Market Discipline in Property-Liability Insurance

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Abstract

In well-functioning markets, firms that experience economic or financial distress generally face substantial discipline by capital and product markets. Worsening conditions of trade motivate or compel firms to downsize, merge, sell assets, restructure debt, and so on. The expected costs of distress motivate risk management ex ante. In the case of financial intermediaries, the extent to which private market incentives for risk management may be weak has received substantial attention, especially for banks and other depository institutions where government deposit insurance substantially protects depositors from losses from firm insolvency.

This paper provides evidence of whether market discipline constrains the growth of property-liability insurers that experience deterioration in their financial condition. If a property-liability insurer fails, state guaranty funds provide material protection against loss to most policyholders, thus contributing to moral hazard. Costly search by prospective insurance buyers and insensitivity to insolvency risk by others (e.g., those compelled to buy liability insurance even though they have few assets at risk if uninsured) also reduce market discipline, at least for some insurers. On the other hand, limitations on the amounts and types of losses that are covered by guaranty funds encourage many buyers to deal with safe insurers, and

moral hazard is plausibly less severe than in banking. Because many insurers also have large franchise values that are exposed to material erosion in the event of financial (or economic) distress, they have significant (private market) incentives to reduce insolvency risk ex ante and to take actions to preserve franchise value following unexpectedly poor performance.

We provide evidence of market discipline by analyzing revenue growth of property-liability insurers surrounding ratings changes by the A.M. Best Company, the largest insurance rating agency, for a large panel of insurers for the period 1991-1996. Consistent with substantial market discipline, univariate comparisons and fixed effects regression results provide strong evidence of lower revenue growth for insurers that experienced rating downgrades in the year of and following the downgrade. The results imply that worsening financial condition and attendant downgrades were accompanied, on average, by lower prices, sales volume, or both.

The evidence of revenue declines is strongest for firms that were highly rated prior to a downgrade. Because solvency regulation is unlikely to bind for those insurers, this finding suggests that their slower revenue growth was not due to increased regulatory monitoring or scrutiny. Our regressions also suggest that high-rated firms that experienced downgrades on average grew more rapidly in the year prior to the downgrade than comparable firms that were not downgraded, which suggests aggressive expansion by some firms prior to the downgrades. We also provide evidence, albeit weaker, that rating upgrades are followed by increased revenue growth.

A large literature has examined the effects of rating changes on firms' stock and bond prices (e.g., Holthausen and Leftwich, 1986). We focus instead on product market responses. Our sample encompasses insurers with publicly-traded stock, stock firms that are not publicly traded, and mutual firms. Our main result – that downgrades are accompanied by slower revenue growth – contrasts sharply with evidence provided by Billet, Garfinkel, and O'Neal

(1998) that banks increased insured deposits following rating downgrades by Moody's. While our analysis by no means implies that insurance guaranty funds have no effect on insurance market discipline (see, e.g., Lee, Mayers, and Smith, 1997, and Bohn and Hall, 1999), they suggest that material market discipline remains despite guaranty fund protection and other factors those dull insurers' incentives for risk management. The findings are thus consistent with Crabbe and Post's (1994) analysis of commercial paper markets (non-financial firms reduce outstanding commercial paper following rating downgrades), and with Fenn and Cole's (1994) indirect evidence of market discipline in life insurance (life insurer stock price declines during 1989-1991 were concentrated among firms with problem assets).

Section 2 elaborates our main hypotheses concerning revenue growth, changes in financial condition, and ratings changes. The sample and data are described in Section 3. Section 4 presents univariate comparisons of revenue growth for subsamples of high and low rated insurers that experienced a ratings downgrade, an upgrade, or no change in rating. Regression results are presented in Section 5. Section 6 contains a brief summary and conclusions.

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Does the Internet Make Markets More Competitive? Evidence from the Life Insurance Industry

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Abstract:

The Internet has the potential to significantly reduce search costs by allowing consumers to engage in low-cost price comparisons online. This paper provides empirical evidence that the rise of Internet comparison shopping sites for life insurance has had a major impact on prices in the 1990s. Using micro data on life insurance policies, the results indicate that, controlling for individual and policy characteristics, a 10 percent increase in the share of individuals using the Internet reduced average prices for the group by up to 5 percent. Rising Internet usage does not lower prices for policies types that are not covered by the websites nor does it appear to lower prices in the period before the insurance sites came online. Overall growth of the Internet has reduced term life prices by 8 to 15 percent and increased consumer surplus by at least $115-215 million per year and perhaps as much as $1 billion. The results also show that the introduction of the Internet search sites is initially associated with an increase in price dispersion within demographic groups, but as the share of people using the technology rises further, dispersion falls.

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1. Introduction

The last five years have witnessed an explosion in the growth of electronic commerce and Internet marketplaces as alternatives or supplements to traditional retail markets (McQuivey et al., 1998). Consumers can now go online and comparison shop between hundreds of vendors with much less effort than in the physical world. The traditional economic view suggests that, as a result, the Internet should reduce search costs for consumers and thereby reduce prices and make markets more competitive.

Despite this presumption of increased competition, however, existing empirical work on the Internet has not been as clear on the issue of how electronic commerce changes competition. Although the inherently limited availability of data on such a new sector has meant that most existing work has involved directly collecting and comparing prices on and offline for a specific sector such as books, the results from this literature have not conformed to the traditional view of falling search costs. These studies have generally found large dispersion of prices online and prices either modestly lower or actually higher than their offline counterparts.[1] To the extent that there is a conventional wisdom in such a new area it is that the Internet may have increased product differentiation and price discrimination more than it has price competition.[2]

Because of the data constraint, however, existing work has not been able to examine the impact of the Internet on offline markets, instead taking prices offline as exogenous. In this paper, we will present the first empirical evidence on the impact of Internet competition on prices and dispersion off line. In this sense, our results are similar to existing empirical literature on search.[3] By combining Internet and life insurance industry data sets over time, we are able to document how important the Internet is for market competition.

We examine term life insurance, a somewhat homogenous product with low marginal cost, for several reasons. First, in the mid-1990s, a group of Internet price comparison sites began that dramatically lowered the cost of comparing the prices of term life policies. Second,

[1] Work by Lee (1997) on cars and Bailey (1998) on books, CDs, and software suggest that prices were actually higher online than in retail stores. More recent work by Brynjolfsson and Smith (1999) on books and CDs and by Clay et al. (2000) on books has found prices the same or lower online but that online price dispersion is quite high, perhaps greater than in retail stores.

[2] See the work of Bakos (1997; 1998) or the survey of Smith, Bakos and Brynjolfsson (1999). Although addressing a different question, the results of Goolsbee (2000a; 2000b) suggest that online buying is quite sensitive to local retail price variation generated by local sales tax rates.

[3] This includes the work on the impact of price advertising on pricing behavior such as Sorensen (forthcoming), Milyo and Waldfogel (1999), Kwoka (1984), or Benham (1972). It also includes other work exploring the sources of price dispersion such as Van Hoomissen (1988) or Dahlby and West (1986).

life insurance is one of the most widely held financial products in the United States. The face value of life insurance policies sold in 1998 exceeded $2 trillion and premia typically amount to several percent of GDP annually (see ACLI, 1999; Cawley and Philipson, 1999). If the Internet reduces prices in this market, the potential welfare implications are enormous. Third, there has been a very serious price decline in the cost of term life insurance in the 1990s that is not well understood and has taken place concurrently with the rise of the Internet (see the description in Dugas, 1999).

To analyze the relationship, we take individual policy-level micro data from Limra International on the prices of insurance policies for various owner and policy characteristics and match it to micro data on the growth of Internet usage and online insurance research from Forrester by the same owner characteristics. In essence we fit hedonic regressions for the price of life insurance on characteristics of the policies and the individuals as well as a measure of how likely the individual is to have used the Internet or to have researched insurance online in a given year.

The results indicate that the Internet significantly increased competition in the market. Once the online insurance sites began, the faster a group adopted the Internet, the faster prices of term life insurance fell for that group. The total impact of the rise from 1995 to 1997 reduced term life prices by 10 to 15 percent. This implies an increase in consumer surplus of at least $115 to $215 million annually. The results seem quite robust in that the Internet did not have any effect on prices during the period before the insurance websites existed, nor on prices of types of life insurance that were not covered by the websites (i.e., whole life policies). Interestingly, the data also show that the Internet-induced reduction in search costs actually increases price dispersion upon introduction. As it becomes more widespread, price dispersion falls.

The paper proceeds as follows: in section 2 we discuss the life insurance industry and the role of the Internet comparison sites. In section 3, we discuss the theory of search when customers have different search costs. In section 4 we discuss our data sources and the basic specification. In section 5 we present the basic results. In section 6 we consider alternative explanations of the results. In section 7 we examine price dispersion within groups. In section 8 we present a basic calculation about the impact on consumer surplus. In section 9 we conclude.

2. The Life Insurance Industry and the Internet

A. Overview of Life Insurance

The market for life insurance is the largest private individual insurance market in the world. In 1998, over 52 million life insurance policies were purchased in the United States, with a face value of nearly $2.2 trillion dollars, bringing the total number of policies in force to 358 million, with a total face value of $14.47 trillion (ACLI 1999).

Life insurance can play a number of important roles in the portfolios of most households. The primary function of life insurance is to protect a primary earner's dependents against potentially catastrophic financial losses in the event of the death of the insured. As such, over half of all life insurance policies are purchased by individuals between the ages of 25 – 44 (Limra International, various years). Other possible reasons for owning life insurance include opportunities for tax-advantaged savings or the provision of liquidity to estates subject to U.S. estate tax laws (Brown 1999, Holtz-Eakin, Phillips & Rosen 1999).

There are many types of policies available. One distinction is between individual, group and credit insurance. Individual life insurance policies are sold directly to individuals and are underwritten separately for each purchaser. Group policies are often provided by employers or unions, and are underwritten for the group as a whole. Credit life insurance is designed to guarantee payment of a mortgage or other loan in the event of the insured's death. Of 52 million policies sold in 1998, 22 percent were individual life policies but these policies account for 60 percent of the face value of coverage. This is because the group, and especially credit life policies, tend to be small.

Within individual life insurance policies, there are two basic types, term and whole. The total amount of coverage for policies bought in 1998 was split almost equally between term and whole life policies. Term life policies provide life insurance coverage for a specified period of time, such as 1-year or 5-years. When the term period ends, these policies provide no additional benefit to the insured. As such, term life policies are pure insurance over the period of the contract and are relatively homogenous. Whole life policies (also known as permanent life or cash value policies), in addition to providing insurance over the "whole of one's life" (Graves 1994), typically include a savings component that builds up a cash value over time. Policy owners can borrow against this cash value, and the accumulation in the cash value account is generally tax-deferred. If at any point the individual cancels the policy, the owner is entitled to receive the full cash value, minus a surrender fee and any outstanding policy loans. For these reasons, whole life policies have higher premiums per thousand dollars of coverage than do term policies.

B. Life Insurance and the Internet

By 1996, there were a number of insurance-oriented web sites that provided consumers with access to on-line quotes for insurance products. The customer would, essentially, answer the medical questionnaire online including age, gender, and the like and enter the amount of coverage they sought. The sites would then report numerous companies that would offer such a policy and would give a price quote from each. Importantly, in almost all cases, the individual does not buy the product online directly from these sites. Indeed, most industry analyses have emphasized the conservative nature of the offline insurance business and their reluctance to conduct commerce online (see Temkin et al., 1998). With these search services, the connection to the offline seller remains. Consumers must still take a blood test, for example, to qualify for various policies. The costs of comparing prices, however, for a given set of risk factors, age, gender, etc. means that users of the service can get dozens of quotes in a matter of seconds that would previously have taken a great deal of search. These Internet search sites essentially provided a new information source between the consumer and the life insurance company that was formerly available only to brokers (see Garven, 2000).[4]

Two important aspects of the Internet insurance sites help us to distinguish the Internet/search cost hypothesis from alternative explanations. First, the comparison sites have focused almost exclusively on term life insurance. This is the more commodity-like product and is, therefore, easy to compare. Whole life policies are more differentiated and the sites did not provide comparison quotes for them. Search costs should not have fallen for whole policies. Second, the comparison sites mainly did not start until 1996, whereas Internet usage had already increased significantly for many groups prior to that time. Internet growth before 1996 should not affect competition in term life insurance, only growth after the comparison sites came online.

We do not have earlier data on the aggregate use of the these sites but Forrester (2000) reports that in 1999, about 5 percent of Internet users had ever researched life insurance online.

[4] The major sites are www.insweb, www.accuquote.com, www.quotesmith.com, www.insuremarket.com, www.rightquote.com, and www.term4sale.com. Quotesmith began as a phone in comparison service and, in late 1995, became the first to provide quotes online.

3. Literature and Theory: Search Costs, Pricing and the Internet

Essentially, our approach is to empirically analyze the impact Internet growth as if it were a reducer of search costs for online users. In that sense it is in the spirit of other empirical search models. Since the original work on search theory of Stigler (1961), there have been numerous models analyzing the impact of search costs and differential information on the distribution of market prices.[5] The most relevant exposition for our empirical work is that of Stahl (1989).

The Stahl model begins with a fraction of customers, μ, having zero search costs and the other having to pay a cost for every store they visit. The customers search stores sequentially and the Nash Equilibrium prices involve the stores choosing prices from a distribution rather than having a pure strategy. The positive search cost customers have a reservation price and stop searching when they find a price below that reservation price. The zero search cost customers sample all prices and buy from the lowest. We view the Internet comparison sites as being a technology like μ. For those with access to the insurance sites, search costs are close to zero.

There are three basic results established in the Stahl model that have direct bearing on our empirical work (of course, some of the results are simply restatements of results in the existing search literature).

First, when there are asymmetric search costs across customers (i.e., some have zero search costs and others do not), firms will tend to draw their equilibrium prices from a random distribution. This means we should expect to see price dispersion in equilibrium.

Second, as the share of customers with complete information (μ) increases, the price distribution shifts downward monotonically. In other words, as the share of consumers with no search costs increases, average prices should fall.

Third, when μ is zero, the price distribution is degenerate at the monopoly price. When μ is one, the distribution is degenerate at the competitive price. As μ increases from zero to one, the distribution moves continuously from one to the other. This is important because it implies that the relationship between search costs and price dispersion is *not* monotonic. Increasing the share with no search costs will *increase* price dispersion for small enough starting levels of

[5] See the work of Diamond (1971), Salop and Stiglitz (1977), Varian (1980), Burdett and Judd (1983), Carlson and McAfee (1983), or Stahl (1989).

asymmetric information across consumers. If μ is large enough to begin with, then increasing μ will reduce dispersion. The large initial μ case is the one assumed by most empirical work on search. Since we will be observing the initial entry of the insurance websites, however, this may correspond with a starting μ close to zero. As the share using the Internet to compare prices online rises from zero, price dispersion should rise and then, eventually fall.[6]

4. Data on Prices of Insurance and Internet Usage

A. Data on Life Insurance

Limra International conducts annual surveys purchasers of individual life insurance contracts in the U.S. Each year, Limra uses a sample of approximately 30,000 policies issued by 35 to 50 participating companies per year, collecting detailed information on the policy characteristics, and prices as well as some demographic information on the insured individuals including age, state of residence, occupation, and income. For purposes of this study, we have combined data from six Buyer's Studies covering the period 1992 through 1997. The data are meant to be representative of the population of life insurance buyers when weighted by their sample weights.[7] They do not include company identifiers, however, so we cannot include firm dummies.

Our primary concern will be with the prices of term life policies and how they respond over time as their buyers begin using the Internet. To keep the product as homogenous as possible for our pricing regressions, we restrict the sample to level term policies owned by the premium payer, insuring the life of only one person, for people aged 20-75, and without any other riders (such as a CPI cost-of-living adjustment, etc.). We also look only at terms of five years or less durations (about 70 percent of term insurance). We do this because during the late 1990s, state insurance regulators were discussing changes to reserve requirements for policies with long-term

[6] Sorensen (1999) has suggested, albeit in a slightly different context, that the maximum dispersion occurs at very low levels of search costs and that for most plausible ranges, reducing search costs reduces dispersion. In our data, we will have transaction prices (i.e., quantity weighted) rather than list prices which is likely to influence this result. We simulated the Stahl model using a linear demand curve and the basic cost structure given in the numerical example of Stahl (1989) and computed the expected difference between the highest and lowest price and the variance. We found that the dispersion was increasing with μ up to about .1 in this case. We found similar results using expected order statistics and quantity weighting to check the influence of using transaction prices rather than list prices.

[7] More details on these data can be found in LIMRA (1999).

premium guarantees (now known as "regulation Triple X"). This regulatory action may have affected prices of longer-term policies in a way that is difficult to adequately control for.

Several individuals lack some of the demographic or policy information so we must drop them. Even with these various restrictions, we still have almost 11,000 person-year observations and about one third of the total term life insurance in the sample. Summary statistics for the insurance variables are listed in table 1.

B. Data on Internet Use

It would have been easiest to track the impact of the Internet if the Limra data had asked the individuals whether they had themselves checked insurance sites online. Lacking such information, however, we instead create a measure of the probability of Internet usage for each individual in each year based on their observable characteristics. To compute this measure, we turn to the Technographics 1999 survey of Forrester, a market research company.

Forrester conducted a nationally representative survey of almost 100,000 people in late 1998 that gathered information on their computer ownership, Internet use, online buying behavior, and the like, as well as demographic and geographic information on the individuals.[8] One of the questions Forrester asks of those with online access is how long they have been online. Another is whether they have ever researched various products online and one of the products they report on is insurance. Importantly for our purposes, the Forrester survey collects age, state, occupation, and income information that we can match to the Limra data. Occupation and income are harder to match than age and state because the occupation codes do not match precisely across the two datasets and because the Forrester income is for the family while the Limra income is for the individual.

We compute for each age-state-year, age-occupation-year, occupation-state-year, and age-income-year the share of people in that group that had online access. The retrospective data on online usage go back to 1994. For 1993 and 1992, we reduce each groups' 1994 online usage by overall rate of growth of domain names as tabulated by the Internet Software Consortium (2000). In the few regressions where we use the early information, this adjustment had little impact on the results since online usage rates were extremely low in those early years. The overall share of people with online access rose from 2.6 percent in 1992, to 5.1 percent in 1993,

[8] More details on the Forrester data can be found in Goolsbee and Klenow (1999) or Bernhoff et al. (1998).

8.9 percent in 1994, 15.7 percent in 1995, 26.7 percent in 1996, and 38.8 percent in 1997. Of key importance for our regressions is the considerable variation in both the levels and growth patterns of online usage between groups. Not all groups grow at the same rate over time.

Because we are concerned with the use of the Internet for comparing insurance prices, including a measure of Internet usage in a price regression is equivalent to assuming that the growth of insurance sites is proportional to use of the Internet. Since the insurance sites mainly did not begin until 1996, our basic measure of Internet use for the group will be zero until 1996 and then equal to the share of people online after that. We will also show results that compare the impact of Internet usage in the earlier years on insurance prices to check if rising Internet use is spuriously correlated with prices.

C. Specification

Over the last half of the 1990s, life insurance consumers witnessed a large decline in the price of term life insurance. Without taking account of any controls, the average price paid per $1000 for a renewable one year term policy was $3.20 in 1993 and by 1997 had fallen more than 20 percent to $2.50.

Ignoring other costs, the actuarially fair pricing of a one-year term policy that pays out a face value of F on the last day of the year will depend on the probability of dying during the period, q_a for an individual of type a, and on the interest rate r according to $P = q_a F/(1+r)$. Higher expected mortality rates (high q) and lower interest rates (r) raise the premium. This approach is consistent with the typical regulatory approach of setting reserves strictly on the basis of interest and mortality, excluding other expenses (Graves, 1994). Extending this formula to multiple year policies is straightforward.

Our regressions will attempt to explain the price paid for term policies. The dependent variable is the log of the price per $1000 of face value of insurance. We do not have a direct calculation of the survival probability for the individual so we include standard variables to proxy for it including age dummies, a non-smoking dummy, a gender dummy, marital status dummies, and a dummy for whether the policy is "rated" meaning the individual belongs to a special risk class because of some personal behavior such as being an amateur pilot. We also include state dummies and occupation dummies to account for differences in health or demographic characteristics across groups that are correlated with life expectancy as well as dummies for whether the policy was purchased from an own agent and whether it was a participating policy.[9]

In addition to these variables, we want to allow for economies or diseconomies of scale in the costs of policies of different sizes and lengths, as discussed in Cawley and Philipson (1999). Therefore we include policy length dummies and three terms for the value of the policy in real dollars to allow for non-linearity (these are the log of the real amount, the real amount, and the real amount squared as well as dummies equal to one if the reported value was censored at the maximum value in the year). In practice, though significant, these non-linearities had little effect on our results as we tried various functional forms and got the same answers. We use the monthly CPI as the deflator and the inverse of one plus the Baa bond rate for the interest rate term (raised to the length of the policy for term lengths more than one year). We also include year dummies. The coefficient on these dummies gives us a price index in log terms for the cost of identical term-life insurance over the period.

5. Basic Results

A. Price Trends for Term and Whole Life Policies

The results from this regression are listed in column 1 of table 2. The explanatory power of the regression is high with an R^2 is .837. These variables explain a large fraction of the variance in policy prices. The coefficients on the explanatory variables are fully in line with expectations. Policies for men cost about 20 percent more than identical policies for females, for smokers 45 percent more than for non-smokers. When interest rates rise (lowering the inverse interest rate term), this reduces prices. Most importantly, the results show a dramatic decline in prices of term life insurance, especially toward the end of the sample. Relative to real prices in 1992, prices for identical policies were about 1 percent lower in 1994 but almost 19 percent in 1996 and 27 percent lower in 1997.

Thus prices seemed to fall most at the time that the Internet insurance comparison sites came online. Whole life prices make an interesting comparison since the insurance sites did not cover such policies. Column 2 of the table repeats the specification of column 1 now for the price of

[9] Participating policies are typically issued by mutual life insurers. They allow the policy owner to participate in the company's surplus via distribution of a policy owner dividend.

whole rather than term policies.[10] Interestingly, at the start of the sample the whole and the term prices changes were very similar —term life prices in 1995 were 6.8 percent below 1992 levels, whole life prices were 6.7 percent below. In 1996 and 1997, however, prices dropped dramatically for term policies while whole life policies remained constant or even rose slightly.

B. Term Price Trends Across Demographic Groups

Next, in table 3, we repeat the term life hedonic regressions but compare price changes among groups for which Internet usage grew at different rates to get suggestive evidence as to whether there is any apparent role for the Internet. Column 1, gives the results for policies in California, Virginia, and Washington—the states with the highest Internet penetration (almost 40 percent in 1997). Column 2 looks at policies in Alabama, Louisiana, Kentucky, and Arkansas-the states with the lowest penetration (about 25 percent in 1997). The results show that prices for identical policies in high Internet states fell significantly faster at the end of the sample (1997 prices were 32 percent below 1992 levels) than they did in low Internet states (1997 prices were about 13 percent below 1992 levels).

The same thing is true in columns 3 and 4 which compare policies for people in occupation codes 1, 10, and 11 (professionals, students, and military) that had average Internet use of about 49 percent in 1997 to policies for people in occupation codes 6, 7, and 8 (operatives, service workers, and farmers) that had Internet usage of 22 percent in 1997. In columns 5 and 6, we see that the price declines were also significantly larger for people under age 30 (Internet use of 46 percent in 1997) compared with people over age 45 (Internet use of 34 percent in 1997).

These regressions suggest a correlation between Internet use and price declines. In our attempt to attach a causal relationship between the two, however, we need more detailed data on Internet usage and we need to confront potential alternative explanations. We address these issues in the sections below.

[10] Since the whole life policies are not of limited duration, there is no way to limit the length of the policies to 5 five years or less. We estimate the policy length as being 80 minus age for women and 72 minus age for men. Given the longer time frame of these policies we use the five-year bond rate rather than the one year and include the interest rate on its own in the regressions, though this did not matter for the results.

C. Basic Results

In table 4, we add the probability of Internet usage (calculated from the Forrester data described above) to the price regressions. We compute the Internet usage in each year share for age-state, age-occupation groups, age-income, and occupation-state groups, as listed at the top of the column. The standard errors are corrected for the fact that the Internet usage variable varies only by group-year and not by individual-year. In every case, the coefficients are negative and significant indicating that prices for identical term life policies for people in a given group fell more during those periods in which the group had faster adoption of the Internet.

Note that these results cannot be explained by level differences in price or life expectancy across groups since this will be absorbed in the age, state, occupation, or year dummies. People age 25 to 30 have lower life insurance prices than people age 45-50 because of health differences, lifestyle choices, and many other reasons and these reasons may be correlated with Internet usage. This will not appear as a positive coefficient on Internet usage in our regression, however. These regressions show the effect of increasing Internet usage on prices separately from whatever price level differences exist across groups.

The magnitudes of the coefficients indicate that increasing the share of a demographic group that uses the Internet by 10 percentage point lowers prices for the group by about 15 to 45 percent depending on the specification. Because of the potential measurement error in the occupation and income variables mentioned above, we will concentrate our results below on the age-state variation but the findings were very similar in almost every case, no matter which one we used.

In addition, the Internet usage variable seems to explain an important share of the total decline in prices over this period. In the baseline results without Internet use, as previously listed in column 1 of table 2, prices fell about 27 percent over the sample. In these specifications, once we control for the role of Internet usage, the year dummies are significantly less important. The total decline is only 6 percent and not significant in the age-state regression meaning that the Internet can explain about three quarters of the total price declines in term life. Even in the regressions where the Internet variable is measured with error (i.e., that include occupation or income) the Internet still appears to explain between one quarter and one half of the total decline.

The implicit assumption in these results is that a constant fraction of all Internet users check insurance sites online and this fraction does not vary across groups. Even with that assumption, unless the fraction is literally one, the coefficient will be modified by some unknown scaling factor. To loosen these restrictions, we turn to the question in the Forrester data about whether the individual with online access has ever researched insurance online. We compute the share of each group that has done so and multiply it by the share with online access in each year. This gives us a measure of the share of the group that both has online access and has researched insurance online. This puts a reasonable scale factor on the results and simultaneously allows for different groups to have differing likelihoods of researching insurance online.

One problem with this measure is that since only 10% of online users report researching insurance and the mean share of Internet users is only about 27% in 1996 and 39% in 1997, there are many smaller demographic groups that suffer from small sample problems so the composite measure may tend to add noise to the Internet variable (i.e., the mean of the online research measure is roughly 2.7% in 1996 and this will tend to show up as zero for small demographic groups). This measurement error will tend to bias the coefficient toward zero.

The results from using this insurance measure by age-state-year as the explanatory variable is presented in column 1 of table 5. Despite the added noise from the small sample problem, the coefficient shows a strong and significant impact of the Internet on prices. For a group with an average probability of researching insurance (about 10%, conditional on Internet access), raising the share of the group using the Internet by one percent lowers prices by about 2.5 percent.[11]

These results point to the importance of Internet usage for prices even within group. In the next section we consider the major alternative explanations for these findings.

6. Alternative Explanations

A. Unobservable Differences Across Groups

Our results account for age, occupation, and state fixed effects. If there are distinct differences in the life expectancies of various interactions of those variables in a way that is correlated with Internet usage, this could bias our results. To deal with this issue, in columns 2 and 3, we add age-occupation-state interaction dummies. When we do this the number of

[11] A coefficient that exceeds one in absolute value, as it does here, is consistent with a search externality in the sense of Salop and Stiglitz (1977), i.e., when a large share of the members of a group begin using the Internet to research insurance, this can reduce prices for everyone in the group, not just the Internet users. Because our data, however, give the share of the entire group that researches insurance online rather than the share of the potential life insurance buyers in each group, we cannot be sure about the absolute magnitude of the coefficient so we will not pursue the externality point in the results that follow.

dummy variables relating to these factors rises from 68 to 2933. Now rather than just younger people having different prices than older people, high-skill different from low-skill, etc., we allow young, high-skill people in California to have different prices than young, high-skill people in Nevada and all the other permutations. Once we do this, we are identifying the impact of the Internet exclusively from the changes across time within a given group— whether prices fall more for 30-35 year old service workers in Florida in those years in which their probability of using the Internet rose more.[12]

The results in both cases still show the same significant effect of the Internet and, if anything, are larger than before. The coefficient in the online usage regression (column 2) is -.71 versus -.51 before. The coefficient in the insurance research regression is –3.15 versus –2.53 before.[13] Note that the increase in the R^2 is modest despite the increase in the number of dummies. In both cases, it rises from about .84 to .88.

B. Spurious Correlation of the Growth of Internet Usage with Other Factors

Fundamentally, the key alternative explanation of the results we have found is that the growth in Internet use is correlated with some other unobserved factor that is reducing prices for the group over this sample by increasing life expectancy, for example.

The natural way to examine this hypothesis is by exploring the effect of Internet usage during the period when there were no online insurance sites (1992 to 1995). During this early period, there is no reason for rising Internet usage to be correlated with lower insurance prices. In columns 4 we add a variable that is equal to the share of the age-state-year with Internet access for 1992 to 1995 and zero in 1996 and 1997 (in addition to our standard measure that is zero from 1992 to 1995 and then positive in 1996 and 1997). In column 5 we interact it with the share of the age-state group that reports having ever researched insurance online. The results in both cases show that prices fell significantly with the rising use of the Internet during the period when the insurance sites existed and with approximately the same magnitude as before, but that rising Internet usage had no significant effect on prices before the sites existed (and the point estimates are positive).

[12] We do not include the full set of possible dummies by age x state x occupation x income because the remaining cell size for all but the largest groups would be extremely small if not actually zero.
[13] Again, the results were very similar using online insurance usage by age-occupation, age-income, etc. or using pure online usage rather than online insurance research. We do not report them here to save space.

C. Changes in Mortality

The actuarially fair price of a single year term life insurance policy is a function of the insured individual's mortality risk, interest rates, and the face value of the life insurance coverage, as we described above. Holding policy characteristics and interest rates fixed, therefore, one would expect a decline in mortality rates to reduce the cost of life insurance. Since mortality rates have been declining over most of the 20th century, it is natural to expect that the price of term life insurance should fall over time as well.

As a general matter, mortality improvement from 1992-1997 was gradual and will have a hard time explaining the sharp price declines witnessed at the end of the sample and significantly more for groups with a high propensity to use the internet. As a specific test of the importance of mortality changes, column 6 computes the log mortality rate for each age-state-year using population data from the Department of the Census and the number of deaths from the National Center for Health Statistics. We also tried including lags and leads of the mortality rate but the results were identical. Note that since we already include state, age, year, and occupation dummies, we identify the impact of innovations in mortality relative to the group mean on the prices of insurance. The coefficient on mortality is positive and significant on prices but the coefficient on the Internet term is not significantly different from the previous regression.[14]

Another demonstration that our results about the Internet are not the result of changes in unobservable factors that influence life expectancy is to examine the impact of Internet usage on whole life prices. Changes to life expectancy should influence both term and whole life policies. Since the comparison sites did not cover whole life policies, however, we do not predict any reduction in search costs in that arena and the Internet should have no effect on prices. The results are presented in column 7 using the online research variable (online usage results were the same). Rising shares of the group using the Internet to research insurance is not associated with lower whole life prices at all. The coefficient is +.388 (and not significant) compared to the significant term life coefficient of –2.5.

[14] An alternative mortality-based explanation is to argue that the sample of life insurance buyers changed in 1996, with less healthy individuals purchasing less insurance. To explain our results, however, this would require that the selection effect be stronger for groups with higher Internet use. To test for this, we ran a sample selection Probit on data from the 1992 and 1998 Surveys of Consumer Finances and found no evidence that the probability of owning term life insurance changed differentially by age, income, education, or occupation groups.

7. Price Dispersion and the Internet

The results confirm that, consistent with the theory of search, as the online insurance sites have made comparison shopping easier Internet users, average prices for such users have fallen significantly. Much of the existing empirical literature about the Internet (and about search theory, too) has examined whether price dispersion falls when search costs are lowered. We have noted, however, that the theory does not have a monotonic prediction for price dispersion, especially when the starting share of fully informed consumers is low, as it is here.

Using our regression results, we can examine the amount of price dispersion within observable groups and correlate it to the share of people using the Internet to research insurance (our proxy for having no search costs). To do this, we take the residuals from the price specification in column 1 of table 2 and compute the standard deviation within age-state group for each year. This is the amount of price dispersion within a group that cannot be explained by the observable characteristics of the people or the policy types.

In column 1 of table 6, we regress these measures of price dispersion on the share of the age-state-year with online access times the share reporting ever having researched insurance online, as well as the square and the cube of the share to allow for non-linearity. In column 2, we also allow for age, state, and occupation dummies. In both regressions, the results show evidence of non-linearity. We graph the predicted values as a function of the share in figures 1 and 2 (the values in figure 2 are net of the fixed effects).[15]

The evidence indicates that price dispersion within groups is rising with the share of people researching insurance online for low shares and then falling with the share online once that share exceeds about 5 percent. Although this may seem counter-intuitive, it is consistent with the theoretical predictions of the literature. When no one has access to full information, giving the information to a very small number of people tends to increase the amount of price dispersion. The fact that our data use transaction prices (thus are weighted by quantity) will tend further emphasize this point in the results.

[15] We found the same non-linear pattern using the inter-quartile range and the total range rather than the standard deviation. To save space, we do not report these results and figures here.

8. The Impact of the Internet on Consumer Welfare

Given the observed impact of the Internet on term life prices, we can make a back of the envelope calculation as to the gain in consumer surplus from the price declines generated by growth of the online comparison sites. To do so we will simply multiply the change in the price by the total amount of term life that was sold in 1995, the year prior to the introduction of these sites. It is important to emphasize again that since we do not know the identities of the companies in our sample, we cannot refute the hypothesis that the Internet primarily shifted people into low quality policies along dimensions that we do not measure. If true, the change in price would not represent a pure increase to consumer surplus.

That said, the total annualized new premiums of all individual life products sold in 1995 was $9.6 billion. According to Limra (2000), 15 percent of these premiums were for term policies, for a total of $1.44 billion of *new* term business. Our results indicated that the increase in online usage from 1995 to 1997 reduced prices between 8 and 15 percent, depending on the specification. This suggests an annual increase in consumer surplus of $115 to $215 million.

This figure may understate the magnitude of the impact of the Internet because new term policies are dwarfed by renewals of term policies, and we suspect that prices on renewals might similarly decline since policy holders have the choice of replacing an expensive policy with a low priced alternative. There were roughly $7 billion of term life renewal premiums in 1995 (ACLI, 1999). If the Internet caused a similar 8% to 15% reduction in these prices, that would add an additional $560 million to $1 billion in consumer surplus, for a total increase of up to $1.25 billion. But even the lower bound of more than $115 million per year is an extraordinarily large consumer gain from a service used by only a small segment of people.

One check on this calculation is to note that this increase in consumer surplus is a direct transfer out of producer surplus. This ought to come straight out of the profits of life insurance companies. In reality, it is hard to measure the impact of this on market values directly since most of the major life insurance companies also sell many other types of insurance (primarily annuities and health) and do not break out profits by type.[16]

The S&P Life Insurance index on Bloomberg, however, indicates that from 1992 to the end of 1995, the index rose, cumulatively, by 62% as compared to 65% for the S&P 500. From the end of 1995 to the end of 1997, however, the index rose, cumulatively by 56% compared with the S&P 500's rise of 64%. The total market capitalization of the 50 largest stock insurance companies at the time of this writing was just under $500 billion so the sector's underperformance amounted to more than $25 Billion 1995 to 1997.[17] Obviously, there are many reasons for the relative performance of life insurance companies in the period but they do not rule out up to $1 Billion dollar reduction in profits due to lower prices and greater competition.

9. Conclusions and Future Directions

In this paper we have examined the market for term life insurance from 1992 to 1997 and documented that the growth of Internet price comparison sites appears to have made the market significantly more competitive. Controlling for policy characteristics and a variety of fixed effects, we find that as the share of people in a group that use the Internet and research insurance online, the more their quality adjusted prices fall. The data also show, consistent with the theory, that increasing the share of people using the Internet in a group tends to raise price dispersion initially and then reduce it as Internet usage continues to grow. The results are robust. The Internet does not appear to reduce the price of whole life policies (which were not covered by the Internet insurance comparison sites) and is not affected by controlling for changes in group specific mortality. Likewise, growth of Internet use before 1996 (i.e., before the insurance comparison sites existed) did not reduce prices.

Overall growth of Internet usage can explain a large portion, and in some specifications all, of the large price declines of the 1990s. The rise of the Internet from 1995 to 1997 appears to have reduced term life prices by about 8 to 15 percent. Internet comparison sites, although seemingly a relatively modest niche of Internet commerce, have increased consumer surplus by at least $115 to $215 million per year and perhaps as much as $1 billion.

In this sense, our results show that, at least for some financial products, the ability of the Internet to reduce search costs can have a significant impact on market power. When it does so,

[16] For example, in 1995 less than 30% of total insurance premiums to the life insurance industry was derived from life insurance premiums (ACLI 1999). Since total term premiums account for roughly 15% of total life insurance premiums, this means that as little as 5% of life insurance company premium income is from term insurance.
[17] At the end of 1997, there were 1511 stock insurance companies in the U.S., though the market capitalization of the stock companies is heavily concentrated among a few players. There were also 100 mutual companies, which

it can lead to major consumer welfare gains but necessarily implies that market power will be diminished for producers in the market. The implications for the market value of online and offline companies could not be more important.

are legally owned by their policyholders and do not issue stock, so they will be excluded from this calculation and thus understate the impact (in 1998, mutuals accounted for 6% of the companies but 28% of the insurance).

TABLE 1: SUMMARY STATISTICS 1992-1997

Type	Term
Premium/($1000 of Face)	3.62 (4.91)
Real Amount of Policy (in '000s of 1990 dollars)	132.97 (136.41)
Length of policy	2.27 (1.86)
Non-Smoker	.774 (.418)
Male	.666 (.472)
Policy is Rated	.077 (.266)
R^(Length)	.881 (.095)
Participating Policy	.883 (.321)
Sold by Own Agent	.975 (.155)
% Online	.169 (.142)
N	10812

Source: Authors' calculations using data from Limra and Forrester.

TABLE 2: BASIC SPECIFICATION

Type	(1) Term	(2) Whole
D93	.0609	-.0597
	(.0133)	(.0134)
D94	-.0146	-.0533
	(.0124)	(.0111)
D95	-.0677	-.0671
	(.0128)	(.0119)
D96	-.1874	-.0111
	(.0133)	(.0148)
D97	-.2702	-.0031
	(.0131)	(.0145)
No-Smoke	-.4596	-.1573
	(.0098)	(.0079)
Male	.1867	.1035
	(.0095)	(.0095)
Rated	.6140	.3365
	(.0201)	(.0141)
R ^ Length	1.453	.8046
	(.36118)	(.0494)
Participating	-.0001	-.0312
	(.0103)	(.0092)
Own Agent	.0955	.4629
	(.0249)	(.0173)
Others: Dummies:	Amount, Length, Marital Age, State, Occupation	Amount, R, Marital Age, State, Occupation
R2	.837	.764
N	10812	29917

Notes: The dependent variable is the log of the real price of insurance per $1000 of face value. Variables are defined in the text. In addition to the coefficients listed, both regressions include the log of the real face value, the real face value, and the real face value squared, dummies if the face amount was censored at the maximum reported value, dummies, and dummies for marital status, as well age age, state, and occupation dummies, as indicated at the bottom of the column. Column (1) concerns term life policies and the regression also includes dummies for policy length. Column (2) concerns whole life policies and the regression also includes policy length as defined in the text and the interest rate term itself as well as the interest rate term to the power of the policy length. Standard errors are in parentheses.

TABLE 3: RESULTS BY CATEGORY

Term Prices	(1)	(2)	(3)	(4)	(5)	(6)
Sample	STATE CA, WA, VA	STATE AL, LA, KY, AR	OCC 10, 11, 12	OCC 6, 7, 8	AGE <30	AGE >45
D93	.0801	.1580	.0439	.0697	.0857	.1239
	(.0395)	(.0555)	(.0229)	(.0372)	(.0264)	(.0321)
D94	.0262	-.0399	-.0221	-.0195	-.0426	.0379
	(.0377)	(.0454)	(.0215	(.0359)	(.0257)	(.0325)
D95	-.0605	-.0788	-.1029	-.0171	-.1127	-.0095
	(.0354	(.0589)	(.0220)	(.0331)	(.0290)	(.0338)
D96	-.1932	-.092	-.203	-.1484	-.253	-.0996
	(.0377)	(.0503)	(.0227)	(.0384)	(.0276)	(.0328)
D97	-.3203	-.1254	-.3311	-.2293	-.3496	-.1411
	(.0411)	(.0526)	(.0218)	(.0413)	(.0260)	(.0344)
Others: Dummies:	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation
R2	.839	.828	.811	.866	.741	.820
N	1451	623	3347	1297	2248	205

Notes: The dependent variable is the log of the real price of insurance per $1000 of face value. All the regressions concern term life policies. The sample is restricted to the group listed at the top of the column. Variables are defined in the text. In addition to the coefficients listed, all the regressions include the variables listed at the bottom of the column. These are the same as those in column 1 of table 1. Standard errors are in parentheses.

TABLE 4: LOG REAL PRICE AS A FUNCTION OF INTERNET USAGE

Type	(1) Age x State	(2) Age x Occup.	(3) Age x Income	(4) Occup. x State
%USE INTERNET	-.5109 (.1189)	-.2269 (.0955)	-.3454 (.1073)	-.1819 (.0860)
D93	.0606 (.0143)	.060 (.011)	.0118 (.017)	.0605 (.0133)
D94	-.01 (.0149)	-.0142 (.0160)	-.0301 (.0135)	-.0142 (.0121)
D95	-.0681 (.0130)	-.0669 (.0146	-.0394 (.0151)	-.0672 (.0129)
D96	-.0515 (.0333)	-.1240 (.0289)	-.0955 (.0341)	-.1409 (.0269)
D97	-.0663 (.0499)	-.1757 (.0403)	-.1401 (.0454)	-.2005 (.0379)
Others: Dummies:	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation	20 Vars Age, State, Occupation
R2	.838	.837	.829	.838
N	10812	10812	8676	10806

Notes: The dependent variable is the log of the real price of insurance per $1000 of face value. All the regressions concern term life policies. The % USE INTERNET is the share of the group listed at the top of the column that had Internet access in the given year. Variables are defined in the text. In addition to the coefficients listed, all the regressions include the variables listed at the bottom of the column. These are the same as those in column 1 of table 1. Standard errors are in parentheses.

TABLE 5: FURTHER CONTROLS

Dependent Variable	(1) Ln(Price)	(2) Ln(Price)	(3) Ln(Price)	(4) Ln(Price)	(5) Ln(Price)	(6) Ln(Price)	(7) Ln(Price)
Including	Research	Interactions	Interactions	Early Years	Early Years	Mortality	Whole Life
%RESEARCH	-2.536		-3.157		-2.436	-2.193	.3876
	(.3701)		(.4831)		(.3922)	(.3849)	(.3871)
% ONLINE		-.7121		-.4447			
		(.1527)		(.1253)			
%RESEARCH (92-5)					.6110		
					(.7014)		
%ONLINE (92-5)				.2841			
				(.1728)			
Ln(Mortality)						.1143	
						(.0453)	
D93	.060	.0410	.0409	.0537	.0587	--	-.0597
	(.0161)	(.0141)	(.0146)	(.0147)	(.0148)		(.0142)
D94	-.0143	-.0123	-.0122	-.0327	-.0188	-.0775	-.0533
	(.0128)	(.0148)	(.0147)	(.0161)	(.0136)	(.0180)	(.0117)
D95	-.0677	-.0654	-.0646	-.1054	-.0765	-.1356	-.0671
	(.0129)	(.0153)	(.0157)	(.0271)	(.0171)	(.0188)	(.0126)
D96	-.1164	.0005	-.1007	-.0619	-.1176	-.1789	-.0215
	(.0161)	(.0439)	(.0200)	(.0338	(.0162)	(.0200)	(.0181)
D97	-.1625	.0081	-.1415	-.0853	.1650	-.2201	-.0177
	(.0214)	(.0643)	(.0263)	(.0510)	(.0216)	(.0255)	(.0212)
Others: Dummies:	20 Vars Age, State Occupation	20 Vars Age-Occ-St	20 Vars Age-Occ-St	20 Vars Age, State Occupation	20 Vars Age, State Occupation	20 Vars Age, State Occupation	20 Vars Age, State Occupation
R2	.838	.885	.885	.838	.838	.836	.764
N	10812	10812	10812	10812	10812	8857	29917

Notes: The dependent variable is the log of the real price of insurance per $1000 of face value. Columns (1)-(6) concern term life policies. Column (7) is a linear probability model of whether the policy was bought through an own agent. The dependent variables are defined in the text. Each regressions also includes the variables listed at the bottom of the column. Standard errors are in parentheses.

TABLE 6: PRICE DISPERSION

	(1) Standard Deviation	(2) Standard Deviation
% Research	3.871 (.971)	3.477 (.981)
(% Research)^2	-68.503 (29.503)	-50.555 (30.017)
(% Research)^3	307.002 (203.984)	187.001 (205.37)
Constant	.264 (.005)	--
Dummies	None	Age, State, Occupation
R^2	.028	.086
N	1248	1391

Notes: The dependent variable is the standard deviation of residuals from the price regression in column (1) of table 2. Standard errors are in parentheses.

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FIGURE 1: STD DEV of Price Residuals by Age-State-Year

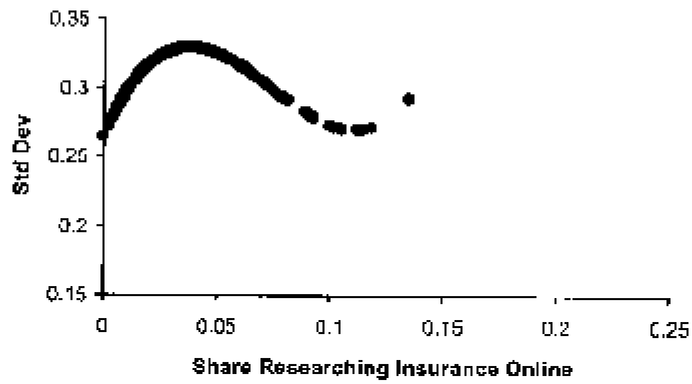

FIGURE 2: STD DEV of Price Residuals by Age-State-Year with Fixed Effects