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Credit-Based Scoring in Insurance Markets

Lawrence S. Powell

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Lawrence S. Powell

Executive Summary

Because insurance companies must set prices for their products prior to knowing their full costs, they use a number of methods to determine expected loss. Insurance scoring—the use of credit information in insurance underwriting and pricing—is an accurate, inexpensive predicator of insured losses, but confusion over its application and meaning often obscures its benefits. Drawing on major studies from the past five years, this study discusses the appropriateness of insurance scoring while demonstrating its positive effects on consumers and the insurance market.

Companies apply risk classification systems in order to determine premiums that correspond to consumers' exposure to risk. Through risk pooling, in which members of a pool each pay the average loss of the group rather than paying for an unpredictable and potentially larger individual loss, insureds are divided into "high-risk" and "low-risk" categories.

Insurance scoring assists in making these classifications. Scores are generally determined through an insured's record of performance on credit obligations, credit-seeking behavior, use of credit, length of credit history, and types of credit used. (Despite a common misconception, insurance scores are not estimated based on income, wealth, race, or ethnicity.) Numerous empirical studies, representing both single-state and nationwide samples and using a wide variety of data sources, conclude that insurance scores are highly correlated with losses, even after controlling for other factors, and serve as powerful predictors of loss relative to other common risk factors.

Although some people are uncomfortable with the use of credit information in insurance rating, its involvement serves to benefit both individuals and society. Due to the accuracy of insurance scoring, such inclusion increases the fairness of the rating process by concentrating on variables that directly predict losses. This can prevent discrimination based on factors unrelated to loss. Powell considers the size of states' residual market mechanisms, which make automobile insurance available to drivers unable to obtain coverage in the voluntary market. As shown in a study from the Federal Trade Commission, while insurance scoring has become more common in ratemaking models, the populations of these residual markets have decreased, suggesting, in concurrence with Powell's hypothesis, that the number of fair outcomes has increased due to increased accuracy from scoring. Insurance scores also enable companies to determine suitable premiums for low-risk consumers, thus aiding them in selecting appropriate premiums for higher-risk applicants whom they may have otherwise declined. Finally, the low cost of insurance scoring reduces the overall cost of providing insurance, savings that insurance companies pass on to customers in the form of lower premiums.

Credit-Based Scoring in Insurance Markets

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Introduction

Insurance companies face an unusual challenge. They must set prices for the products they sell before they know all of the costs. To meet this challenge, they employ necessarily complex pricing methods developed by actuaries using applied economic and statistical techniques. It should then come as no surprise that some aspects of actuarial science and insurance pricing are puzzling to people who have not developed substantial expertise in this field.

Insurance scoring, the use of credit information in insurance underwriting and pricing, is an example of a beneficial practice that is sometimes misunderstood. Insurance scoring benefits consumers in several ways, all of which stem from its accuracy as a predictor of insured losses.

In this paper, I present comprehensive information about insurance scoring and develop conclusions regarding its effects on insurance markets. In Section 1, I present a brief conceptual summary of insurance pricing and insurance scoring. In Section 2, drawing from existing studies, I present evidence that insurance scores are powerful and accurate predictors of insurance losses. In Section 3, I develop evidence of the effects of credit scoring on insurance markets. In Section 4, I conclude with discussion of the appropriateness of insurance scoring.

Section 1: Insurance Pricing and Insurance Scoring

An insurance company facilitates risk pooling, reducing the uncertainty of individual pool members. Uncertainty decreases because the ultimate value of a group's losses is more predictable than that of an individual. Swiss mathematician Jacob Bernoulli first proved this phenomenon, known as the law of large numbers, around 1690. Relying on the law of large numbers, members of a risk pool can each pay the average or expected loss of the group, rather than paying for a much less predictable and potentially larger individual loss on one's own.

Risk pooling is most effective when all members of the pool have the same distribution of expected loss. Insurance companies rely on risk classification systems to ensure that groups of insureds pay premiums commensurate with their exposures to risk. When insurers pool exposures with unequal expected losses, the low-risk group must subsidize the high-risk group. This creates an incentive for low-risk pool members to purchase less insurance than high-risk pool members, a scenario called adverse selection. Adverse selection can break down the risk pooling mechanism and, in extreme cases, lead to insolvency of the pool. Furthermore, suppressing rates for high-risk insureds dampens their incentives to take care,

increasing total losses (Danzon and Harrington, 2001; Derrig & Tennyson, 2008).

Insurance companies use information about insurance applicants to classify them into groups with very similar expected loss. Of course, no risk classification system is perfect. In addition to other restrictions, insurers can only use rating information if it is cost-effective, meaning the cost of obtaining the information is less than the difference in expected loss between groups. For example, assume there are only two types of drivers, low-risk and high-risk. The low-risk group has expected loss of $500 and the high-risk group has expected loss of $700. If it costs more than $100 to classify a driver, it will be more cost-effective to simply pool the groups and charge both $600. However, if an insurer can identify low-risk drivers for, say, $20, it benefits the low-risk drivers to charge them $520, while charging the high-risk drivers $720. On the other hand, insurers can be more precise in risk classification if they hire private investigators to follow each driver for six months before offering an insurance policy. Obviously, this would cost more than $100, and raise privacy concerns. To generate enough money in the risk pool to cover expected losses, low-risk drivers would have to pay more than $600. In this case, there is no justification for such classification.

Insurers use many variables to classify drivers based on expected loss. These include, but are not limited to, geographic location, age, gender, marital status, miles driven, type of vehicle, use of vehicle, driving record, and insurance score. An insurance score is a numerical prediction of propensity for loss estimated using certain information from a driver's credit history. The actuarial literature shows it is one of the most accurate and cost-effective loss predictors available (Miller and Smith, 2003).

There are several apparent misconceptions about insurance scores. To understand why insurance scores are beneficial to insurance systems, it is important to start with an accurate description that is free of incorrect assumptions. The variables commonly used to estimate insurance scores include measures of performance on credit obligations, credit-seeking behavior, use of credit, length of credit history, and types of credit used (FTC, 2007). They do not include income, wealth, race, ethnicity, or any other prohibited factor.

Insurance scores and credit scores are calculated using some of the same information, but they are not equivalent. The important difference is that credit scores use these variables (and others) to estimate the probability of a borrower defaulting on a financial obligation, while insurance scores estimate the probability of having insured losses.

One observed barrier to understanding insurance scoring is manifest in the common criticism that an intuitive link between insurance scores and driving ability does not exist. While several studies develop potential causal links between insurance scores and driving, it is perhaps more compelling to recognize an alternative relation. The use of insurance scores does not rely on a link between credit information and "driving ability." Rather, it is a link between insurance scores and insured losses.

There are many factors unrelated to driving ability that increase the likelihood of insured losses. For example, someone who always makes debt payments on time to avoid higher interest rates the next time they borrow may also choose not to file a small insurance claim to prevent future increases in insurance premiums. Insurance scores may also measure hazards other than lack of driving ability.

Section 2: Predictive Accuracy of Insurance Scores

The correlation between driving outcomes and credit information appears in academic literature as early as 1949 (Tillman and Hobbs, 1949). Over time, evidence of the empirical relation between automobile insurance losses and insurance scores has developed to address not only the simple correlation between insurance costs and insurance scores, but also the additional predictive power and accuracy insurance scores contribute to insurance pricing models containing traditional pricing variables.

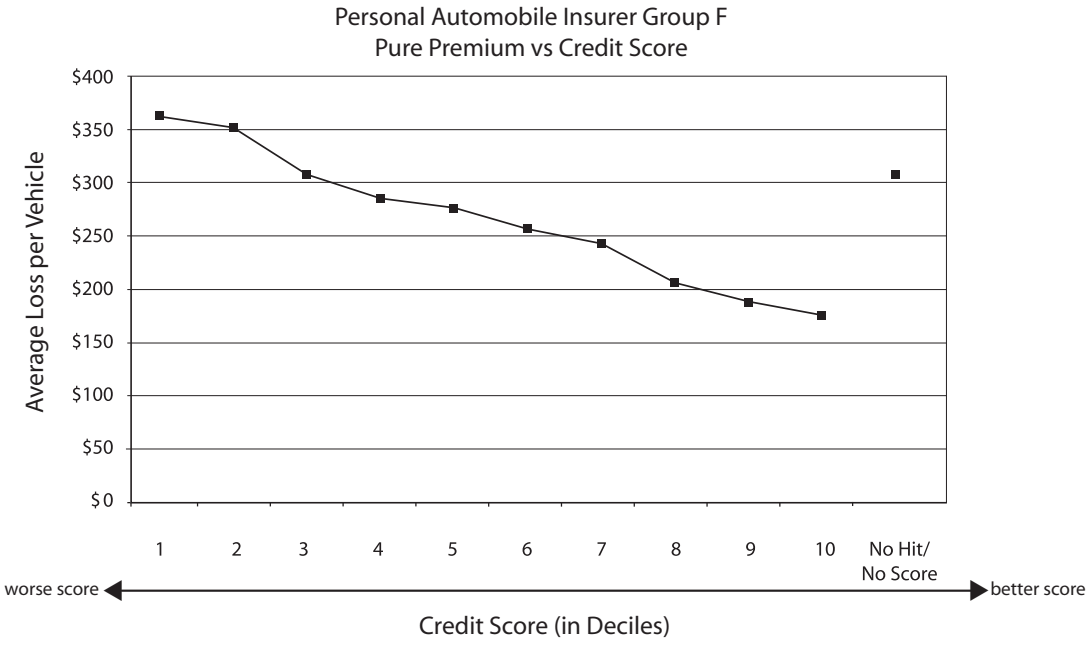
In this section, I review methods and results from several studies investigating the relation between insurance scores and insurance losses. The findings consistently and conclusively demonstrate that insurance scores are highly correlated with losses. The studies also show that insurance scores supply information about insurance losses not contained in other underwriting and rating variables.

More than a dozen studies related to insurance scoring have appeared in the public domain in the last decade. To improve the exposition of information, I present evidence from various studies in order of increasing complexity. This does not match the exact temporal order in which they were released. Furthermore, many of these studies produce very similar evidence and reach nearly identical conclusions. I make an effort to report from the most recent and clear studies.

The most basic result is the simple correlation between insurance scores and losses. A study conducted by the Texas Department of Insurance in 2004 (TDI, 2004) firmly establishes the simple correlation between insurance scores and losses. Using data representing approximately 2 million insurance policies, the authors group exposure units by deciles of credit scores and graph the coinciding average loss frequency and loss amount.

Figures 1 and 2 appear in TDI (2004) as Charts 7 and 9, respectively. Figure 1 shows that average loss per vehicle declines steadily across deciles of

Figure 1. Credit Score and Average Loss per Vehicle



Notes
1. Includes BI (bodily injury) and PD (property damage)
2. Losses are capped at basic limits ($20,000/$40,000/$15,000)

Source: TDI (2004)

credit scores. Those with the lowest scores average approximately $360 per vehicle, while those with the highest scores average approximately $175 per vehicle. Similarly, Figure 2 shows number of claims per 1,000 exposures decreasing from approximately 110 for those with the lowest credit scores to just over 60 for those with the highest scores. These results are qualitatively similar across all of the companies reporting automobile insurance data for the study.

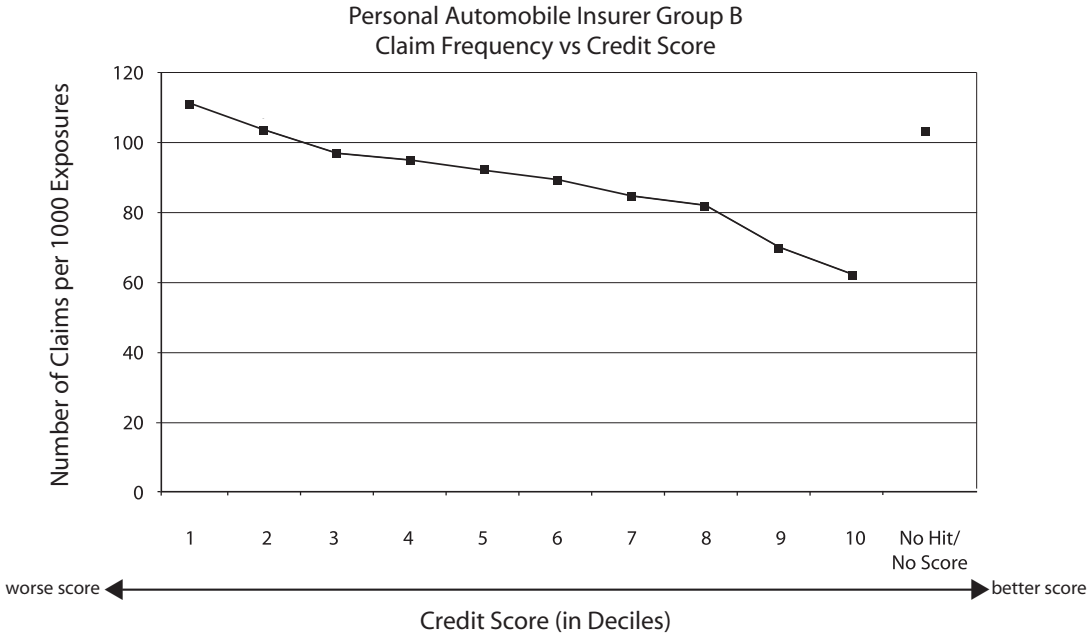
Other studies reach similar conclusions using data from nationally representative samples (Miller and Smith, 2003; FTC, 2007) rather than the single-state sample used by TDI.

Critics of TDI (2004), including the Texas Department of Insurance itself, point out that simple correlation between a rating variable and losses is neither necessary nor sufficient to establish its validity as a predictor of losses. This is true because no variable alone can produce a more accurate prediction of losses than when combined with other accurate predictors of losses. Therefore, in addition to simple linear correlation between predictors and losses, one must also consider the interactions among a group of predictor variables. To do so requires multivariate analysis.

Multivariate analysis, as the name implies, involves analysis of two or more predictor variables at the same time. EPIC (2003), FTC (2007), and a second study by TDI (2005) employ multivariate analysis to determine if insurance scores are risk related. I summarize the analysis and primary findings of these studies below.

TDI (2005) examines a large database of personal automobile and homeowners insurance policies in Texas. The authors performed multivariate analysis considering the interaction of insurance scores and several other common predictors of insurance losses. They find that the strong correlation between insurance scores and losses persists even when controlling for other underwriting factors. TDI (2005) concludes that "credit scoring provides insurers with additional predictive information, distinct from other rating variables,

Figure 2. Credit Score and Number of Claims per 1000 Vehicles



Notes

1. Includes BI (bodily injury) and PD (property damage)

Source: TDI (2004)

which an insurer can use to better classify and rate risks based on differences in claim experience." The authors also find that "use [of insurance scoring] is justified actuarially and it adds value to the insurance transaction."

Miller and Smith (2003) examine a nationally representative sample of insurance scores, underwriting data, and policy outcomes (losses). The study produces four primary findings. First, insurance scores are correlated with risk of loss, even after controlling for relationships with other variables. The correlation is due primarily to loss frequency rather than loss severity. Second, insurance scores are correlated with some other common risk factors; however, even after controlling for other factors, insurance scores significantly increase the accuracy of the risk assessment process. Third, insurance scores are very powerful predictors of loss relative to other common risk factors. Finally, results from the study apply generally to all states and regions.

FTC (2007) also examines a large, nationally representative database to determine the relation between insurance scores and losses. The study finds that "even when non-credit variables are included in the analysis, credit-based insurance scores continue to predict the amount that insurance companies are likely to pay out in claims to consumers." More specifically, they find insurance scores are effective predictors of risk under automobile policies. They are predictive of the number of claims consumers file and the total cost of those claims. The use of scores is therefore likely to make the price of insurance better match the risk of loss posed by the consumer. Thus, on average, higher-risk consumers will pay higher premiums and lower-risk consumers will pay lower premiums.

These recent studies envelop a spectrum of backgrounds and data sources. Private groups and government agencies conduct them. They represent single-state and national samples. They employ different measures and methodologies. Nonetheless, they all reach the same general conclusion: insurance scores are highly predictive of losses, even when controlling for other factors. As noted at the outset, insurers are unique in the U.S. economy, as they do not know the ultimate cost of their product when they sell it. Having a tool to more effectively predict losses helps insurers price their products more fairly, benefiting all consumers.

Section 3: Effects of Insurance Scoring on Insurance Markets

Because insurance scoring is an accurate and inexpensive predictor of insured losses, it should lead to more fair and efficient outcomes in insurance markets. However, critics of insurance scoring claim it is detrimental to consumers. While several studies test the accuracy of insurance scoring, very little has been done to test its effects on insurance markets.

FTC (2007) briefly explores comparisons of states that allow insurance scoring to states that do not. Unfortunately, results from FTC (2007) are inconclusive. Indeed, data problems, confounding events, and measurement error make testing such hypotheses difficult.

Development of Hypotheses

In this section, I expand the current literature by presenting evidence of market outcomes in relation to the use of insurance scoring. In doing so, I test two hypotheses regarding effects of insurance scoring on insurance markets. The first hypothesis is that scoring reduces the size of residual markets. The second hypothesis is that scoring does not increase the average cost of insurance. When considered in tandem, results from these two hypotheses provide clear evidence applicable to the most important effects insurance scoring could have on insurance markets.

Residual markets play a troubling role in state insurance markets. When insurance companies refuse to insure a driver voluntarily, state statutes require that automobile insurance be made available via a residual market mechanism. While these mechanisms take several technical forms, such as joint underwriting associations, reinsurance facilities, and assigned risk plans, they are largely indistinguishable in practice and in outcomes.

Policy makers claim that residual markets are necessary because automobile insurance is required of all drivers. When rate regulation limits the maximum rate insurers may apply to a driver, insurers will not voluntarily insure some drivers because expected losses and expenses exceed expected revenues. Drivers who cannot obtain coverage in the voluntary market may then purchase insurance from the residual market mechanism in their state.

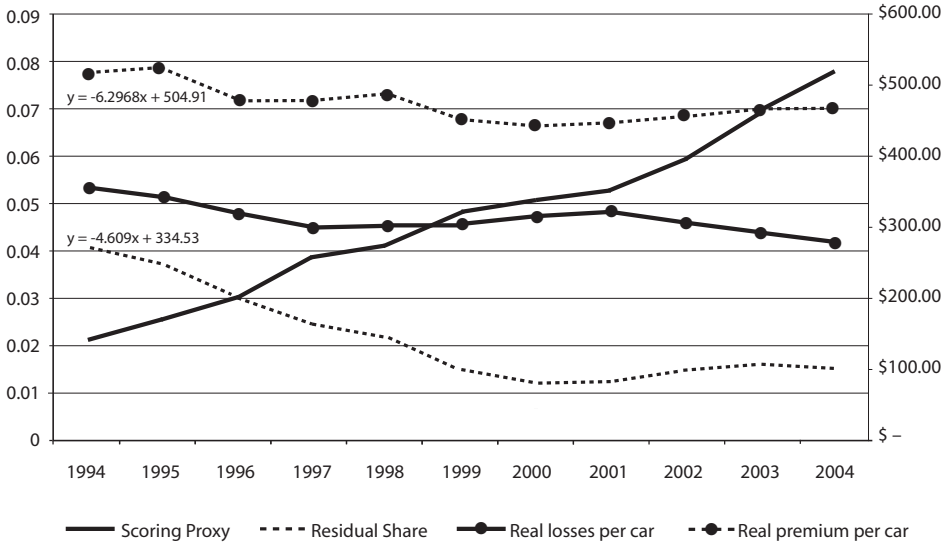
By definition, residual market premiums are less than expected costs. The shortfall created by inadequate premiums is subsidized by assessing insurers in the voluntary market. Each active insurer writing the automobile cover must pay an assessment to the residual market based on market share. For example, if a company writes twenty percent (20%) of premiums in a state, it must pay twenty percent (20%) of the residual market deficit.

This system creates obvious cross-subsidies in the voluntary market. Good drivers are forced to subsidize bad drivers. In addition to the inherent unfairness of this outcome, it creates problematic safety incentives for the worst drivers. These drivers are encouraged to drive more and to take less care when driving.

Empirical Analysis

Prior studies struggle to estimate the extent to which insurance scoring was used to price insurance. For example, FTC (2007) assumes that insurance scoring entered the market around 1997 and uses a time trend to measure effects of scoring on various market measures. To mitigate this problem, I use market penetration of Progressive Insurance Company and its subsidiaries (Progressive) by state to proxy for the use of scoring. Progressive was the first insurance company to use insurance scoring in automobile insurance. The company's website indicates Progressive began using insurance scores to price insurance in 1991. As Progressive gained market share with lower prices

Figure 3. Scoring, Residual Markets, and Cost: 1994–2004



and higher profits, its competitors followed suit. Therefore, Progressive's market share by state is at least a decent proxy for the volume of insurance scoring taking place in the market, and certainly improves on the time trend method.

Figure 3 presents my analysis as a graph. Premium and loss data are collected from the National Association of Insurance Commissioners (NAIC) InfoPro database (1994–2004). The number of insured vehicles and the number of vehicles insured by a residual market mechanism are collected from *AIPSA Facts* (various years). Each number is calculated using state data summed to the national level.

The solid blue line represents market share of Progressive by premium volume. From 1994 until 2004, Progressive's market share grew from 2.1 percent to 7.7 percent. During the same time, the share of vehicles insured by residual market mechanisms (broken red line) decreased from 4.0 percent to 1.4 percent. Thus, as the proxy for insurance scoring increases, the percentage of vehicles in the residual market exhibits a sharp decrease. This is consistent with the hypothesis that the improved accuracy from scoring allows the voluntary market to underwrite risks that were previously insured by residual market mechanisms.

The two black lines near the top of Figure 3 represent real premiums and real losses per car (in 2004 U.S. dollars) during the same period. The top line is premium per car. It decreases from $507 in 1994 to $462 in 2004. The straight line splitting this curve indicates the linear trend of these data. The equation (y=–6.3x+505) is the mathematical representation of the trend. The coefficient estimate for x (–6.3) indicates that premium per insured vehicle decreased by an average of $6.30 per year. Similarly, losses per vehicle dropped from $354 to $281 with a slightly smaller linear trend of $4.61 per year.

It is important to note that this analysis does not prove conclusively that insurance scoring was the cause of either change in insurance markets. Other events certainly influenced residual markets, premiums, and losses. However, it is instructive to witness the increasing fairness achieved by reducing explicit cross subsidies created by residual markets, and the decreasing cost of insurance, while the use of credit scoring more than quadrupled in the market.

Section 4: Appropriateness of Insurance Scores

Regulators require insurance rates to meet three criteria. They must not be inadequate, excessive, or unfairly discriminatory. A rating criterion is unfairly discriminatory if it is does not bear a reasonable relationship to the expected loss and expense experience among insured exposures. Given the evidence presented in Section 2, insurance scores clearly meet the third criterion. However, some people remain uncomfortable with the application of credit information in insurance rating. In this section, I describe the individual and societal benefits of insurance scoring. Finally, I present evidence that competition in insurance markets prevents discrimination based on any factor other than expected losses.

Insurance scoring benefits society in several ways. All of the benefits accrue from improved efficiency and accuracy of risk estimates. The first benefit is that insurance scores provide a very high level of accuracy for a relatively small cost. Using insurance scores reduces cost for insurance companies. Because the market for insurance is competitive, this savings is passed through to consumers as lower premiums. Data from a recent report by the Arkansas Insurance Department indicates that only 9 percent of all personal lines policies receive a premium increase due to insurance scoring; while 30 percent receive a premium decrease. Using a slightly different method, the FTC (2007) study estimates that insurance scor-

ing results in a decrease in insurance premiums for 59 percent of drivers.

The next benefit of insurance scoring is that improved accuracy may make insurers more willing to offer insurance to high-risk consumers for whom they would otherwise be unable to determine an appropriate premium (FTC, 2007). For example, insurance scoring information can allow an insurer to offer coverage to drivers living in a geographic area with high traffic density at a price the driver can afford. Without information from insurance scores, insurers would not be able to differentiate sufficiently among these drivers. Therefore, they would not be able to offer the coverage at a lower price to lower-risk drivers living in the area. Consistent with this assertion, FTC (2007) finds limited evidence that the advent of credit scoring in automobile insurance coincided with substantial decreases in residual market mechanisms. This suggests insurers, with the benefit of credit information, are more willing to offer coverage to high-risk drivers (at a risk-based price) than they were before the introduction of insurance scores.

Another advantage of using insurance scores is that it improves accuracy of information used to classify drivers. In addition to calculating more accurate loss predictions, the scores themselves are less likely to contain material factual errors than several of the driving history variables used to underwrite insurance. Studies by Associated Credit Bureaus (Arthur Andersen & Company, 1992) and TransUnion report material errors in credit information in only 0.2 percent of credit records. In striking contrast, a study by the Insurance Research Council (IRC, 1991) found public information available on only 40 percent of a sample of known automobile losses. Underreporting of traffic citations also appears problematic. IRC (1991) indicates less than a third of all traffic citations are accurately reported in state driving records. Furthermore, consumers have a strong incentive to correct inaccurate credit information, whereas the opposite incentive exists for driving records, since recorded driving events can only be adverse events. Data describing instances in which drivers avoid collision by defensive driving and alertness are not collected.

The final benefit of insurance scoring I address is that because scoring produces more accurate loss estimates, it results in outcomes that are more equitable for individuals and society as a whole. As noted in Section 2, insurance scoring is likely to make the price of insurance better match the risk of loss posed by the consumer. Thus, on average, higher-risk consumers will pay higher premiums and lower-risk consumers will pay lower premiums (FTC, 2007). This addresses a very common problem in the insurance mechanism called cross-subsidization.

When insurers cannot accurately classify applicants for insurance, they must either decline applications or charge the same premium to high-risk and low-risk drivers. The latter case obviously leads to cross-subsidization—when low-risk drivers must overpay to make up for underpaying high-risk drivers. However, the former case, declining applications for insurance, ultimately leads to the same outcome. This type of cross-subsidization is facilitated by residual markets for insurance.

Each state has a residual market mechanism to make insurance available to drivers whom the voluntary market will not cover. Residual market mechanisms effectively set a maximum price that insurers may charge for insurance. If insurers are not willing to offer coverage at this price, consumers may purchase coverage at this price from the residual market. However, if the premium is not enough to cover losses and expenses, insurers in the voluntary market must make up the deficit in proportion to their market shares.

FTC (2007) shows that as insurance scoring has become more common in ratemaking models,

the populations of states' residual markets have decreased. This suggests insurance scoring results in more equitable or fair outcomes compared to less accurate rating models that do not use insurance scores.

Another way to address the appropriateness of insurance scoring is to consider the level of competition occurring in insurance markets. If insurance markets are competitive, insurers will not be able to charge excessive or unfair prices. If an insurer tries to set prices based on anything other than expected losses and costs, it will either suffer substantial losses if the price is too low, or, if the price is too high, it will lose market share as its competitors offer a lower price to the same consumers.

Effective competition is a fundamental characteristic observed in U.S. insurance markets. Competition prevents insurers from charging excessive or unfair prices. For 2005, NAIC data show an average of 157 insurance companies underwriting the private passenger automobile cover in each state. It is, therefore, reasonable to believe that an insurer cannot systematically overcharge a group of drivers because any one of the other 156 existing companies, or perhaps a new company, has an opportunity to cover that group of drivers at an equilibrium price.

While competitive markets are very effective at making the goods and services consumers want available to them, critics have voiced concerns that, when a drop in credit is unrelated to insurance risk, some individuals could be mistreated by insurance scoring. In response to such concerns, almost every state has regulations in place to recognize the benefits of insurance scoring, while limiting its use in certain scenarios. It is worth noting that many insurers offered the same protections as these regulations require before the laws were enacted. This is another example of competitive markets creating an optimal outcome.

Conclusion

Setting reasonably accurate prices for insurance is a difficult task because insurers must establish prices without the benefit of knowing all of the costs involved. To offset this hardship, actuaries have developed complex pricing models using applied economic and statistical tools. While this complexity is necessary, it unfortunately leads to a lack of understanding among people who have not developed such specific expertise.

Insurance scoring is an example of a beneficial tool used in ratemaking that is often misunderstood. Insurance scores are relatively powerful and accurate predictors of losses, even when controlling for other factors known to be correlated with losses. When insurers use insurance scores to improve the accuracy of predicted losses, it benefits individuals and society. It increases the equity or fairness in insurance pricing outcomes because, on average, premiums are more closely related to consumers' risk of loss. Insurance scoring also adds value to insurance transactions. It reduces the overall cost of providing insurance because insurance scores are accurate and inexpensive rating variables.

Insurance scoring appears to have a beneficial effect on insurance markets. Empirical evidence suggests scoring improves availability in the voluntary market without increasing price. This prevents harmful cross-subsidies that lead to increased losses and inherently unfair redistribution of money from low-risk drivers to high-risk drivers. Importantly, these results hold in both univariate and multivariate statistical tests.

Finally, the vigorous competition exhibited by the property and casualty insurance industry suggests that pricing of insurance based on anything other than expected losses is nearly impossible. Insurance markets show strong signs of effective competition, including a large number of suppliers and low barriers to entry.

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LAWRENCE S. POWELL is a Research Fellow at The Independent Institute and holds the Whitbeck-Beyer Chair of Insurance and Financial Services at the University of Arkansas, Little Rock. He earned a bachelor's degree in Insurance and Finance from the University of South Carolina and a Ph.D. in Risk Management and Insurance from the University of Georgia.

His research focuses on the effects of regulation on insurance markets and appears in leading academic and practitioner journals. Before pursuing an academic career, Powell worked in several aspects of the insurance industry including production and claims. An active consultant to public and private entities, he participates in formation, operation, and evaluation of insurance companies and provides expert services to support legislation and litigation.

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