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The coexistence of distribution systems under price search: Theory and some evidence from insurance

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Abstract

This paper analyzes a pure price search model of an insurance market in which two different search technologies are simultaneously available: sequential search and nonsequential search. Sequential search characterizes firms that sell directly to consumers and nonsequential search characterizes firms who use independent agents that sell the products of a number of different firms. The separation of firms and consumers into the two market sectors is endogenously determined, and the conditions for equilibrium coexistence are derived. The characteristics of price distributions in the two sectors are then compared in a coexistence equilibrium. Price distributions observed in automobile insurance markets are found to be consistent with the predictions of the theoretical model. © 1998 Elsevier Science B.V.

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1. Introduction

The theoretical literature on consumer search demonstrates that nondegenerate price distributions can exist under a variety of assumptions regarding consumers' information sets and search technologies. Empirical studies have found the nature of price dispersion in insurance markets to be broadly consistent with these results (Mathewson, 1983; Dahlby and West, 1986; Berger et al., 1989; Schlesinger and von-Schulenberg, 1991). This paper incorporates an important aspect of insurance markets which has not previously been considered in the price search literature: the coexistence of two different

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systems for distributing products. Some insurance firms (referred to here as direct writers) use direct selling techniques or agents who represent solely one firm. Other insurance firms use independent agents who sell the policies of more than one insurer. These different methods of distribution dictate that consumers use different shopping strategies to locate price information. Hence, the coexistence of the two distribution systems can be analyzed from a search perspective.[1]

Most existing analyses of price dispersion in insurance markets have assumed a sequential search process, under which consumers contact one firm at a time and choose the lowest price from the set of sampled firms. Sequential search seems a natural assumption for the direct writing system, as consumers must contact each insurer to receive a price quote. The independent agency system allows consumers to undertake nonsequential search, however. Under this system, consumers may contact only their insurance agents, who then provide an insurance policy from among those insurers represented.

This paper examines the implications of these rival search technologies for equilibrium outcomes in an otherwise competitive market for a homogeneous product. We analyze the potential for the coexistence of the two systems in equilibrium, and characterize the price distributions in such an equilibrium. The price distributions predicted by our theoretical model are then compared to those observed in automobile and homeowners insurance, markets in which products are relatively homogeneous and hence price search should be important. The theory is found to be consistent with empirical reality, lending further credence to the hypothesis that search costs are important for explaining insurance market equilibrium.

Our study contributes to two distinct literatures. First, it extends the literature on price search to consider market outcomes when alternative search technologies are available. This is important since consumers in many markets have a variety of ways in which to locate prices, and might be presumed to optimally choose among them. Our paper also contributes to the literature on the equilibrium coexistence of different systems for marketing a product. This subject has received much study in both the general economics literature and that devoted to insurance institutions.[2] Most existing research has focused on the relative advantages of the competing distribution systems in dealing with incentive conflicts between a firm and its sales agents. This literature thus derives the internal motivations for a firm's choice between marketing directly or through independent agents, abstracting from consumers' choice of firm. This paper considers the choices of both firms and consumers regarding which distribution system to utilize, abstracting from agency problems to focus on search behavior.

This paper is related to Posey and Yavas (1995) in emphasizing that the independent agency and direct writing systems are distinguished by the search processes of consumers using the systems. These authors modeled the insurance market in terms of two-sided search, with consumers searching to find an appropriate insurance policy and firms

[1] This point was first noted by Posey and Yavas (1995).

[2] Recent studies of the insurance market include Berger et al. (1997) and Regan and Tennyson (1996). General studies using empirical evidence from insurance include Marvel (1982) and Grossman and Hart (1986) and Sass and Gisser (1989).

searching to find customers with appropriate risk characteristics for their products. Independent agents act as middlemen in facilitating a match between consumers and firms, while under direct writing matches are made without the aid of a middleman. Two key features of the model are that insurance products differ across firms, and price is exogenously determined.

Our paper differs in that it examines the case in which firms offer identical products, and consumers search only over price; hence, price is determined in equilibrium in our model. The sole distinction between independent agency and direct writing is the method employed by consumers to obtain price information. The basic search processes employed in the paper are adapted from the sequential and nonsequential search models developed in MacMinn (1980). The contribution of this paper is to incorporate the two models into a single market to examine coexistence.

The next section describes the foundations of the theoretical model. Section 3 and Section 4 develop and analyze the model, deriving the necessary and sufficient conditions for equilibrium coexistence of the two search technologies, and examining the characteristics of a coexistence equilibrium. Section 5 illustrates that price distributions in personal automobile insurance lines are consistent with the predictions of our theory. The final section of the paper summarizes and interprets our findings.

2. The market environment

Consider a single market for a homogeneous insurance product. There exists a continuum of firms in the market, distinguished only by their costs of producing this product. Each firm faces constant marginal costs of production, and each can produce sufficient output to meet all demand. Firm per unit costs range over the interval $[\underline{m}, \bar{m}]$. Let $H(m)$ denote the distribution function of firm costs and $h(m)$ its associated density function, with mean μ_{m} and standard deviation σ_{m}.

There are two possible methods of distributing the product to consumers: through direct writing or through independent agents. Each firm can employ only one of these methods.[3] The marketing systems are distinguished by the search processes consumers must employ to find a firm with the lowest (acceptable) price. Direct writing necessitates that consumers search for prices by sampling sequentially from the set of direct writing firms. The use of independent agents allows consumers to choose randomly one agent from a continuum in the market, and receive the lowest priced policy the agent offers.[4] Each agent is assumed to represent $n>1$ firms who are randomly assigned from the distribution of firms using the independent agency selling methods.[5]

[3] Although, in practice, some firms employ more than one distribution method, they typically choose a single method for each product. Our model does not consider the choice of primary distribution system for the firm as a whole, but rather the choice of system for a single homogeneous product.

[4] This assumption is made to preserve analytic simplicity. If agents deviate from this strategy, for example by offering that policy which yields the highest commission or other benefits to the agent, the case for consumer use of independent agents will be weakened.

[5] This may be thought to characterize a market in an urban area where insurers sell through more than one agent and have no control over which other insurers their agents represent.

The market also contains a continuum of consumers, each of whom buys exactly one unit of the product. Each consumer chooses either the sequential search process (shopping among direct sellers) or the nonsequential search process (shopping among independent agency firms) before beginning to shop for a policy.[6] Consumers are distinguished only by their costs of sequential search. Search costs are assumed to arise due to the need to locate and contact insurers, and to compare prices across policies. These costs may differ across consumers due to differences in their level of comfort in making price inquiries, or to differences in their knowledge of how to locate or contact insurers. Consumer search costs per contact, c, are assumed to be uniformly distributed on the interval $[0,T]$.

As an alternative to sequential search, consumers may instead choose a nonsequential search process. This process involves contacting only a single independent agent who undertakes price search and price comparisons for the consumers. In general, nonsequential search may cost some fixed amount to initiate. However, this cost is unlikely to vary much across individuals, since it is the agent who contacts insurers and compares prices. For analytical simplicity, we thus assume there are no costs to nonsequential search.[7]

In equilibrium each consumer will choose to shop in that marketing system which yields the lowest expected total price given his search costs, the pricing decisions of firms, and the fraction of firms using each system.[8] Each firm will utilize the marketing system which yields it maximum expected profits given its costs, consumer search strategies, and the distribution of consumers across the systems. We model decisions as being made in two stages. In the first stage each consumer and firm chooses a marketing system in which to operate; in the second stage firms choose prices and consumers choose search strategies which are optimal within their chosen marketing systems.

We solve for the equilibrium of the model by backward induction. The solution procedure for the second stage thus begins with a set of assumptions regarding the division of firms and consumers across the marketing systems. Taking this division of firms and consumers across the sectors as given, we characterize the equilibrium price distributions in each market sector. We then derive the choice of market sector by each consumer and firm, and show that our assumptions regarding the division of firms and consumers across sectors are consistent with first stage optimization.

3. Stage 2: equilibrium price distributions

Consumers are distinguished by their costs of sequential search, and these costs are incurred only in the direct writing market; hence, it seems reasonable to suppose that

[6] This assumption is consistent with experimental evidence presented by Moon and Martin (1996) that most individuals generally utilize a single, consistent search strategy, even across different tasks.

[7] This assumption is consistent with the survey findings that a majority of consumers locate their insurance agent through referrals from friends or relatives (Berger, et al. (1989).

[8] Consumers are assumed to be risk neutral with respect to search. This assumption is made for tractability, as it results in a one-to-one correspondence between the decision variable of firms and the variables of interest to consumers. Moreover, we believe that the wealth uncertainity induced by search is likely to be of relatively small consequence even to individuals who are sufficiently risk averse to purchase insurance.

consumers with high search costs will prefer the independent agency system. To capture this idea, we assume that there exists some (as yet unspecified) $k \in [0,T]$ such that consumers with costs of search less than or equal to k use the direct writer market and those with search costs greater than k use the independent agency market. Note that k/T consumers have search costs less than k.

The total price paid by a consumer using sequential search is the price of the product plus the costs of search. Hence, a firm in the direct writing market which has a product price equal to that of a firm in the independent agency market would be placed at a competitive disadvantage with respect to the latter firm. This implies that firms using the direct writing market must be able to offer a lower product price in order to induce consumers to undertake costly search. We, therefore, assume that only firms with low costs of production select the direct writing system, and those with higher production costs use independent agency. More formally, we assume that there exists some (as yet unspecified) $m^* \in [\underline{m}, \bar{m}]$ such that firms with costs less than or equal to m^* use direct writing, and those with costs greater than m^* use independent agency.

3.1. The direct writer market: sequential search[9]

We assume that firms with production costs in the interval $[\underline{m}, m^*]$ have entered the direct writer (DW) market, and that consumers with search costs in the interval $[0,k]$ shop in this market. Taking as given these sets of consumers and firms in the market, we solve for the *equilibrium price function* $p_{\rm D}(m;k,m^*)$. The function $p_{\rm D}(m;k,m^*)$ is an equilibrium price function if it maximizes the expected profits of DW firms given consumer demand, where consumer demand is obtained from minimizing each DW consumer's expected total cost of consumption as a function of prices. The equilibrium price characterizes an equilibrium distribution of prices in the DW market, which we will denote by $F_{\rm D}(p_{\rm D})$ defined over $[\underline{p}_{\rm D}, \bar{p}_{\rm D}]$ with density function $f_{\rm D}(p_{\rm D})$, mean $\mu_{\rm D}$ and standard deviation $\sigma_{\rm D}$.

Each consumer in the DW market searches sequentially and continues to contact firms until a price less than or equal to his reservation price is observed. At this point, exactly one unit is purchased. The reservation price of each consumer is endogenously determined, as a function of his costs of search c. A consumer with marginal search cost c has a corresponding reservation price r, determined by the condition that the marginal cost of search just equals its expected marginal benefit. The expected marginal benefit of one additional search (Lippman and McCall (1976)) is simply the expected difference between the consumer's reservation price and the price sampled. Hence, each consumer sets

$$c = \int_{\underline{p}_{\rm D}}^{r} (r - p_{\rm D}) {\rm d}F_{\rm D}(p_{\rm D}) = \int_{\underline{p}_{\rm D}}^{r} F_{\rm D}(p_{\rm D}) {\rm d}p_{\rm D} \equiv g(r), \qquad (1)$$

where the second representation of marginal benefit is obtained by integrating by parts.

The expected total price paid by a consumer is simply the expected purchase price plus the expected costs of search. It can easily be shown that the total price for each consumer

[9] The search process in the direct writer market is based on the sequential search model developed in MacMinn, 1980.

is exactly equal to his reservation price:

$$V_D(c) = E[p_D \mid p_D \leq r] + \frac{c}{F_D(r)} = r \quad (2)$$

where $1/F_D(r)$ is the expected number of searches before a purchase is made. Let $\bar{r}$ represent the reservation price for an individual with search cost k,

$$k = g(\bar{r}) = \int_{\underline{p}_D}^{\bar{r}} (\bar{r} - p_D) \mathrm{d}F_D(p_D) = \bar{r} - \mu_D. \quad (3)$$

The consumer with the highest search cost in the DW market thus expects to pay $V_D(k) = \mu_D + k$.

The equilibrium price distribution for the DW market can be obtained by examining firm behavior given consumer demand. Condition (1) characterizes the reservation price for each consumer. Expected demand from consumers with search cost c at a price less than or equal to p_D is thus $(1/T)F_D(p_D \mid p_D \leq r)$. Total expected demand at a price of exactly p_D is obtained by summing over all search costs and differentiating with respect to p_D. Some algebraic manipulation then yields expected demand for a firm charging p_D of

$$\delta_D(p_D) = \frac{1}{T}(\mu_D + k - p_D). \quad (4)$$

Note that the intercept of the expected demand function is $p_D = \mu_D + k$, the reservation price of the consumer in this market with the highest search cost.

A DW firm with cost m chooses price p_D to maximize expected profits by solving

$$\max_{p_D} \pi_D(p_D, m; k, m^*) = (p_D - m)\frac{1}{T}(\mu_D + k - p_D). \quad (5)$$

The solution to this problem defines the equilibrium price function, and the corresponding equilibrium price distribution, in the DW market.

Lemma 1: *Prices in the* DW *market are uniformly distributed over the interval* $[\underline{p}_D, \bar{p}_D]$, *with* $\underline{p}_D = (3/4)\underline{m} + (1/4)m^* + k$ *and* $\bar{p}_D = (1/4)\underline{m} + (3/4)m^* + k$. *The equilibrium price function for the* DW *market is*

$$p_D(m; k, m^*) = \frac{m}{2} + \frac{\underline{m} + m^*}{4} + k.$$

Proof: See Appendix.

From Lemma 1, we derive the mean and standard deviation of the DW price distribution:

$$\mu_D = \frac{\underline{m} + m^*}{2} + k = \mu_{mD} + k; \ \ \sigma_D = \frac{\bar{p}_D - \underline{p}_D}{\sqrt{12}} = \frac{1}{2}\sigma_{mD}. \quad (6)$$

Notice that the mean of the DW price distribution exceeds the mean of the DW cost distribution μ_{mD} by the size of the highest search cost in the market, and that DW price variance is less than DW cost variance σ_{mD}. Notice also that the maximum consumer search cost affects only the level of DW prices, and not price variation: k enters linearly into price, and hence raises the price of all DW firms equally.[10]

3.2. The independent agency market: nonsequential search[11]

We assume that firms with production costs in the interval $[m^*, \bar{m}]$ have entered the independent agency (IA) market, and that consumers with search costs in the interval $[k,T]$ shop in this market. Given these sets of consumers and firms in the market, we solve for the equilibrium price function $p_{\mathrm{I}}(m;k,m^*)$. The equilibrium price function also characterizes an equilibrium distribution of prices in the market, which is denoted by $F_{\mathrm{I}}(p_{\mathrm{I}})$ defined over $[\underline{p}_{\mathrm{I}}, \bar{p}_{\mathrm{I}}]$, with density function $f_{\mathrm{I}}(p_{\mathrm{I}})$, mean μ_{I} and standard deviation σ_{I}.

Each consumer in the IA market randomly and at zero cost selects one from the set of agents, and receives the lowest priced product the agent offers.[12] Formally, a consumer in the IA market obtains a random sample of size n from the price distribution $F_{\mathrm{I}}(p_{\mathrm{I}})$ and pays the minimum price: $\min\{p_{\mathrm{I}}^1, \ldots p_{\mathrm{I}}^n\}$, where p_{I}^j is the jth observation in the sample of size n. The density function of $\min\{p_{\mathrm{I}}^1, \ldots p_{\mathrm{I}}^n\}$ is $nf_{\mathrm{I}}(p_{\mathrm{I}})[1 - F_{\mathrm{I}}(p_{\mathrm{I}})]^{n-1}$. Hence, a consumer in the IA market expects to pay a price of

$$V_{\mathrm{I}} = \int_{\underline{p}_{\mathrm{I}}}^{\bar{p}_{\mathrm{I}}} p_{\mathrm{I}} n f_{\mathrm{I}}(p_{\mathrm{I}})[1 - F_{\mathrm{I}}(p_{\mathrm{I}})]^{n-1} \mathrm{d}p_{\mathrm{I}} = \underline{p}_{\mathrm{I}} + \int_{\underline{p}_{\mathrm{I}}}^{\bar{p}_{\mathrm{I}}} [1 - F_{\mathrm{I}}(p_{\mathrm{I}})]^n \mathrm{d}p \tag{7}$$

The equilibrium price distribution can be determined by analyzing firm behavior given that of consumers. The expected demand in the market at a price no greater than p_{I} is $\{1 - [1 - F_{\mathrm{I}}(p_{\mathrm{I}})]^n\}(T - k)/T$, where $(T-k)/T$ denotes the set of consumers using the IA market. Total expected market demand at price exactly equal to p_{I} can be obtained by differentiating this expression with respect to p_{I}. This yields expected demand for a firm charging p_{I} of

$$\delta_{\mathrm{I}}(P_{\mathrm{I}}) = n[1 - F_{\mathrm{I}}(p_{\mathrm{I}})]^{n-1}\left(\frac{T-k}{T}\right). \tag{8}$$

An IA firm with cost m thus maximizes expected profit by choosing p_{I} to solve

$$\max_{p_{\mathrm{I}}} \pi_{\mathrm{I}}(p_{\mathrm{I}}, m; k, m^*) = (p_{\mathrm{I}} - m)n[1 - F_{\mathrm{I}}(p_{\mathrm{I}})]^{n-1}\left(\frac{T-k}{T}\right). \tag{9}$$

The solution to the problem (9) defines the equilibrium price function, and the corresponding equilibrium price distribution, in the IA market.

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[10] In equilibrium, however, k will affect the degree of price dispersion through its effects on the value of m^*.

[11] The search process modeled in the independent agency market is adapted from the nonsequential search model presented in MacMinn.

[12] This implies that only the lowest priced firm at each agent will make any sales. This does not rule out price dispersion because firms can be represented by multiple agents, and hence higher priced firms still have positive probaility of being the lowest price firm represented by some agent.

Lemma 2: *Prices in the IA market are uniformly distributed over the interval* $[\underline{p}_{\mathrm{I}}, \bar{p}_{\mathrm{I}}]$, *with* $\underline{p}_{\mathrm{I}} = ((n-1)/n)m^* + (1/n)\bar{m}$ *and* $\bar{p}_{\mathrm{I}} = \bar{m}$. *The equilibrium price function for the IA market is*

$$p_{\mathrm{I}}(m; k, m^*) = \left(\frac{1}{n}\right)\bar{m} + \left(\frac{n-1}{n}\right)m.$$

Proof: See Appendix.

Lemma 2 defines the mean and standard deviation of the IA price distribution as,

$$\mu_{\mathrm{I}} = \left(\frac{n+1}{2n}\right)\bar{m} + \left(\frac{n-1}{2n}\right)m^* = \mu_{\mathrm{mI}} + \left(\frac{1}{2n}\right)(\bar{m} - m^*);$$

and

$$\sigma_{\mathrm{I}} = \frac{\bar{p}_{\mathrm{I}} - \underline{p}_{\mathrm{I}}}{\sqrt{12}} = \left(\frac{n-1}{n}\right)\sigma_{\mathrm{ml}}. \tag{10}$$

As in the sequential search market, the mean of the IA price distribution μ_{I} exceeds that of the cost distribution μ_{mI}, and the standard deviation of IA prices σ_{I} is less than the standard deviation costs σ_{mI}. Further examination of the price distribution reveals that price variability is determined by the prices of the lowest cost independent agency firms relative to the maximum production cost in the market, and that this is driven by the size of n. A larger n raises effective competition in the independent agency market. Hence, as n increases, firms with lower costs lower their prices in order to preserve the likelihood that they are the lowest priced firm in any randomly selected sample of size n.

The uniform distribution for p_{I} allows V_{I}, the price a consumer in the IA market expects to pay, to be expressed as

$$V_{\mathrm{I}} = \left(\frac{2}{n+1}\right)\bar{m} + \left(\frac{n-1}{n+1}\right)m^*. \tag{11}$$

Notice that (11) implies that $V_{\mathrm{I}} < \mu_{\mathrm{I}}$; that is, the price an IA consumer expects to pay is less than the mean price for IA firms. This is because, although prices are uniformly distributed across *firms*, firms with lower prices obtain more customers. A given consumer receives a random sample of prices and the expected value of the sample is μ_{I}, but she obtains the lowest price in that sample. Firms with higher costs charge higher prices but receive fewer customers.[13]

4. Stage 1: equilibrium market structure

Prior to engaging in trading behavior, each consumer and firm chooses one market sector in which to participate. This decision will be made taking as given the choices of

[13] Why the highest priced firm does not exit, thus causing the IA market to unravel, can be explained in two alternative ways. First, the model here applies to only a single product. Insurers typically offer many different products, specializing in particular product lines but offering a full range of policies nonetheless. Hence, a firm which is high cost (price) for one product need not be high cost (price) for all products. Second, firm costs (and hence prices) are stochastic over time. Winter (1991) shows that firm-specific shocks to losses or investment returns in one period can lead to changes in total costs of coverage (through their effects on the stock of capital) in future periods. Hence, a firm with high cost (price) in one period need not be high cost (price) in all periods.

all other participants, and the second period equilibrium price distributions which will therefore arise in each market. Our analysis focuses on whether the second stage price distributions are compatible with entry into both market sectors in the first stage, and hence with equilibrium coexistence of the two marketing systems. We have posited that low search cost consumers and low production cost firms will enter the DW sector. A coexistence equilibrium is therefore defined as follows:

Definition: *The pair* $(k, m^*) \in (0, T)x(\underline{m}, \bar{m})$ *represents an equilibrium division of firms and consumers into the DW and IA markets if, given the equilibrium price distributions* $p_{\mathrm{D}}(m; k, m^*)$ *and* $p_{\mathrm{I}}(m; k, m^*)$,

1. *consumer for whom* $c \leq k$ *use the DW system, and consumers for whom* $c > k$ *use the IA system.*
2. *firms for which* $m \leq m^*$ *use the DW system and firms for which* $m > m^*$ *use the IA system.*

We establish the existence of such an equilibrium by construction.

We begin with consumers' choice of market sector in which to shop, taking as given m^* such that firms separate into the two sectors. The individual with the highest search cost in the sequential search market must be just indifferent between undertaking sequential search and not doing so. That is, $V_{\mathrm{D}}(k) = V_{\mathrm{I}}$, or equivalently, $\mu_{\mathrm{D}} + k = V_{\mathrm{I}}$. Substituting for V_{I} and μ_{D} in this relationship defines k as a function of m^*:

$$k = \left(\frac{1}{n+1}\right)\bar{m} + \left(\frac{n-3}{4(n+1)}\right)m^* - \frac{\underline{m}}{4}. \tag{12}$$

Eq. (12) can be though of as the 'consumer reaction function'. Observe that it is increasing and linear in m^*: a greater fraction of firms using direct writing results in a larger fraction of consumers choosing to shop in the direct writing sector. The values of $\underline{m}$, $\bar{m}$ and n affect the positioning of this reaction function in k–m^* space. Larger values of m decrease $k(m^*)$, implying that less disperse firm production costs (or equivalently with m^* held constant, a smaller fraction of firms using the direct writing system) results in fewer consumers shopping in the direct writer market. Conversely, larger values of $\bar{m}$ increase $k(m^*)$, implying that more disperse firm production costs (or a larger fraction of firms using the independent agency system) increases the fraction of consumers shopping in the independent agency market. Large values of n decrease $k(m^*)$, implying that a larger sample of prices received in the independent agency market results in a greater fraction of consumers using that market.

We can also characterize the choice of marketing system by firms, taking as given k such that consumers separate into the two sectors. The firm which is just indifferent between direct writing and independent agency must expect to receive equal profits under each system. Hence, the production cost m^* is defined by the condition $\pi_{\mathrm{I}}(p_{\mathrm{I}}(m^*; k, m^*), m^*) = \pi_{\mathrm{D}}(p_{\mathrm{D}}(m^*; k, m^*), m^*)$:

$$(T - k)(\bar{m} - m^*) = \left(\frac{\underline{m} - m^*}{4} + k\right)^2 \tag{13}$$

Eq. (13) is the 'firm reaction function', and implicitly defines m^* as a function of k. Notice that there are two solutions to (13), defining two distinct relationships between m^* and k:

$$m^*(k) = \underline{m} - 8T + 12k \pm 8\left[T^2 + \frac{(T-k)}{4}(\bar{m} - \underline{m}) + 2k^2 - 3Tk\right] \tag{14}$$

It can be shown that only the negative root of this equation can lead to coexistence of independent agency and direct writer firms.[14] The positive root leads to an equilibrium with only direct writing firms. Since we are interested in coexistence equilibria, we focus on the negative root throughout the remainder of the paper.

From the negative root of (14), it can be shown that m^* increases with k, implying that an increase in the fraction of consumers using a marketing system increases the fraction of firms using that system. The positioning of the firm reaction function in k–m^* space varies with respect to the parameters T, $\underline{m}$ and $\bar{m}$. An increase in T decreases $m^*(k)$, implying that more disperse consumer search costs induce more firms to enter the independent agency market. An increase in $\bar{m}$ also decreases $m^*(k)$; hence, more disperse firm production costs imply relatively more firms choose independent agency marketing. An increase in $\underline{m}$ results in a more than proportional increase in $m^*(k)$, implying that less disperse firm production costs lead to relatively more firms in the direct writing sector.

The reaction functions $k(m^*)$ and $m^*(k)$ characterize a system of two equations in two unknowns. Our task is now to demonstrate that the solution to this system is consistent with coexistence of the two marketing systems. This necessitates first establishing that consumers and firms will separate into the two market sectors in the way that we have hypothesized: with low (high) search cost consumers and low (high) production cost firms using the DW (1A) system. We then prove that the critical values of the search cost and production cost distributions which divide consumers and firms into the market sectors may lie in the interior of their respective distributions.

4.1. Equilibrium choice of marketing system

It is easy to see that individuals with search costs below the critical value k in Eq. (12) will use the DW system, and those with search costs above k will use the IA system. Because $V_D(c)$ is increasing in c, and V_I is constant, when consumers split between the two marketing systems at k – with those having search cost above k using the IA system and those having search cost below k using the DW system – no consumer will have an incentive to deviate from his marketing system choice.

In order to prove that firms with costs less than the critical value m^* choose direct writing and those with costs above m^* choose independent agency, we must demonstrate that taking k and the marketing system choices of other firms as fixed, no firm will have an incentive to switch marketing system. With a continuum of firms, it can be assumed that if a single firm switches systems there will be no impact on the price distributions.

[14] This is proven in the Appendix. From the negative root of (14) it can be seen that a sufficient condition to assure that the solution to m^* is nonimaginary is that firm production costs are sufficiently disperse relative to consumer search costs: $\bar{m} - \underline{m} > 4T$. This condition is also assumed to be satisfied throughout the remainder of the paper.

Moreover, since firms in the DW market have lower costs than those in the IA market, any DW firm switching to the IA market will maximize profits by charging the price charged by the lowest cost IA firm (the firm with cost m^*). Similarly, any IA firm switching to the DW market will maximize profits by charging the price charged by the highest cost DW firm (the firm with cost m^*). Using this insight and substituting for $k(m^*)$ from (12) allows the equilibrium price functions in each market to be expressed for all values of m. These price functions are presented in the appendix and are denoted $p_{\mathrm{D}}^*(m;m^*)$ and $p_{\mathrm{I}}^*(m;m^*)$. Using these expressions yields equilibrium profits as a function of m, $\pi_{\mathrm{D}}(p_{\mathrm{D}}^*(m;m^*),m)$ and $\pi_{\mathrm{I}}(p_{\mathrm{I}}^*(m;m^*),m)$, for DW and IA firms, respectively. The equilibrium profit function of a DW firm can be shown to be decreasing and convex in m for all $m<m^*$, and decreasing and linear for all $m>m^*$; conversely, the equilibrium profit function of an IA firm can be shown to be decreasing and linear in m for all $m<m^*$, and decreasing and convex for all $m>m^*$.[15] This, combined with the fact that profits must be equal at m^*, implies that the conditions for nonswitching are simply conditions on the relative slopes of the profit functions as m approaches m^*.

Formally, the necessary and sufficient condition for no firm to have an incentive to switch marketing systems is

$$\left.\frac{d\pi_{\mathrm{D}}(p_{\mathrm{D}}^*(m;m^*),m}{dm}\right|_{m=m^*} < \left.\frac{d\pi_{\mathrm{I}}(p_{\mathrm{I}}^*(m;m^*),m}{dm}\right|_{m=m^*} \tag{15}$$

This situation is depicted in Fig. 1.

4.2. *Equilibrium coexistence of marketing systems*

Eq. (12), Eq. (14) and Eq. (15) define the conditions which assure that consumers and firms will separate into the two marketing systems in the manner hypothesized. If these conditions are satisfied at values of k and m^* in the interiors of their respective distributions, a coexistence equilibrium is obtained. Hence, the interior conditions $m^* \in (\underline{m}\bar{m})$ and $k \in (0,T)$ make up the final conditions for a coexistence equilibrium. Straightforward algebraic manipulation of these five conditions yields the following proposition:

Proposition 1: *A coexistence equilibrium exists if and only if*:

$$4 < \frac{\bar{m} - \underline{m}}{T} < \frac{(n+1)^2}{n+2}$$

Proof: See Appendix.

The proposition states that coexistence of direct writing and independent agency firms requires that the range of firm's production costs be neither too large nor too small relative to the range of consumers' sequential search costs, and that n must be sufficiently large.[16] The left hand inequality requires the range of firm production costs to be sufficiently great relative to the range of consumer search costs. If this condition is not

[15] This is proven in the Appendix (see Lemma 3).

[16] In addition to the condition stated in the proposition, coexistence cannot occur if n is less than 4.

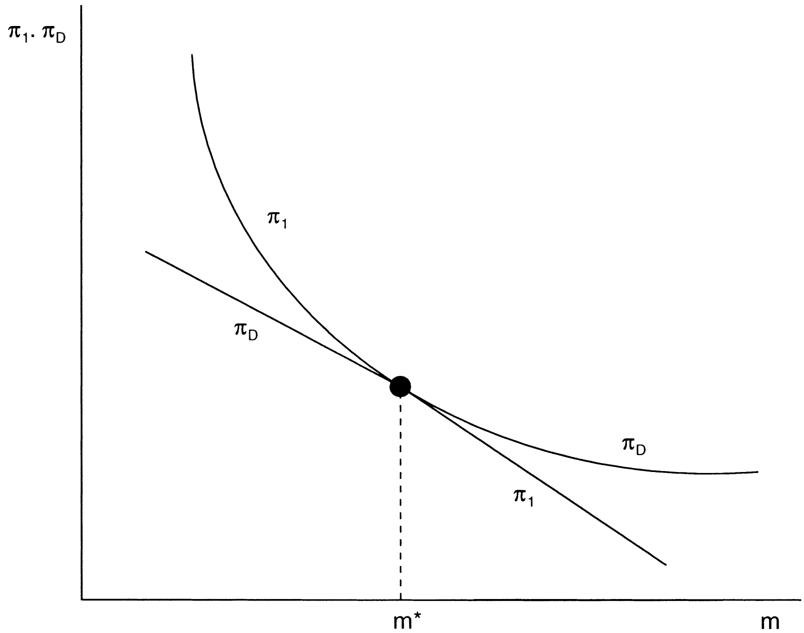

Fig. 1. Equilibrium profits as a function of production costs for independent agency and direct writer firms.

satisfied, all firms and consumers utilize the direct writing market. The right hand inequality requires the range of consumer search costs to be sufficiently large relative to the range of production costs, and the number of firms sampled under independent agency to be sufficiently large. If this inequality is not satisfied then all firms will choose independent agency marketing, but all consumers will choose the direct writing market. Hence, no equilibrium will exist.

The necessary and sufficient conditions for equilibrium coexistence allow us to characterize the price distributions in a market in which both the DW and IA marketing systems operate.[17] These are summarized in Proposition 2.

Proposition 2: *The following characteristics of price distributions will arise in a coexistence equilibrium*:

1. *The mean level of price* (*cost*) *for* DW *firms is less than the mean price* (*cost*) *for* IA *firms*.
2. *The dispersion of prices* (*costs*) *across* DW *firms is less than the price* (*cost*) *dispersion across* IA *firms if* $8(n+1)^2T < (n+3)^2(\bar{m} - \underline{m})$.
3. *The dispersion of prices relative to the dispersion of production costs is less in the* DW *sector than in the* IA *sector.*

[17] We can also show that under our assumptions the aggregate market share of the DW sector will exceed that of the IA sector, and that DW firms are larger on average (in terms of number of policies sold) than IA firms. Interestingly, both of these are features of the U.S. markets for personal property-liability insurance.

Proof: See Appendix

Part (i) of the proposition, that the mean cost and price level is lower in the DW market sector, follows necessarily from the fact that firms separate into the two sectors based on their costs of production. We cannot definitively say whether the fraction of firms using the DW system is greater or less than one-half. That is, it is not clear whether m^* is greater than or less than the mean of the production cost distribution. Under the uniform distribution, this also implies that the relative variance of costs and prices in the DW and IA sectors is ambiguous. However, price dispersion under IA is more likely to be greater than that under DW for smaller ranges of search costs (since this leads to relatively fewer DW firms) and for larger ranges of production costs (since this leads to relatively more IA firms). The effect of n on cost and price variance is ambiguous, since changing the value of n has opposing effects on the number of IA consumers and the number of IA firms.

While the absolute range of costs and prices in the DW and IA sectors cannot in general be ranked, we can show that prices in the IA sector will be more disperse *relative to production costs*. This result is first seen in Eq. (6) and Eq. (10), a comparison of which demonstrates that the variance of prices as a proportion of cost variance is always greater under nonsequential search (IA) than under sequential search (DW).[18] This implies that firms with identical differences in production costs are able to maintain greater price differences under nonsequential search than under sequential search. Hence, nonsequential search protects price dispersion.

5. Empirical price distributions

Our theoretical model characterizes coexistence equilibria under the assumption that the direct writing and independent agency systems differ only with respect to the search methods used by consumers to locate price information. If costly search is an important element determining the use of insurance marketing system, we would expect to observe insurance cost and price distributions with the characteristics predicted by our model. In this section of the paper, we examine the empirical content of our predictions: namely, whether the price distribution in the direct writer sector is characterized by lower mean price and cost, and by less price dispersion relative to cost dispersion, than the independent agency sector.

We examine price distributions in markets for property and liability insurance sold to individual consumers: automobile liability insurance, automobile physical damage insurance and homeowners insurance. These insurance markets are those which most closely meet our theoretical ideal of homogeneous products. These coverages are sold using forms which are standardized across the industry. The policyholders are individuals and families seeking coverage for personal property and wealth, and hence the nature of the coverage sought is very similar across consumers. The underwriting criteria utilized by firms are highly routinized in these lines of business, and most claims are handled

[18] This holds for n greater than 2, a necessary condition for equilibrium coexsitence of the two marketing systems.

routinely as well. These characteristics imply relative product homogeneity, and hence price search should be important in these markets.

Cost and price data are obtained from annual accounting statements that insurance companies report to regulators. The data source is A.M. Best Company's *I.E.E.* database for 1992. This data source contains calendar year data on the premiums, expenses and losses of insurance firms by line of business. These data are far from ideal for our empirical purpose, which obliges us to compare price and cost variation across sellers of a homogeneous insurance product. However, the nature of our predictions necessitates that we obtain data on prices and costs from all firms for a single product and market. Such data are not available and would be impossible to construct from publicly available databases. In this context, the advantages of the accounting reports are that they contain data on all firms reporting to regulators and that the cost and premium data are reported on a comparable basis; that is, at the firm level by line of insurance.

The measure of price that we examine is the ratio of total premium revenue to total losses incurred by an insurer in the line of business examined (the *unit price*). This price measure is commonly used in the empirical insurance literature, and represents the average markup of premiums over and above payments to consumers for losses experienced. Viewing the expected loss payment as the benefit received by an insured from his policy, and noting that in the aggregate actual losses should approximately equal expected losses, the unit price is an approximation to the price per dollar of insurance consumed.[19]

Measuring price per unit of loss implies that one dollar of expected loss is the basic unit of sale in the insurance policy. Hence, the quantity of insurance sold in a market is appropriately measured by the aggregate value of losses incurred in that market. In accordance with this interpretation, we measure market shares and the relative size of firms in terms of volume of losses incurred in each line of business. For comparison purposes, we also report market shares and firm size in terms of a more traditional measure of insurance output, total premium revenue. To maintain consistency, insurer costs should also be measured relative to losses. Accordingly, we define the per unit costs of an insurer in a given line of business as the total underwriting expenses incurred per dollar of losses incurred. For comparison purposes, we also use a more traditional measure of costs used in the insurance literature, the ratio of underwriting expenses to premium revenue.

Our analysis is undertaken via comparison of means and variances across the two marketing systems, for each type of insurance studied. These statistics are calculated using data for firms that write at least $1 million in premium volume in the line of business. Our analysis utilizes data for individual insurance firms, rather than consolidated data for insurance groups, due to the possibility that different companies within a group could use different marketing systems. We exclude firms with missing values for any of the variables, and those for which cost, premiums or losses reported were negative. Negative accounting values can arise because a firm is withdrawing from a

[19] One problem with using losses as a measure of output is that the reported amount of losses contains both estimates of losses to be paid in the future, and revisions of past estimates of losses for policies written in previous time periods. Berger, Cummins and Weiss (1997) provide a thorough discussion of the use of insurer accounting data and the measurement of output in insurance firms.

Table 1
Comparison of DW and IA market characteristics, 1992 data

	Auto liability		Auto physical		Homeowners	
	DW	IA	DW	IA	DW	IA
Number of firms	79	272	80	265	73	250
Unit price mean	1.363	1.482 [a]	1.712	1.933 [a]	1.373	1.485
Unit price variance	0.062	0.122 [a]	0.078	0.137 [a]	0.704	0.239 [a]
Losses output measure:						
Market share	0.676	0.324	0.700	0.300	0.665	0.335
Unit cost mean	0.289	0.422 [a]	0.371	0.552 [a]	0.365	0.504 [a]
Unit cost variance	0.017	0.023	0.026	0.024	0.037	0.037
Var(price)/Var(cost)	3.647	5.304 [a]	3.000	5.708 [a]	19.03	6.460 [a]
Premiums output measure:						
Market share	0.671	0.329	0.722	0.278	0.601	0.399
Unit cost mean	0.206	0.274 [a]	0.209	0.282 [a]	0.261	0.332 [a]
Unit cost variance	0.007	0.005	0.007	0.005	0.010	0.004
Var(price)/Var(cost)	8.857	24.40 [a]	11.14	27.40 [a]	70.40	59.75

Unit price=(direct premiums earned-policyholder dividends)/direct losses incurred.
Unit cost=underwriting expenses/direct losses incurred or underwriting expenses/direct premiums written.
[a] denotes significantly different from DW value at the 5% significance level.

line of business, or because of imperfect methods of allocating fixed valued across lines of business. The analysis also excludes firms which reported underwriting expenses greater than the output measure, since this may also indicate that the firm is withdrawing from the line of business.

Statistics on unit prices and unit costs for each marketing system and line of business are reported in Table 1. Consistent with our theory and with prior research using formal econometric methods, the data show that direct writers have lower average costs and lower average prices in each of the insurance lines studied (Joskow (1973); Cummins and Vanderhei, 1979; Barrese and Nelson, 1992). Price variance is greater in all three lines in the IA sector than in the DW sector, but there are no significant differences in cost variance across the two sectors, irrespective of the method used for measuring unit costs. The variance of unit prices *relative* to the variance of unit costs is smaller for direct writers in both of the automobile insurance lines, however. This is in line with our theoretical predictions.

That this finding does not hold for homeowners insurance is likely due to problems with the accounting data for 1992 in this line. The homeowners insurance line has been subject to an unusual number of catastrophe losses since the late 1980s. This could invalidate our use of the accounting data on incurred losses, since we must assume that actual losses experienced are approximately equal to ex-ante expected losses. This will be violated in lines that have experienced catastrophe losses. This interpretation of the problem is supported by noting the large variance of homeowners' unit prices, and unit costs when the output measure is incurred losses. These variances are much greater than those for the automobile lines, especially for direct writers, and the unit cost variance based on losses is much greater than that based on premiums in the homeowners line. Unfortunately, 1992 is the only year for which we have firm level data on both prices and costs by line of business, prohibiting a test of this conjecture using data from another year.[20]

6. Conclusion

This paper analyzes a pure price search model of an insurance market in which two different search technologies are simultaneously available. In this market firms can either sell directly to consumers or use independent agents who represent a number of different firms in the market. Consumers shopping with the direct writing firms must employ a sequential search process to locate price information. Consumers shopping among the independent agency firms employ a nonsequential search process.

The separation of firms and consumers into the two market sectors is endogenously determined in the model, and the existence and characteristics of equilibrium in which both systems exist in the market are examined. In a coexistence equilibrium, low cost firms and low search cost consumers trade in the sequential search sector, and high cost firms and high search cost consumers trade in the nonsequential search sector. This arises because consumers with high sequential search costs are better off using the nonsequential search process even though they pay a higher product price.

Observed data on unit price distributions from automobile insurance markets are consistent with the predictions of our theoretical model. Direct writing firms are found to have lower costs and lower prices on average, and the variance of their prices relative to the variance of their costs is lower in these markets. These characteristics are in keeping with the coexistence of the direct writing and independent agency systems being determined by costly price search.

Of course, our theoretical analysis abstracts from many features of insurance markets which may affect distribution system choice. Insurance products are not strictly homogeneous, and hence price may be only one of many factors in consumers' purchase decisions. This implies that differences in agents' incentives to provide services to customers or to the insurer may be important in determining distribution system choice. Other agency problems between the insurer and the sales agent may also be important. These additional considerations notwithstanding, it is nonetheless intriguing that the characteristics of insurance price distributions are consistent with the existence of costly price search.

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[20] We do have detailed data for 1988–1991 on premiums, losses, and expenses *net of reinsurance transactions*. Reconstructing the analysis in Table 1 for 1988 using the net data does improve our results somewhat, in that price/cost variance remains lower for direct writers in both automobile lines, and there is no significant difference in price/cost variance between direct writers and independent agents in the homeowners line. We do not believe that the data net of reinsurance are the most appropriate for our theory, however.

Appendix

Proof of Lemma 1: The first order condition for the problem stated in Eq. (5) in the text is

$$\frac{1}{T}(\mu_D + k - p_D) - \frac{1}{T}(p_D - m_D) = 0. \quad \text{(A1)}$$

This defines the following relationship between m_D and p_D:

$$m_D = \phi_D(p_D) = 2p_D - \mu_D - k \quad \text{(A2)}$$

with $\phi'_D(p_D) = 2$. The inverse of this function is

$$p_D = \phi_D^{-1}(m_D) = \frac{m_D + \mu_D + k}{2}. \quad \text{(A3)}$$

Taking expectations of both sides and solving for μ_D gives $\mu_D = \mu_{mD} + k$, where μ_{mD} is the mean of the DW cost distribution. Denoting the density function of DW costs by $h_D(m_D)$, uniformly distributed over $[\underline{m}, m^*]$, the equilibrium price density function can be written as

$$f_D(p_D) = h_D[\phi_D(p_D)]\phi'_D(p_D) = \frac{2}{2\bar{p}_D - \mu_D - k - (2\underline{p}_D - \mu_D - k)} = \frac{1}{\bar{p}_D - \underline{p}_D} \quad \text{(A4)}$$

and the equilibrium price distribution is

$$F_D(p_D) = \frac{p_D - \underline{p}_D}{\bar{p}_D - \underline{p}_D} \quad \text{(A5)}$$

Using (A3), the relationship between μ_D and μ_{mD}, and the uniform distribution of DW costs, gives the price function for the DW system stated in the lemma.

Proof of Lemma 2: The first order condition for the problem stated in Eq. (9) in the text is

$$[1 - F_I(p_I)] - (p_I - m_I)(n-1)f_I(p_I) = 0. \quad \text{(A6)}$$

This gives the following functional relationship between m_I and p_I:

$$m_I = \phi_I(p_I) = p_I - \left(\frac{1}{n-1}\right)\left(\frac{[1 - F_I(p_I)]}{f_I(p_I)}\right). \quad \text{(A7)}$$

Denoting the density function of IA costs by $h_I(m_I)$, uniformly distributed over $[m^*, \bar{m}]$, and its associated distribution function by $H_I(m_I)$, the distribution function $F_I(p_I)$ and density function $f_I(p_I)$ can be determined by

$$F_I(p_I) = H_I(\phi_I(p_I)) \text{ and } f_I(p_I) = h_I(\phi_I(p_I)). \quad \text{(A8)}$$

Substituting for $\phi_I(p_I)$ gives the following differential equation,

$$F_I(p_I) = \frac{p_I - m^* - \left(\frac{1}{n-1}\right)[1 - F_I(p_I)]/f_I(p_I)}{\bar{m} - m^*} \quad \text{(A9)}$$

which has the solution

$$F_{\mathrm{I}}(p_{\mathrm{I}}) = \frac{p_I - \underline{p}_I}{\bar{p}_I - \underline{p}_I} \text{ and } f_I(p_I) = \frac{1}{\bar{p}_I - \underline{p}_I}, \tag{A10}$$

Substitution of Eq. (A10) into Eq. (A7) and obtaining the inverse gives the price function for the IA system stated in the lemma.

Equilibrium price functions:

As noted in the text, with a continuum of firms, it can be assumed that if a single firm switches systems there will be no impact on the price distributions and that any DW (IA) firm switching to the IA (DW) market will maximize profits by charging the price charged by the lowest (highest) cost IA (DW) firm (with cost m^*). Therefore, substituting $k(m^*)$ from Eq. (12) into the function in Lemma 1 gives the following expression for the equilibrium price function in the DW market:

$$p^*_{\mathrm{D}}(m;m^*) = \begin{cases} \frac{m}{2} + \left(\frac{1}{n+1}\right)\bar{m} + \left(\frac{n-1}{2(n+1)}\right)m^* & \text{for } m < m^* \\ \left(\frac{n}{n+1}\right)m^* + \left(\frac{1}{n+1}\right)\bar{m} & \text{for } m > m^* \end{cases} \tag{A11}$$

and using Lemma 2, the equilibrium price function in the IA market can be expressed as

$$\begin{array}{ll} p^*_{\mathrm{I}}(m;m^*) = \left(\frac{1}{n}\right)\bar{m} + \left(\frac{n-1}{n}\right)m & \text{for } m > m^* \\ \left(\frac{1}{n}\right)\bar{m} + \left(\frac{n-1}{n}\right)m^* & \text{for } m < m^* \end{array} \tag{A12}$$

Lemma 3:

1. $\pi_{\mathrm{D}}(p^*_{\mathrm{D}}(m;m^*),m;m^*)$ *is decreasing and linear in m for all* $m > m^*$; *and decreasing convex for all* $m < m^*$.
2. $\pi_{\mathrm{I}}(p^*_{\mathrm{I}}(m;m^*),m;m^*)$ *is decreasing and linear in m for all* $m < m^*$, and decreasing and convex for all $m>m^*$.

Proof of Lemma 3:

For a firm in the DW market with cost $m<m^*$, the expected profit obtained by remaining in that market is the profit given in Eq. (5) in the text, at the price given in Eq. (A11).

$$\pi_{\mathrm{D}}(p^*_{\mathrm{D}}(m;m^*),m) = \frac{1}{4T}\left[\left(\frac{2}{n-1}\right)\bar{m} + \left(\frac{n-1}{n+1}\right)m^* - m\right]^2 \tag{A13}$$

Alternatively, if a firm with cost $m<m^*$ were to switch to the IA market it would have an expected profit equal to that given in Eq. (9) for cost m at the price given in Eq. (A12) for m^*:

$$\pi_{\mathrm{I}}(p^*_{\mathrm{I}}(m;m^*),m) = \frac{1}{T}(\bar{m} + (n-1)m^* - nm)\left(T - \left(\frac{1}{n+1}\right)\bar{m} - \left(\frac{n-3}{4(n+1)}\right)m^* + \frac{m}{4}\right) \tag{A14}$$

The first derivative of Eq. (A13) with respect to m is

$$-\frac{1}{2T}\left[\left(\frac{2}{n+1}\right)\bar{m}+\left(\frac{n-1}{n+1}\right)m^{*}-m\right]<0 \tag{A15}$$

and the second derivative, 1/2T, is positive. The first derivative of Eq. (A14) with respect to m is

$$-\frac{n}{T}\left[T-\left(\frac{1}{n+1}\right)\bar{m}-\left(\frac{n-3}{4(n+1)}\right)m^{*}+\frac{\underline{m}}{4}\right] \tag{A16}$$

which is constant in m. For a firm in the IA market with cost $m>m^*$, the expected profit obtained by remaining in that market is the profit given in Eq. (9) in the text at the given in Eq. (A12):

$$\pi_{\mathrm{I}}(p_{\mathrm{I}}^{*}(m;m^{*}),m)=\frac{1}{T}(\bar{m}-m)\left[\frac{\bar{m}-m}{\bar{m}-m^{*}}\right]^{n-1}\left(T-\left(\frac{1}{n+1}\right)\bar{m}-\left(\frac{n-3}{4(n+1)}\right)m^{*}+\frac{\underline{m}}{4}\right) \tag{A17}$$

Alternatively, if a firm with cost $m>m^*$ were to switch to the DW market it would have an expected profit equal to that given in Eq. (5) in the text for cost m at the price given in Eq. (A11) for m^*:

$$\pi_{\mathrm{D}}(p_{\mathrm{D}}^{*}(m;m^{*}),m)=\frac{1}{T}\left[\left(\frac{1}{n+1}\right)\bar{m}+\left(\frac{n}{n+1}\right)m^{*}-m\right]\left[\left(\frac{1}{n+1}\right)(\bar{m}-m^{*})\right] \tag{A18}$$

The first derivative of Eq. (A15) with respect to m is

$$-\frac{n}{T}\left(\frac{\bar{m}-m}{\bar{m}-m^{*}}\right)^{n-1}\left[T-\left(\frac{1}{n+1}\right)\bar{m}-\left(\frac{n-3}{4(n+1)}\right)m^{*}+\frac{\underline{m}}{4}\right]<0 \tag{A19}$$

and the second derivative is positive. The first derivative of Eq. (A18) with respect to m is

$$-\frac{1}{T}\left(\frac{1}{n+1}\right)(\bar{m}-m^{*}) \tag{A20}$$

which is constant in m. Finally, note that Eq. (A15) and Eq. (A20) are equivalent when evaluated at $m=m^*$; and Eq. (A16) and Eq. (A19) are equivalent at $m=m^*$.

Proof of Proposition 1:

The equilibrium conditions (12), (14), (15) and the interior conditions are written here as follows:

$$k=\left(\frac{1}{n+1}\right)\bar{m}+\left(\frac{n-3}{4(n+1)}\right)m^{*}-\frac{\underline{m}}{4} \tag{A21}$$

$$m^{*}=\underline{m}-8T+12k-8\left[T^{2}+\left(\frac{T-k}{4}\right)(\bar{m}-\underline{m})+2k^{2}-3Tk\right]^{(1/2)} \tag{A22}$$

$$-\frac{1}{T}\left[\left(\frac{1}{n+1}\right)(\bar{m}-m^{*})\right]<-\frac{n}{T}\left[T-\left(\frac{1}{n+1}\right)\bar{m}-\left(\frac{n-3}{4(n+1)}\right)m^{*}+\frac{\underline{m}}{4}\right] \tag{A23}$$

$$0 < k \tag{A24}$$

$$k < T \tag{A25}$$

$$m^* > \underline{m} \tag{A26}$$

$$m^* < \bar{m}. \tag{A27}$$

Conditions (A21) and (A22) are two equations in two unknowns which have the following solution:

$$m^* = \frac{(n+1)^2\underline{m} - 4(n+2)\bar{m} + 4(n+1)^2T}{n^2 - 2n - 7} \tag{A28}$$

$$k = \frac{(n^2 - 2n - 3)T - (\bar{m} - \underline{m})}{n^2 - 2n - 7}. \tag{A29}$$

Conditions (A23) through (A27), respectively, can be rewritten as follows by substituting in these values for m^* and k and manipulating algebraically:

$$\bar{m} - \underline{m} > 4T \tag{A30}$$

$$\bar{m} - \underline{m} < (n^2 - 2n - 3)T \tag{A31}$$

$$\bar{m} - \underline{m} > 4T \tag{A32}$$

$$\bar{m} - \underline{m} < [(n+1)^2/(n+2)]T \tag{A33}$$

$$\bar{m} - \underline{m} > 4T \tag{A34}$$

Condition (A33) implies condition (A31) so the conditions for coexistence of the two marketing systems reduces to the two conditions (A30) and (A33). Note that the positive root of the functional relationship $m^*(k)$ (as stated in Eq. (14)), $m^* = \underline{m} - 8T + 12k + 8[T^2 + (T - k/4)(\bar{m} - \underline{m}) + 2k^2 - 3Tk]^{1/2}$ along with the function $k(m^*)$ form a system of equations with solution $m^* = \bar{m}$ and $k = (\bar{m} - \underline{m})/4$ which does not lead to coexistence of the marketing systems.

Proof of Proposition 2:

(i) $\mu_D < \mu_I$: $V_I = \mu_D + k$ implying that $V_I > \mu_D$. Furthermore, from (10) and (11), $\mu_I = (n + 1/2n)\bar{m} + (n - 1/2n)m^* > V_I = (2/n + 1)\bar{m} + ((n-1)/(n+1))m^*$. Therefore, $\mu_D < \mu_I$.

(ii) $\mu_{mD} < \mu_{mI}$: Follows from the fact that firms with costs $\underline{m} < m < m^*$ become DW's and those with costs $m^* < m < \bar{m}$ become IA firms.

(iii) $\sigma_{mD} < \sigma_{mI}$ if $8(n+1)^2T < (n+3)^2(\bar{m} - \underline{m})$: $\sigma_{mD} - \sigma_{mI} = (m^* - \underline{m})/\sqrt{12} - (\bar{m} - m^*)/\sqrt{12}$ has the same sign as $m^* - (\bar{m} + \underline{m})/2$. Substituting in m^* from (A26) and further manipulation shows that $\sigma_{mD} - \sigma_{mI}$ has the same sign as $8(n+1)^2T - (n+3)^2(\bar{m} - \underline{m})$. $\sigma_D < \sigma_I$ if $8(n+1)^2T < (n+3)^2(\bar{m} - \underline{m})$: From (6) and (10), $\sigma_D = (1/2)\sigma_{mD}$ and $\sigma_I = [(n-1)/n]\sigma_{mI}$. Since $[(n-1)/n] > 1/2$ for all $n > 1, \sigma_D < \sigma_I$ whenever $\sigma_{mD} < \sigma_{mI}$, which, as shown above is whenever $8(n+1)^2T < (n+3)^2(\bar{m} - \underline{m})$.

(iv) $\sigma_D/\sigma_{mD} < \sigma_I/\sigma_{mI}$. $\sigma_D/\sigma_{mD} = 1/2 < \sigma_I/\sigma_{mI} = [(n-1)/n]$ for $n > 1$.

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