relative price dispersion than men. For the most part, consumers appear to under-value participating relative to non-participating individual life insurance.

IV. CONCLUSIONS

The model in this paper attempts to explain the observed price variability for the pure protection elements of individual life insurance contracts. The key ingredients are uninformed but rational consumers capable of research into characteristics of policies and search across firm attributes and fully-informed life insurance firms capable of price discrimination across potential customers through life insurance agents. In the face of open entry into the ranks of agents and differences in the cost of consumer search and the evaluation of policies by consumers, the model yields an equilibrium distribution of life insurance prices.

The model is tested with the available price data whose construction permits comparisons across firms within policy categories (within-group comparisons) but forbids comparisons across policies (between-group comparisons). In general, a model based on product-quality uncertainty by consumers and price discrimination by life insurance firms appears to offer a consistent explanation of price levels and variance. In contrast, pure price-shopping models do not offer consistent explanations of price variability. While we cannot measure directly the productivity of individual consumer search effort, our empirical results are consistent with increased consumer search where the probability of death is greater, and where there are fewer sellers (i.e., more sellers reduce the need for consumers to search extensively). These are rational consumer responses. Further, our results indicate that consumers under-value participating relative to non-participating whole life insurance contracts but likely do not under-value term insurance relative to whole life insurance. Any under or over-valuation may be traced to consumer misperceptions.

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