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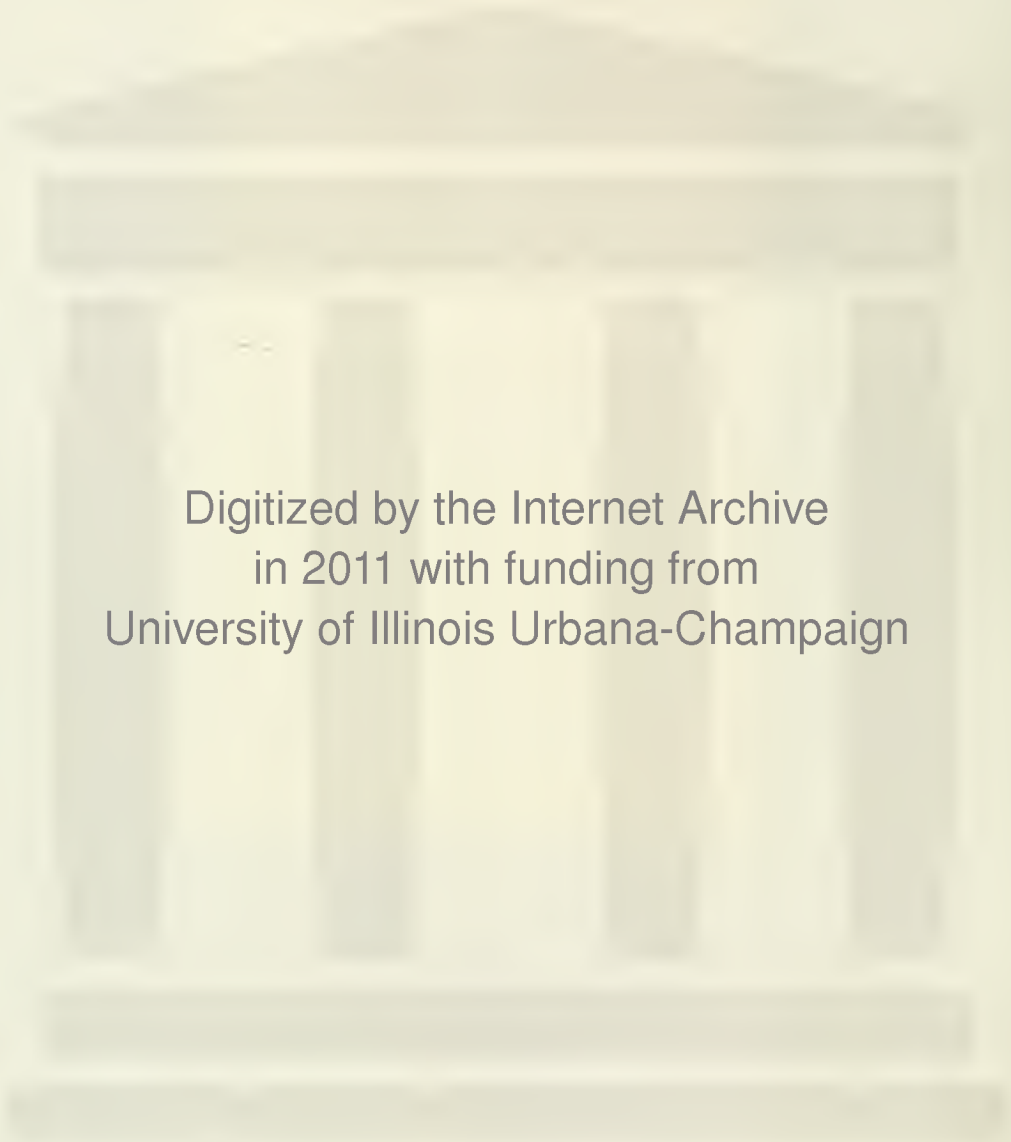

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PAPER NO. 1257

Multiperiod Contracting with Non-Portable Information: The Case of Sticky Insurance Prices

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The Case of Sticky Insurance Prices

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Many helpful comments were received during presentations of earlier drafts at the University of Illinois Finance Workshop and at the Risk Theory Seminar.

Multiperiod Contracting with Non-Portable Information:
The Case of Sticky Insurance Prices

ABSTRACT

In a multiperiod contract, the generation of information over the life of the contract may be used to redress problems of information asymmetry existing at inception. In much of the earlier literature, sequential information becomes impounded in prices thereby relieving problems such as adverse selection and moral hazard as the contract matures. We model and illustrate a different response observed in insurance markets. If sequentially generated information is non-portable, prices may become sticky over the contract life. However, new information will permit the insurer to practice reverse selection against its clients as their contracts come up for renewal. In competing for the right to extract quasi rents from selected future renewals, insurers write new business at a loss. This form of "low balling" describes an alternative market response to adverse selection when sequentially generated information is non-portable.

I. Introduction

In contracts of any sort between two parties, characteristics of one party that are observable by the other party may affect the price and other terms of the contract. Characteristics of the creditworthiness of the borrower impact interest rates, collateral requirements and covenants in debt contracts. Reputation and past reliability affect the price consumers are willing to pay for brand name consumer goods. A manager's ability and performance record play a role in determining the salary and perquisites a firm is willing to offer as compensation. So, too, are observable characteristics of an insured, such as age, sex, driving record, type of vehicle and garage location, priced into automobile insurance contracts. However, at the time the contract is written, not all information that is relevant to contract performance may be observable. The resulting information asymmetry may give rise to problems of agency, adverse selection and moral hazard. If contracts are set up for a single period, these problems may act as a deterrent to the negotiation of contracts with ensuing welfare loss. Multiperiod contracting permits performance monitoring with indirect observation of material characteristics. The opportunity for performance related pricing suggests that multiperiod contracts often dominate single period contracts (see Radner (1981) and (1985), Townsend (1982), Rubinstein and Yaari (1983), Dionne and Lasserre (1985), Chan, Greenbaum and Thakor (1985)).

The analyses of Rubinstein and Yaari and of Dionne and Lasserre address a particular form of multiperiod pricing of insurance contracts. Information relevant to the estimation of an individual's

loss distribution (past losses) is revealed to the insurance firm progressively over time. This information is translated into premium incentives which partially offset the effects of moral hazard and adverse selection. With this reasoning in mind, consider what might happen if an insurer wrote a cohort of policies at time t, and left these policies on the books for a number of years. Presumably, as the insurer received informational updates it would revise its estimates of the loss distribution of the individuals concerned and correspondingly change the premium to restore appropriate contracted incentives. If, in addition, the market for insurance products is assumed to be competitive, the price changes should roughly match the changes in loss expectancy. However, in examining cohorts of policies, pricing behavior appears to be very different. The ratio of losses incurred to premiums earned (termed the loss ratio) shows a clear and dramatic tendency to decline as policies age on the books of the insurer. Typically, new policies are written at a loss but the insurer is able to extract quasi rents from policyholders who have been with the firm for a number of years. If this pattern is driven by the generation of progressive information, it is apparent that this information is not fully impounded in prices. The declining loss ratio is accompanied by declines in both the frequency and severity of losses causing the numerator of the loss ratio to decline. When considered together, these various trends suggest that insurance premiums tend to be inflexible in a downward direction.[1] These patterns appear to be well known in the insurance industry and sometimes referred to as the "aging phenomenon."

The aging pattern appears to be a form of "low balling" and has analogies elsewhere. Low balling (setting opening prices below average cost in order to extract quasi rent on future renewal business) has been noted, inter alia, in bidding for franchises (Goldberg 1976) bidding for cable television contracts (Williamson 1975), the provision of auditing services (DeAngelo 1981) and in employment contracts (Lazear 1979). Our model most closely relates to that of DeAngelo in that we will show that competition for new contracts, which over time will generate future client specific quasi rents, will drive the price for new business below average cost. In our model, these client specific quasi rents are generated by the progressive production of non-portable information which is not shared by the existing firm with rival producers. This information permits the insurer to practice reverse adverse selection against its clients thereby progressively reducing claim costs on each cohort of policies.

In developing this "low balling" model of insurance we extend and qualify the literature on multiperiod insurance pricing (notably Rubinstein and Yaari (1983), Dionne and Lasserre (1985), Boyer and Dionne (1986), Landsberger (1984)). That literature had focussed on the unfolding of loss experience and using each "Bayesian update" to revise insurance premiums. This process is seen as an antidote to the moral hazard and adverse selection problems present in new business. However the portability of new information, and therefore its disposition, has not been examined. We show that, when unfolding information is non-portable, this information will be used by the existing insurer for selective renewal. As a consequence, renewal prices will not impound

new information and prices will tend to be sticky over time. The structure of our model resembles Sweezy's (1939) kinked demand curve used for analyzing oligopolistic structures. Our model well explains the observed "aging phenomenon."

II. The Aging Effect In A Cohort of Insurance Policies

In this section examples of insurance pricing are presented that appear to be consistent with "low balling." The examples were provided by two major insurers with large automobile lines. The firms asked not to be identified. In our discussions with actuaries from many other firms, we have received verbal confirmation that the aging pattern is widespread. The examples relate to automobile insurance and, to provide a focus, we will continue to discuss this line of business. The examples are presented in Table 1. The loss ratios (the ratio of incurred losses to earned premiums) decline clearly and dramatically with the age of the policy. For firm A the severity and frequencies of losses classified by policy age are also shown. Both loss frequency and loss severity show a definite tendency to decline with age. Thus, although the effects of changes in the denominator $(\text{premiums})^2$ cannot be dismissed, the declining loss ratio may be sufficiently explained by progressive reduction in the numerator (losses) as the policies' age.

Given expenses and investment income, it is evident that firm A is losing value on its new business but is recouping the loss on older business. At this juncture, it is unclear whether the value of the book of business as a whole, capitalized at the time when contracts are first written, will include monopoly rents. For this reason we

will refer to the apparent rents which the firm extracts from its older policies as quasi rents since these may simply offset subsidies offered when the policies were new.

In the following sections we offer an explanation of the aging pattern. We address the generation of information over the lifetime of insurance contracts. If this information is non-portable, then it may be used by the contracting insurance firm to exercise selective renewal. This is, in effect, reverse adverse selection by the insurer against its clients. This would explain the declining loss experience. But the non-portability of information also leads to the prediction that prices would be sticky as the insurance policies age. Together the declining losses and sticky prices provide an explanation of aging. This is developed in Section IV. But first we must examine the disposition of information generated in insurance contracts.

Insert Table 1 about here

III. The Disposition of Information in Multiperiod Insurance Contracts

For convenience, the notation used in this paper is summarized below:

I = set of behavioral characteristics of insured that affect loss density function. Insured observes full set I.

i = characteristics of insured observed by all insurers at inception, $i \subset I$.

Δi = characteristics observed by contracting insurer, but not by rival firms, at renewal $i + \Delta i \subset I$.

$f(L|I)$ = insured's estimate of his(her) loss density function conditional on observation of I.

$g_j(L|i)$ = insurers estimate of the insured's density function at time j conditional on observation of information subset i.

F_j = demand function at time j for a cohort of insureds exhibiting observable characteristics i to insurer.

p = premium per policy.

q = number of policies issued.

L = expected value of losses per policies, capitalized to the beginning of the year in which the policy is written or renewed.

g = initial estimate of the probability that an insured is a "good" risk (i.e., expected losses are below average for the rating class).

π = number of policies on which adverse information is revealed in the first year $\pi \subset q$.

k = proportion of π which is renewed in second year.

j = proportion of the residual group $(q-\pi)$ (i.e., for which no adverse information is received) that is renewed in second year.

A = subscript to denote policies in sub group π (adverse information).

N = subscript to denote policies in sub group $q-\pi$ (no adverse information).

E = capitalized earnings on a cohort of policies.

D = discount factor.

x = annual expenses per policy.

m = additional expenses incurred at beginning of year 1 per policy (primarily marketing and underwriting expenses).

e = demand elasticity.

The asymmetry of information under an insurance contract gives rise to the familiar issues of adverse selection and moral hazard. The nature of the asymmetry usually analyzed (e.g., Rothschild and Stiglitz (1976), Wilson (1977), Shavel (1979), Rubinstein and Yaari (1983), and Riley (1985)) is as follows. The insured possesses certain characteristics that are associated with the propensity for loss. The insurer attempts to induce the insured into signalling his or her true

loss propensity by selecting a particular policy or amount of coverage or to redress an undercharge in earlier periods by increasing rates for insureds with losses. In these situations, all insurers have access to the same information set about the insured. In this analysis, the existing insurer is assumed to develop information about its insureds that is not portable and thus not necessarily impounded in prices.

The full set of information relevant to estimation of the loss distribution is denoted I. Some of these characteristics (e.g., age, sex, type of vehicle driven, geographical location, number of prior accidents etc.) are observable to the insurer at the time the contract is written. This subset of information is denoted i.

$$i \subset I$$

The information asymmetry usually recognized reflects on the difference between I and i. The insured is well aware of his (her) own behavior and characteristics. Thus, the insured's conditional estimate of his (her) loss distribution is

$$f(L|I)$$

But the insurer's conditional estimate of the loss distribution at the inception of the policy is:

$$g_I(L|i) \quad \text{where } g_I(L|I) = f(L|I).$$

When the insurance policy is due for renewal (perhaps after one year), the information set may have changed. One possibility is that the observable characteristics of the insured may have changed (e.g.,

the insured is one year older, the vehicle has been changed, the drivers may have been involved in accidents, or there is a change in the location of the risk). Such changes would redefine the information set I but the asymmetry may persist because the "hidden" characteristics of the insured may still be unobservable to the insurer. The observable changes could change the basic insurance premium charged. Moreover, if the policyholder were to take his business to another firm, the new insurer presumably would record the changed observable features and charge an appropriate premium. Such changes in observable characteristics are not pursued here; instead this analysis focuses on information updates which redress the information asymmetry. Thus the information set I is held constant over time.

Although the insurer observes only some portion i of the information set I when the policy is first contracted, it may well be that as the contract unfolds, the insurer is offered an opportunity to monitor the insured and to observe directly or indirectly some of those characteristics that were hidden at inception. For example, the insurer can observe the conduct of the insured in bargaining and testifying, in following the contract conditions, or in making timely premium payments. Moreover, the insurer gets a full report on the number and circumstances of any claims made on the policy. Thus, after the contract has been in force for some time, the insurer can be expected to know its insured better. At renewal of a two period contract (i.e., at the start of the second period), the information available to the insurer is $(i+\Delta i) \subset I$. Correspondingly, the insurer's estimate of the loss distribution at renewal is

$$g_2(L|(i+\Delta i)) \quad \text{where } g_2(L|I) = f(L|I)$$

It is convenient to refer to the information set i as PATENTLY OBSERVABLE, and to the set Δi as LATENTLY OBSERVABLE. The latently observable information is, by definition, not observable to the insurer at the inception of the policy and is only generated through the proximity of the contractual relationship. Although this information may be available to the existing insurer at renewal, it will not be observable to rival firms who might compete for the renewal business, unless the existing firm chooses to share this information. Thus, if the policy were not renewed with the same firm but a new policy were contracted with another insurance firm, the new firm would record only patently observable information i. The salient characteristic of the latently observable information is its non-portability.

Following through the dynamics of these thoughts, a new insurance contract with one firm faces information asymmetry between the insured and the insurer. Over time the asymmetry may diminish as the existing insurer can monitor its own insureds. But such monitoring is not undertaken by rival firms. Thus the diminishing asymmetry between the insured and the contracting insurer may be replaced by a widening asymmetry between the contracting insurer and its rivals. Of course, the issue is not confined to insurance contracts. The current employer of a manager will have a comparative advantage in assessing managerial skills vis a vis rival firms who have not had the opportunity to monitor his (her) performance. Likewise, the existing insurer has a comparative advantage in estimating the loss distributions

of its own existing book of business vis a vis rival insurance firms who might compete for that business.

Now consider the demand function for insurance assuming that the firm has categorized its new policyholders according to observed characteristics. Thus, there is a set of rating groups, each group containing observably homogeneous policyholders. The demand for one such group is examined. The distribution of the aggregate loss payout (as estimated by the policyholders who have full information on their loss characteristics) is assumed to be described completely by its first "n" moments, M_{fn}. The demand for new policies from this group is

$$F_1 = F_1(M_{fn};\ p;\ p_c;\ \theta_1)$$

where p is the price charged by the firm in question, p_c is the vector of prices of rivals and θ is the set of nonprice variables (e.g., perceived service, financial solidity, etc.) that may affect demand. At renewal, the demand is

$$F_2 = F_2(M_{fn};\ p;\ p_c;\ \theta_2).$$

Since the information set I has not changed for each insured, the demand function will shift in price quantity space only if the prices charged by rival firms change or if there are changes in the nonprice variable (e.g., the client becomes dissatisfied with the firm's service). Unless the existing firm shares information from the set Δi, there is no reason for the prices charged by rival firms to change. At the beginning of period 1 rivals could observe only i and at the beginning of period 2 they will still observe only i. Consequently, the

demand function will shift only in response to changes in nonprice factors defined by the vector θ.

IV. A Model of Insurance Selection and Pricing with Non-Portable Information

A two-period wealth maximizing strategy for the insurer is now determined. The assumptions used to generate this model are:

1) All insureds in a cohort display identical observable characteristics i.

2) All insurers observe these characteristics at inception. At this time all insurers share the same information.

3) However, insureds may differ with respect to non-observed characteristics. The group is divided between "good" and "bad" risks but the relevant characterstics which distinguish any individual are known only to that individual. Thus, the insured observes the full information set I that determines this loss density function. The underlying characteristics of each insured, as defined by the set I, are constant over time.

4) Each firm is a price taker on new business.

5) Firms write new policies at the beginning of the first period. Further information (Δi) is revealed to the contracting insurer on its own policyholders at the end of the first period. This information is not revealed to rival firms. The existing firm will invite or decline renewal of its own policies at the beginning of the second period. If renewal is invited, an appropriate premium is charged.

6) The insurer is a wealth maximizer. Wealth is defined as the sum of all profits capitalized at the beginning of the first period.

7) Initial expenses, m, per policy decline with the number of policies issued. Other costs (i.e., renewal costs, x, and the expected loss per policy, L) are invariant with respect to quantity. These restrictions are not fundamental to the insights of the model but permit considerable simplication.

These assumptions are intended to describe a market that is competitive with respect to patently observable information. However, information

asymmetries do exist. The insured has a comparative information advantage with respect to all insurers. However as policies mature, this comparative advantage is reduced. In its place, the contracting insurer develops a comparative advantage over rival firms with respect to its own policyholders.

Little generality is lost by concentrating on a cohort of new policies that are observably similar and are charged the same premium at inception. However within this group there are "good" and "bad" risks distinguished by hidden or latent characteristics. "Good" risks have a lower than average expected loss, signified by $\underline{L}$, for the group and "bad" risks have a higher than average loss expectance for the group, signified by $\overline{L}$. Each insurer knows that its new policyholders may include a disproportionate number of "lemons." These are risks for which previous insurers have accrued adverse information and have declined to renew. But this information is not revealed by the previous insurer and the new insurer is unable to distinguish lemons from other new policyholders. Thus, the new firm estimates that with probability g, a new policyholder will be a "good" risk and with probability (1-g), a bad risk. This probability may be based on previous experience. Since all insurers have the same (i.e., observable only) information on new policyholders, they all hold the same estimate "g." Thus, a single price, p, exists in the market for new policies.

Now consider the effects of the generation of latent information on some subset of policies $\pi \subset q$. The information revealed to the contracting insurer on these policies is unfavorable in the sense that it causes the

insurer to reduce its probability that each of these policyholders will be a good risk. For each individual n in the subset π,

$$\text{Prob } n \subset \pi \text{ being a good risk is } \underline{g} \text{ where } \underline{g} < g.$$

Policies renewed from the subset π will be denoted by subscript A. The insurer receives no information on policyholders in the residual subset $(q-\pi)$. However, the average expected losses in this group will have changed since it now excludes the subgroup π who are likely to be worse than average. The probability that an individual n in this subset is a good risk is,

$$\text{Prob } n \subset (q-\pi) \text{ being good risk is } \overline{g} \equiv \frac{qg - \pi\underline{g}}{q - \pi}$$

Since $\underline{g} < g$, then $\overline{g} > g$. Under this scheme, "No news is good news!" Policies renewed from the residual subset $(q-\pi)$ will be denoted by subscript N.

These information effects produce a somewhat familiar form to the function for renewal business for the contracting firm. By assumption, all firms observe the information subset i and each firm is a price taker on new business. Thus, after one year, if the contracting insurer increases the price for renewal of its policies above the new price, it will lose the renewal business to rivals. Policyholders can take their business elsewhere and be offered the market determined new price. But the infinite demand elasticity does not extend to price reductions since we are not discussing new business to the contracting firm but its renewal business. Although a price reduction may affect the proportion of policyholders that renew their policies, this

proportion is naturally bounded at unity. Consequently, the demand curve for policy renewals will be kinked at the new business price.

The firm maximizes its profits with respect to the quantity of new policies q, the proportion k of renewals from subset π and the proportion j of renewals from subset $(q-\pi)$.

$$(1)\quad \underset{q,k,j}{\text{MAX}}\ E = \underset{q,k,j}{\text{MAX}} \left[\underset{q}{\text{MAX}}\ [q(p_1 - x - g\underline{L} - (1-g)\overline{L} - m)] \right.$$

$$\left. + \underset{k,j}{\text{MAX}} \{ [D_A^{-1}\pi k(p_{2A} - x - g\underline{L} - (1-\underline{g})\overline{L})] \right.$$

$$\left. [D_N^{-1}(q-\pi)j(p_{2N} - x - \overline{g}\underline{L} - (1-\overline{g})\overline{L})] \} \right]$$

Solving recursively, we first look at the derivatives for k and j. These are respectively

$$(2)\quad D_N^{-1}(q-\pi)[P_{2N}(1 - \frac{1}{e_N}) - (x + j\frac{dx}{dj} + \overline{g}\underline{L} + (1-\overline{g})\overline{L})]$$

$$(3)\quad D_A^{-1}\pi[P_{2A}(1 - \frac{1}{e_A}) - (x + k\frac{dx}{dk} + g\underline{L} + (1-\underline{g})\overline{L})]$$

Unless there is a sizable reduction in marginal expenses, condition (3) will be negative at the new price. The new price can be no greater than the marginal cost of new business, given wealth maximization and competition for new business. The marginal cost of the subset π will be higher than that for new business. Attempts to increase the price for this business will encounter the high (infinite) elasticity of the demand curve. This situation is depicted in Figure 1 which shows the kink in the demand curve at the new price p_1 and infinite elasticity

with respect to price increases. Given the restrictions imposed, the marginal cost curve is constant and, for the "bad" risk group, lies above p_1. The firm renews no policies in this case since MC > MR at all quantities.

The lower portion of the demand curve has different features. Recalling the discussion between latent and patent information, it was assumed that information revealed to the insurer at renewal represented a redress of an opening information asymmetry between the insured and insurer. Thus, while the insurer may revise its loss probabilities on acquiring this information, the insured still has the same information, I. Unless there are other disturbances (death of policyholders, dissatisfaction with nonprice features of the insurance contract, changes in tastes, etc.) there would be no change in the demand function. In this circumstance, all those buying new policies at the new price would continue to renew at the same price. In consequence, the demand curve would have zero elasticity of the value j=1 (i.e., all policyholders in the set $q-\pi$ would renew and the demand curve would be vertical at j=1). With disturbances of the form described, some policyholders may indeed fail to renew at the current price but may be persuaded to renew if the price were to fall. In this case the demand curve would exhibit some positive elasticity at quantities below j=1. But since renewals are constrained at j=1, the demand curve would revert to zero elasticity at this volume. With these thoughts in mind, we show an inelastic lower segment to the demand schedule and now address underwriting renewal strategy for the subset $(q-\pi)$. In proceeding, the reader may bear in mind the strong

anologies with kinked demand curve developed by Sweezy (1939) to analyze oligopoly and its predictions of price stability.

If the insurer is to sell policies to the subgroup $(q-\pi)$, it is apparent that the (constant) marginal cost must be no greater than marginal revenue at new current price p_1. In fact, since costs have fallen due to the weeding out of the set π, condition (3) will be positive at the new price p_1. But the discontinuity in the marginal revenue curve implies that a small price reduction would cause a discrete change in the sign of condition (3) from positive to negative. Consequently it is optimal for the insurer to renew j* policies at the prevailing price p_1.

Putting these thoughts together, it is observed that policies would be renewed at the new price or renewal would be declined by the insurer. A possible exception to this observed price stickiness may arise if both (a) the improvement in loss expectancy for the set $(q-\pi)$ is dramatic and (b) demand below p_1 is of elasticity in excess of unity. Condition (b) is required to ensure equality of marginal cost and marginal revenue in the positive quadrant. This possibility is illustrated in Figure 2; the new price and proportion renewed are p_R and j*. Having discussed this prospect, we think it unlikely. For reasons stated earlier, the information released to the insurer represents a correction of a prior asymmetry vis a vis the insured. Therefore, insureds have no cause to revise their loss expectations and, in the absence of major exogenous changes, demand should be inelastic (possibly of zero elasticity) in this region.

Finally, there is the question of how many policies the firm should initially underwrite at the prevailing market price p_1. Bearing

in mind that no policies will be renewed for the subset π (i.e., $k^*=0$) and that $p_{2N} = p_1$ the first order condition of (1) with respect to q is

$$\{[p_1] - [x+g\underline{L}+(1-g)\overline{L}+m+q\frac{dm}{dq}]\}$$

(4)

$$- \{[D_N^{-1}j(1 - \frac{d\pi}{dq})p_1] - [D_N^{-1}j(1 - \frac{d\pi}{dq})(x+\bar{g}\underline{L}+(1-\bar{g})\overline{L})]\} = 0$$

We assume that this condition may be satisfied given the "U" shape initial costs m. The expression shows the marginal costs and marginal revenues on year 1 business (first braces) and on year 2 business (second braces). The analysis of condition (2) reveals that the term in the second braces will be positive ($p_1 > (x+\bar{g}\underline{L}+(1-\bar{g})\overline{L}$) which implies that marginal cost will exceed price on first year business. (The term is the first braces will be negative.) The intuition of this result is straightforward. The firm will apparently oversell (marginal policies are written at a loss) new policies in order to increase the number of profitable renewals remaining in the residual set ($q-\pi$). It is also apparent from condition (4) that the firm will make normal capitalized profits on the cohort as a whole in light of the perfectly competitive nature of the new business market. The price p_1 will be set below that necessary to cover average cost of the representative firm on year 1 business. Any different opening price would be corrected by the entry and exit of new firms.

V. Some Signaling Issues

The prediction of price stickiness rests upon the privacy of new information to the contracting insurer. The asymmetry between the

contracting insurer and its rivals may be closed if a clear signal can be transmitted that cannot be mimicked (see Spence (1974), Rothschild and Stiglitz (1976), Riley (1975)). At renewal, the existing insurer has no incentive to send such a signal but those insureds, for whom adverse information has not been revealed, would benefit from such a signal. However, it appears that the contracting insurer may be forced to disclose the information it has acquired on its own clients, Δi, by its invitation to renew. Simply by requiring new clients to bring evidence of invited renewal from their previous insurer, a rival can exactly replicate the dichotomous renewal strategy of the contracting insurer. In these circumstances, the prediction of price stickiness will fail. At the beginning of the second period, all insurers would now separate policies along the lines of the contracting insurer. We would observe separate contracts being offered to the two groups for which different information was revealed.

In practice, the prevalence of declining loss ratios implies either that firms fail to pick up the renewal signal or the information signal is more cloudy and is unable to fully transmit the information subset Δi. In the example developed above, the information gap between the contracting insurer and its rivals was closed only because one signal (the invitation to renew) was required to convey a single piece of information (whether adverse information had arisen). In fact, the information set Δi is likely to be more complex, represented by an "n" element vector, and may be used to classify into more than two groups. Clearly one signal is inadequate.

A second consideration is that the contracting insurer has an incentive to "scramble" the renewal signal and thereby make it more costly for rival firms to observe. In a different context, many employees are "fired" not by undertaking a formal dismissal procedure but by use of devices which make it attractive for the employee to seek other employment (e.g., no raise, no promotion, assignment of "dirty" jobs, etc.). Similarly the insurer can often "persuade" insureds not to renew by use of devices such as lowering policy limits or increasing deductibles, taking a less than generous position in settling a claim or imposition of an unacceptable premium increase. Under such circumstances, the invitation to renew has little meaning.

It is possible that rivals could monitor the whole range of behavior of the contracting insurer with respect to individual clients and indirectly infer the information Δi. But observing this myriad of signals is costly to rivals, thereby maintaining the comparative advantage of the contracting firm.

VI. Discussion

The underwriting and pricing strategy developed here may be characterized on the following lines. By writing new policies, the contracting insurer purchases an option to renew those contracts in subsequent periods. The selective option to renew at a constant price yields quasi rents on renewals. The fixed striking (renewal) price arises from the nonportability of sequential information. The loss taken on new contracts may be thought of as the price of the renewal option. In a competitive market this option price would equal the

capitalized value of future quasi rents, thus the cohort as a whole would not generate monopoly rents.

The analogy with options is useful if not pushed too far.[3] In investment options, the value of the option is directly related to the variance of the terminal value of the underlying asset. In our example, the variance is determined, in part, by the unobserved variability in new contracts. This unobserved variability is the feature that gives rise to the "lemons" problem, i.e., to adverse selection against the insurer. In this model the greater the hidden diversity, the more valuable the option to renew at a fixed price. The insurer is quite willing to write new policies at a loss knowing well of adverse selection. The greater the diversity, the greater the potential information that can be revealed to the contracting insurer at renewal. By using this information to practice selective renewal at a fixed price, the insurer has at its disposal a (partial) antidote to the adverse selection problem. This mechanism is quite different to that offered by other writers (Boyer and Dionne (1986), Dionne and Lasserre (1985), Landsberger (1984)). These writers start with the proposition that adverse selection stems from the inability to price correctly each individual policy. But in their analysis the generation of sequential information will affect price (e.g., through experience rating) and the impounding of information in prices offers a solution (at least in part) to adverse selection. Our model offers a different mechanism based upon the privacy of sequential information to the contracting insurer. Adverse selection is redressed not by using the generated information to change prices, but by putting it to work to practice

reverse selection by the insurer against its clients. The difference between our model and prior models rests on the portability of information. While not denying that some information is portable and may feed into prices, the observed aging phenomenon implies that other information is non-portable. This lends support to our nonprice/reverse selection model as a complimentary antidote to adverse selection.

These thoughts also carry implications for long term contracting. Typically, an insurance policy runs for a period of six months or one year. Consider the case for a longer term contract that guarantees renewal at a fixed price. Such a contract would be costly to the insurer since it foregoes the right to select renewals. If the composition of demand were fixed, and markets competitive with respect to observable information, the loss taken on new business would provide a measure of the value of potential long term contracts. However, the demand for such contracts is likely to be concentrated amongst those policyholders for whom short term contracts offer a high probability of nonrenewal. Consequently, the loss taken on new business would provide only a lower bound on the value of a potential guaranteed renewal option since the renewal option itself would expose the insurer to further adverse selection. This issue carries some regulatory implications since some states limit the right of insurers to decline renewal (e.g., New York permits auto insurers to decline only up to 2% of their current policies).[4] This analysis implies that the introduction of such a law, ceteris paribus, would lead insurers to increase prices for new policies to cover the loss of the nonrenewal option and that insurers would not exhibit such a dramatic "aging" pattern.

Finally the model developed here yields a set of specific predictions which explain aging. The model predicts that insurers (a) will write new business at a loss (they will oversell new policies) in order to secure the option on client specific quasi rents on future renewals, (b) will not disclose latently observable information concerning their existing clients to rivals, (c) will selectively renew policies on the basis of latent information, (d) will tend to maintain the new price even though surviving policies are, on average, better risks, and (e) will exhibit declining loss ratios as successive cohorts of policies age. These features define a market response to adverse selection when sequentially generated information is non-portable.

Footnotes

[1]This price inflexibility is similar to the two examples cited by Stiglitz (1984) in a description of imperfect information and price stickiness. The use of price as an indicator of quality and the effect of search costs were used by Stiglitz to explain sticky prices.

[2]Had the severity and frequency data been available on the same basis (e.g., both referring to all coverages or both referring to physical damage), we could isolate the effects of the numerator and denominator on the loss ratio. Unfortunately, comparable frequency and severity data were not available.

[3]The reader will note that the insured also has an option to renew. In effect we are dealing with a portfolio of different options.

[4]The statutes regulating nonrenewal of automobile insurance policies tend to give insurers free rein in electing not to renew a policy. Thirty-three states and the District of Columbia do not restrict non-renewals, five states restrict nonrenewals to the same grounds as cancellations, and twelve states, including New York, legislate specific grounds and other limitations on nonrenewals. For a complete analysis of cancellation and nonrenewal provisions, see the American Insurance Association (1986).

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Figure 1

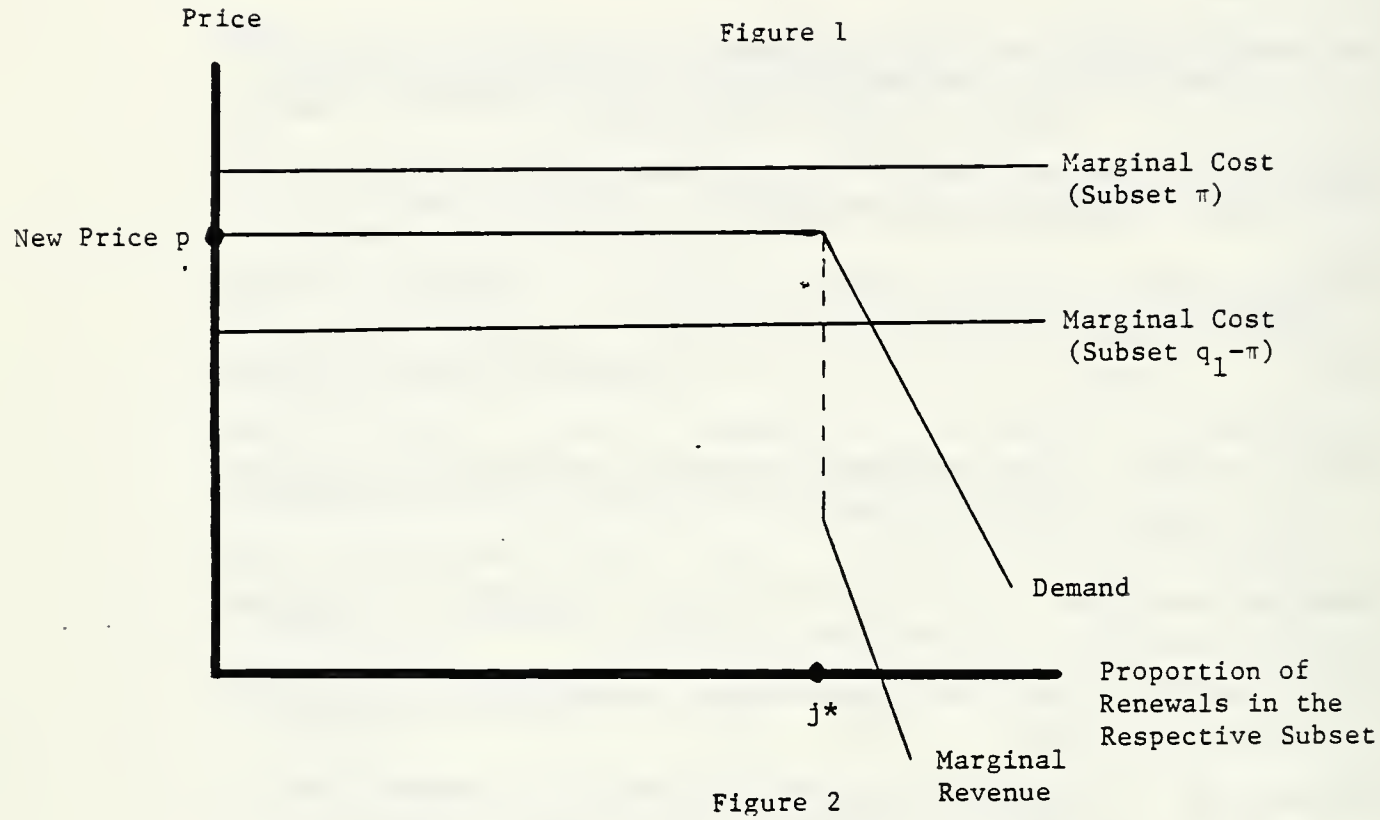

Figure 2

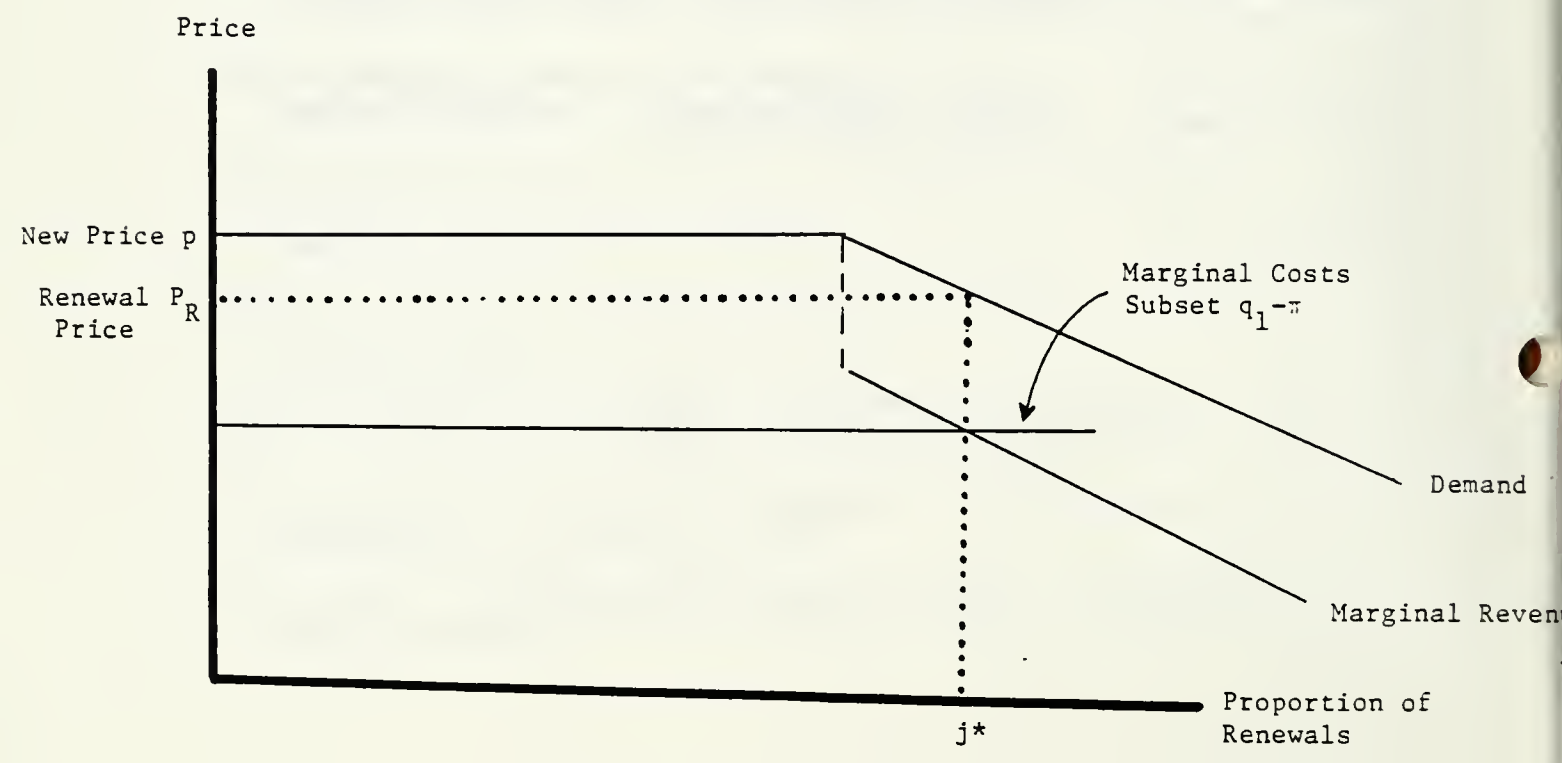

Table 1

Aging Phenomenon in
Private Passenger Automobile Insurance

Company A

Age of Policies in Years	Loss Ratio	Frequency*	Severity**
1	97.9	26.0	664
2	87.7	23.8	604
3	74.7	21.0	569
4	76.2	19.7	592
5	67.6	18.9	564
6	63.2	17.9	568
7	58.2	17.5	504
8	63.1	17.8	538
9	60.0	17.7	482
10	55.8	17.4	NA
11	56.3	16.6	NA
12	53.1	17.3	NA

Company B

1-4	53.7
5 and over	39.1

*Total claims on all coverages combined per 100 policies.

**Physical damage claims only.

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