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4 Rate Regulation and the Industrial Organization of Automobile Insurance

Susan J. Suponcic and Sharon Tennyson

4.1 Introduction

Property-liability insurance markets, especially those for personal coverages such as automobile insurance, have traditionally been closely regulated. Areas of government oversight include the imposition of licensing and capital requirements, the monitoring of solvency and liquidation of insolvent firms, and, in some cases, direct regulation of insurance rates. Under the provisions of the McCarran Ferguson Act of 1945, this regulation is undertaken by the individual state governments rather than at the federal level. As a result, the extent of regulatory intervention and enforcement differs across locations.

A primary area of state differences in regulation is the degree to which rates for private passenger automobile insurance are regulated. Just over half of the states intervene directly in the rate-making process for automobile insurance. The most common method of rate regulation is the *prior approval* system, under which each insurer's rates must be approved by the state insurance commissioner prior to their introduction into the market. A few states instead require all insurers to charge rates that are set by the insurance commissioner, or by an industry rating bureau. The remaining states allow rates to be competitively determined, although most require that insurers file rate changes with the state commissioner.

The effects of rate regulation on insurers' underwriting margins have been

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the subject of numerous analyses.[1] Most studies assess underwriting results by the *unit price* of insurance, the ratio of premium revenue received to losses incurred by the insurer. This ratio is a measure of the average price paid by insureds per dollar of benefits (loss payments) received. Early studies tended to find that regulation raised unit prices for automobile insurance, suggesting that regulation promoted collusive pricing or inhibited price competition (Joskow 1973; Ippolito 1979; Frech and Samprone 1980). However, these studies examined the time period from the late 1960s to early 1970s, a period when virtually all states regulated rate setting and deregulation was a very recent phenomenon. Later studies, availed of greater variability in regulatory regimes and longer time horizons for comparison, have consistently found the opposite result: lower unit prices for automobile insurance in states that regulate rates (Pauly, Kunreuther, and Kleindorfer 1986; Harrington 1987; Grabowski et al. 1989). Thus, at least since the mid-1970s, rate regulation has had the effect of reducing insurers' premium revenues relative to insured losses, thereby lowering the average unit price of insurance.

The magnitude of unit price reductions under regulation has been shown to be relatively small on average, decreasing unit prices by 0.03 to 0.07. The price-decreasing effects of regulation are significantly larger in a few selected states, however (Harrington 1987; Grabowski et al. 1989). These findings have raised concerns about potential distortionary effects of rate regulation on insurance markets. Pauly et al. (1986) present indirect evidence, based on the estimation of cost functions, that rate regulation may lower quality or service provision by insurers. Grabowski et al. (1989) demonstrate that stringent rate regulation reduces insurance availability, where availability is assessed by the fraction of drivers able to purchase insurance in the voluntary insurance market.[2] Kramer (1992) investigates the effects of rate regulation on insurance company financial health and finds evidence of a relationship between stringent regulation of rates and increased risk of insurer insolvency.

This paper investigates the hypothesis that rate regulation distorts the industrial structure of state automobile insurance markets. As noted by Harrington (1992), insurers will be reluctant to commit resources to regulated states if current regulation is excessively stringent or if the regulator cannot commit to an established level of regulation in future periods. More generally, restrictive regulation may affect the operating decisions of insurers in the state. Our analysis focuses on how differences across insurers in costs, size, production technology, and market position will lead to different responses to regulation,

1. See Harrington (1984) and Grabowski, Viscusi, and Evans (1989) for comprehensive reviews of the literature.

2. Residual market pools exist in all states to provide insurance to drivers unable to obtain coverage in the open market. Regulation that holds prices below the competitive level will increase the fraction of drivers insured in the residual market, due to rationing in the voluntary market sector. The findings of Grabowski et al. (1989) are consistent with this view of regulation for several highly regulated states.

thereby distorting the industrial structure of the market. If the net effect of regulation is to lower the relative market presence of the lowest cost insurance providers, insurance market efficiency will be adversely affected.

The paper is organized as follows. Section 4.2 describes the industrial structure of automobile insurance markets. Section 4.3 discusses how differences in insurer organization and market position will lead to different responses to regulation. The remaining sections investigate the empirical content of these arguments. Section 4.4 compares the structure of automobile insurance markets in regulated and unregulated states. Sections 4.5 and 4.6 provide more controlled investigations of the effects of rate regulation, using multivariate analysis of regulatory effects on state insurance market structure. The final section of the paper summarizes our findings and suggests future research avenues.

4.2 The Industrial Organization of Automobile Insurance

Automobile insurance industry statistics for 1989 are presented in table 4.1. We use 1989 as the basis for our cross-sectional analysis because it is a year

Table 4.1 **Private Passenger Automobile Insurance Market Statistics, 1989**

		State Markets	
Statistic	National Market	Mean	S.D.
Total premiums ($)	74,399,743,314	1,485,019,174	1,930,625,557
Unit price	1.33	1.37	0.13
Number of firms			
Total	526	103.38	26.00
Direct writers	101	27.88	6.71
National firms	78	62.64	7.89
National direct writers	21	18.62	2.47
Auto specialists	233	34.18	11.40
National auto specialists	20	16.98	2.39
Big Four	4	3.54	0.50
Market share			
Direct writers	0.646	0.642	0.117
National firms	0.697	0.701	0.125
National direct writers	0.476	0.481	0.139
Auto specialists	0.677	0.654	0.119
National auto specialists	0.432	0.431	0.113
Big Four	0.410	0.424	0.134
Measure of concentration			
C4	0.417	0.540	0.086
HHI	659	1,043	311.66

Source: Authors' calculations based on A. M. Best Company data tapes for Best's Executive Data Service.

Note: For definitions, see section 4.2.1 of the text.

of calm in the insurance business cycle, and it is the most recent year before major changes began in the insurance regulatory environment: 1989 was the last year that the major insurance rating bureaus issued advisory rates to their members, and the passage of California's Proposition 103 in late 1988 prompted consideration of regulatory initiatives in other states in subsequent years. These changes could differentially affect the competitive strategies or capabilities of different types of insurers, thereby affecting market structure.

4.2.1 The National Automobile Insurance Market

A. M. Best Company identifies 526 different groups and independent single companies writing positive auto insurance premiums in the United States in 1989.[3] In keeping with the large number of firms in the market, traditional measures of concentration are relatively low in the industry: the four-firm concentration ratio (C4) is 42 percent, and the Herfindahl-Hirschman Index (HHI) for the market is 659, based on direct premiums written. These values are not large in comparison to other industries (Klein 1989), and an HHI of under 1,000 falls into the range defined as "unconcentrated" by U.S. Department of Justice merger guidelines.

The variation in insurer size is considerable. The largest four writers in the market (known in the trade press as the "Big Four") obtain market shares of 20 percent (State Farm), 12 percent (Allstate), 5 percent (Farmers), and 4 percent (Nationwide), respectively, and only 13 other firms write over 1 percent of the market. Yet the largest 50 firms write over 80 percent of all auto insurance premiums. Fully 90 percent of auto insurance premiums are written by only 90 firms. To put this into perspective, this means that 436 firms share only 10 percent of the private passenger auto insurance market.

Insurers also differ greatly in the extent of geographic areas served. For example, only 78 of the 526 firms in the market write auto insurance in all nine census divisions in the country. The remainder sell in only some regions of the country, and 191 firms sell in only a single state. Hence a vast majority of firms in the market have operations that are concentrated in particular geographic areas. While the national firms (those that sell in all nine census divisions)[4] make up only 15 percent of insurance providers by number, these firms write 70 percent of total private passenger auto insurance premium volume. This implies that insurance markets are highly segmented by geographic location—with relatively few firms writing the bulk of premiums nationally and a much

3. Best Company lists a total of 570 groups and independent sellers of private passenger automobile insurance; however, some of these firms reported zero or negative premiums for this line and are omitted from the analysis.

4. Under the standard categorization popularized by Best Company reports, 40 firms are known as "national" insurance writers. However, this categorization is not based on automobile insurance writings: not all of these carriers sell auto insurance nationally, and there are a significant number of insurers categorized by Best as "regional" who do write nationally. We feel that our definition of national sellers is superior for purposes of analyzing the auto insurance market.

larger number of local or regional firms writing the balance of the market in their particular area.

The data also reveal significant differences in the market presence of firms using different organizational forms. There are two major systems of distribution used in the industry. Some insurers ("direct writers") use sales agents who sell exclusively the products of that specific firm. Other firms utilize the more traditional independent agency system, under which each agent may sell the policies of a number of insurance companies. Numerous empirical studies have shown direct writers to be lower cost sellers of automobile insurance than independent agency firms (Joskow 1973; Cummins and VanDerhei 1979; Barrese and Nelson 1992). Yet direct writing entails larger investment in firm-specific assets and greater sunk costs of entry than independent agency because the degree of integration and centralization is greater.

In accordance with their operating cost advantage, direct writers dominate the auto insurance market, achieving a nearly 65 percent market share in 1989. However, consistent with the higher fixed costs of direct writing, there are fewer firms employing this system than the independent agency system. Of the 526 firms in the market only 101 are direct writers; the remaining 425 are independent agency writers. This fact, in conjunction with the statistics on market shares, implies that on average direct writers are much larger than independent agency writers. There are substantial size differences among direct writers, however; a few extremely large firms, such as State Farm and Allstate, significantly influence averages for the group. While the 10 largest direct writers in the industry each write well over $1 billion in auto insurance premiums, the median-sized direct writer has premium revenue of only $39 million. Nonetheless, this is significantly greater than the median premium volume of $10.5 million for independent agency writers.

In addition to differences in market shares, there are also great differences in specialization across firms.[5] Of the 526 firms writing in the market, 88 firms (16.3 percent of all firms) write over 90 percent of their insurance premiums in private passenger automobile lines, and 233 firms (44.3 percent of firms) write at least 50 percent of their business in auto insurance. Since private passenger auto insurance makes up only 35 percent of total property-liability insurance premiums nationally, we classify these latter insurers as "auto specialists." This group contains several high-profile automobile insurers, including State Farm and Allstate, as well as a large number of relatively small specialist firms. At the other extreme from the auto specialists, 94 firms (17.9 percent of firms) write under 10 percent of their business in private passenger auto insurance. This latter category of firms includes a number of well-known brand-

5. These differences are likely to be related to differences in organizational structure because of the resulting differences in cost structures and production technologies. For empirical evidence on the relationship between insurer organizational structure and market positioning, see Mayers and Smith (1988), Marvel (1982), and Regan and Tennyson (1996).

name insurance writers, including Chubb, Firemans' Fund, and CIGNA. Although these firms may write substantial premium volume in private passenger auto insurance, their relative focus on these lines is limited.

This brief portrait of the national automobile insurance market highlights the great variation across firms in terms of size, geographic focus, and relative specialization in automobile insurance. These differences and differences in insurer organizational form are likely to reflect underlying differences in production and cost technologies. The data also show that a comparatively small number of firms, relative to the total number in the market, serve the vast majority of the market at the national level. This suggests that a relatively small number of large producers may possess a cost or technological advantage over the remainder of the producers in the market. This point of view is supported by comparisons of insurer expense data: the Big Four, national auto specialists, and direct writers all exhibit significantly lower expense ratios (underwriting expenses as a percentage of premium volume) than other automobile insurers (Tennyson 1996).

4.2.2 State Automobile Insurance Markets

In the national automobile insurance market, we observe a great deal of market segmentation by geographic location, as evidenced by the relatively small number of firms that sell nationally. This implies that auto insurance markets may differ substantially across states and that state markets may look very different from what is suggested by national market statistics. Closer examination of state insurance markets reveals evidence of both of these features in the data.

For comparison to the national market statistics, the second and third columns of table 4.1 present means and standard deviations of the industrial characteristics of state automobile insurance markets. The number of sellers in each state varies from 33 to 151, with a mean value of 103, much lower than the national total of 526 firms. State-level values for C4 vary from 33.2 percent to 80.4 percent, with a mean of 54 percent; the HHI by state ranges from 503 to 2,220, with a mean of 1,043. Thus, market concentration varies a great deal across states and is generally greater than at the national level.

The numbers and market shares of different types of sellers also vary across states. For example, the number of direct writers per state varies from 8 to 40, with a mean value of 28; direct writer market share by state ranges from 28 to 88 percent, with a mean value of 64 percent. The number of national writers ranges from 30 to 73 across states, with a mean of 63, and their state market share varies from 41 to 99 percent, with a mean of 70 percent. The number of auto specialists per state ranges from 7 to 60, with a mean of 34, and their market share ranges from 33 to 82 percent, with a mean of 65 percent.

These differences across states in the numbers of firms and their relative market shares suggest that the effects of rate regulation on market structure may vary greatly across states. It is also possible that this diversity in fact re-

flects the effects of regulation, if regulation distorts firms' entry and output decisions. The remaining sections of the paper further develop and explore the hypothesis that differences in state insurance market structure are related to differences in regulatory stringency.

4.3 Insurer Responses to Stringent Regulation

This section of the paper considers how insurers' choices regarding capacity allocation and output may respond to restrictive regulation of rates in a state insurance market. Consistent with the evidence presented in the previous section, and with previous characterizations of automobile insurance markets (Joskow 1973), we assume that a relatively small number of firms enjoy a persistent cost advantage over the remaining firms in the market. Firms engage in Bertrand competition over prices, but limited capacity prevents the large firms from meeting the entire market demand. Entry barriers, perhaps due to scarce managerial inputs or to increasing returns to scale, protect this segment of the industry from vigorous entry. These features imply that the large, low-cost firms can earn greater rates of return than the fringe firms in unregulated markets.

In analyzing the effects of regulation, it is important to keep in mind that rate regulation does not impose a uniform price constraint on insurers. Under the prior approval system, each insurer's rate proposal is supported by data on its loss and expense experience; the proposed rates are then evaluated with respect to some measure of a fair rate of return for the insurer. Hence, rates can and do vary across insurers; regulation simply limits the profitability of business written. The implications of profit regulation will differ from those of a regulatory price ceiling. In particular, limits on rates of return will be most binding for low-cost insurance providers, whereas a price ceiling will be most binding for high-cost providers.

Market structure is determined by both the market entry and exit decisions of firms and the output decisions of the firms that choose to sell in the market. We consider first the effects of regulation on insurer entry and exit decisions. To the extent that regulation reduces insurer returns below those available in other markets, firms will choose not to enter regulated markets. Concerns about future regulatory stringency may also deter entry if insurers must incur sunk investments to enter the market (Harrington 1992). Sunk investments required of insurers include investments in distribution and claims-handling networks, advertising in local markets, and costs of regulatory compliance in the state. The more stringent is regulation, and the larger are the necessary sunk investments, the greater will be the distortions to entry.

Incumbent firms in a market must decide whether to exit in response to stringent regulation. Empirical evidence from the 1960s through the early 1980s suggests that the nature and stringency of rate regulation has changed over time from profit increasing to profit reducing (Pauly et al. 1986; Grabow-

ski et al. 1989). More recent evidence suggests that the trend toward more restrictive rate regulation may be continuing: in 1988 the state of California passed legislation that mandated rate rollbacks for all insurers, and at least 14 other states have since considered similar measures. This increased regulatory stringency may drive incumbent firms out of the market.

Withdrawal from regulated markets may be inhibited, however, by the existence of fixed, state-specific inputs to production. Important inputs into insurance production are labor, real capital, and financial capital. In the short run, labor inputs may be variable, but capital inputs are generally fixed. What we term real capital includes investments in distribution networks and claims-handling facilities, which are fixed in the short run. Financial capital incorporates surplus funds to bolster solvency and is also fixed. Unlike real capital, however, financial capital is not tied to any one line of business or state market even in the short run. Thus, to the extent that labor and real capital inputs are in place, insurers can quickly and costlessly reallocate capacity across insurance markets by a simple reallocation of financial resources. Insurers may nevertheless be slow to withdraw entirely from a regulated market because real capital resources are not mobile across markets in the short run.

There are also other factors at work that imply that insurers' response to rate regulation may be to reduce market share rather than to exit the market. Regulators in many states have the ability to force insurers to pay explicit or implicit exit ransoms. For example, the courts have consistently upheld the ability of regulators to withdraw licenses for all business in the state if an insurer wishes to withdraw from a heavily regulated line such as automobile insurance. Some states also force withdrawing insurers to continue contributions to the residual market deficit for a period of time after withdrawal from the state (Cummins and Tennyson 1992). These actions will significantly raise exit costs for insurers in regulated markets, which may discourage or slow the pace of exit (Harrington 1992). Firms that operate in more than one line of insurance may be especially slow to exit the regulated line as this could threaten licenses to write in other lines in the state.

One hypothesis that can be drawn from this discussion is that, all else equal, fewer firms will choose to operate in regulated states, since entry is relatively unattractive and exit is relatively attractive in these markets. Predictions regarding the relative numbers of different types of firms are less clear-cut, however. We might expect the number of direct writers in regulated insurance markets to be relatively lower than the number of independent agency writers because direct writing requires greater sunk investments in the market and hence direct writer entry into regulated environments will be discouraged. However, once these investments have been made they will inhibit exit if the regulatory environment worsens, implying that direct writers could be more prevalent under regulation. On the other hand, firms using the independent agency system tend to be less specialized in automobile insurance than direct writers (Regan and Tennyson 1996). This may slow their rate of exit from unfa-

vorable market environments since their lack of specialization implies greater costs of exit in terms of profits forgone in unregulated lines of insurance.

National firms, especially those specializing in automobile insurance, may be quick to exit unprofitable auto insurance markets because their costs of exit may be lower due to their existing distribution networks elsewhere. However, market exit implies dismantling state distribution networks, and reentry at a later date would involve additional start-up costs. These firms may thus find it less costly to reduce market share than to exit, since they can easily reallocate financial resources to the most profitable state markets.

If regulation is not sufficiently stringent to induce market exit, regulatory profit restrictions will nonetheless lead to reductions in output in the regulated lines of business. The relative reliance on state-specific real capital inputs and alternative opportunities for the use of financial capital will determine differences in output reductions across insurers in response to regulation. This reasoning yields definitive predictions about the relative effects of restrictive rate regulation on the market shares of different types of firms.

Low-cost producers, especially those with existing distribution systems in other less stringently regulated states, should reduce output the most in the face of rate regulation. This reflects the ability of firms with lower production costs to achieve higher rates of return than other firms in the absence of regulation. These producers thus have higher opportunity costs of devoting resources to a regulated market for which rates of return are held below those achievable elsewhere. A national distribution system also lowers the cost to a firm of reducing market share in a regulated state since the firm can reallocate financial resources to other state markets without new investments in real capital inputs.

The (opportunity) costs of capacity reallocation may vary with the output mix of the insurer, however. Greater diversity of exposures across lines of business in a state may increase the costs of reducing auto insurance market share if this adversely affects the insurer's reputation or relationships with sales agents. Hence, market share reductions under regulation may be most observable in national firms that specialize in automobile insurance. This reasoning also implies that direct writers should have lower market shares in regulated states since these firms tend to be low-cost producers of automobile insurance. This should be especially true for direct writers that operate nationally.

4.4 Market Structure in Regulated and Unregulated States

The theoretical discussion above suggests a number of dimensions along which automobile insurance market structure may be affected by rate regulation. The remaining sections of the paper investigate the extent to which these distortions occur in practice, by examining differences in insurance market structure across regulated and unregulated states.

In this section of the paper we examine data on the mean values of the number of firms and firm market shares in regulated and unregulated states for the

year 1989. The analysis is undertaken at the level of state aggregates, for all private passenger automobile insurance coverages combined. States are first grouped into two basic categories—regulated and unregulated. Consistent with previous studies, states that employ prior approval regulation, state-made rates, or mandatory bureau rates are considered regulated; states that primarily require insurers to file rates rather than to seek approval of rates are considered unregulated. The regulatory system employed in each state was determined from information obtained from the National Association of Insurance Commissioners and the Alliance of American Insurers.

The state of California is omitted from this portion of the analysis because of the passage of Proposition 103 in late 1988. This controversial legislation introduced prior approval regulation of insurance rates, along with a number of other controls on the practices of insurers in that state. Due to the lags inherent in implementation of these regulations and to the continuing challenges of the legislation by insurers, it is unclear whether California should be considered regulated or unregulated in 1989. Our sample thus contains 25 regulated states and 24 unregulated states.[6]

To further differentiate those states that are the most heavily regulated, we also classify five states that have extremely large residual markets for automobile insurance as states with "stringent" regulation. All states operate residual markets for automobile insurance, which are designed to provide at least minimal coverage to those individuals unable to obtain insurance in the private market. Previous studies have documented that stringent regulation of insurance rates is associated with large fractions of the population insured through these residual mechanisms (Grabowski et al. 1989). The five stringently regulated states in our sample are Massachusetts, New Hampshire, New Jersey, North Carolina, and South Carolina. In each of these states at least 20 percent of drivers were insured in the residual market throughout the 1980s.[7]

Table 4.2 compares summary measures of market structure for unregulated states, regulated states, and stringently regulated states. We first note that, consistent with intuition, the average number of firms selling automobile insurance is lower in regulated and stringently regulated states than in the unregulated states. This difference is significant at the 10 percent confidence level for regulated versus unregulated states, and significant at the 1 percent confidence level for stringently regulated versus unregulated states. This comparison is particularly meaningful since the table also shows no significant differences in the average size of the auto insurance market across these sets of states, where

6. Including California in either state category significantly affects the results of the comparison of mean values.

7. By comparison, unregulated states insured only an average of 1.2 percent of drivers in the residual market, and other regulated states insured on average 2.3 percent of drivers in the residual market, over the time period 1980–90. However, two regulated states (New York and Rhode Island) insured between 10 and 15 percent of drivers in the residual market for at least some portion of this time period.

Table 4.2 **Private Passenger Automobile Insurance Statistics by State Regulatory Status, 1989**

	Unregulated		Regulated		Stringent	
Statistic	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total premiums (thousand $)	1,087,895	863,030	1,474,385	1,575,869	1,429,383	791,093
Unit price	1.39	0.13	1.34	0.14	1.23*	0.18
Number of firms						
Total	108.24	22.56	96.71*	27.80	83.00***	12.73
Direct writers	30.60	5.28	24.75***	6.81	19.80***	2.39
National firms	64.44	4.73	60.38**	9.82	56.40**	5.81
National direct writers	19.40	1.41	17.75***	3.07	16.20***	1.48
Auto specialists	37.20	9.55	30.46**	12.22	23.20***	4.27
National auto specialists	17.72	1.54	16.13***	2.85	14.20***	1.79
Big Four	3.76	0.44	3.29***	0.46	3.00***	0.00
Market share						
Direct writers	0.679	0.084	0.599***	0.133	0.520**	0.150
National firms	0.670	0.107	0.741**	0.159	0.732**	0.043
National direct writers	0.476	0.100	0.491	0.150	0.465	0.116
Auto specialists	0.711	0.069	0.588***	0.126	0.541***	0.095
National auto specialists	0.440	0.092	0.424	0.134	0.375	0.155
Big Four	0.459	0.100	0.386**	0.157	0.279**	0.167
Measure of concentration						
C4	0.562	0.058	0.518**	0.106	0.454**	0.087
HHI	1,111.57	221.33	977.19*	380.95	756.47***	219.97

*Significantly different from unregulated states at the 10 percent confidence level, one-sided test.

**Significantly different from unregulated states at the 5 percent confidence level, one-sided test.

***Significantly different from unregulated states at the 1 percent confidence level, one-sided test.

market size is measured by total written premium volume.[8] Hence, the fact that there are fewer firms writing in regulated state markets is not attributable to differences in market size. The same result holds for each specific type of insurance seller: in every category of firm examined, there are fewer firms operating in regulated and stringently regulated states than in unregulated states. This is what we would expect if rate regulation affects firms' incentives for market entry and exit.

The largest percentage reductions in number of firms are for direct writers and for auto specialists. Relative to unregulated states, on average there are 19 percent fewer direct writers and 18 percent fewer auto specialists in regulated states, and 35 percent fewer direct writers and 37 percent fewer auto specialists in stringently regulated states. This compares to an 11 percent reduction in the total number of firms in regulated states, and a 23 percent reduction in the number of firms in stringently regulated states, relative to the unregulated state average. These results are consistent with the hypothesis that firms with relatively high proportions of business in the regulated line will be less likely to enter and more likely to exit when faced with profit restrictions. The results for direct writers may also reflect the effects on entry of greater sunk investments required for direct writers to enter a market.

The numbers of firms in the various "national" categories included in the table are reduced significantly by regulation and stringent regulation, but by less in percentage terms than the reduction in the total number of firms. This may reflect a greater tendency by these firms to reduce market share in relatively unprofitable markets rather than to exit. It may also be a consequence of the definition of national firm in our study, however, which requires that the firm sell auto insurance in a substantial number of states. This latter interpretation is supported by the fact that the number of Big Four auto insurers (State Farm, Allstate, Nationwide, and Farmers) is lower in regulated and stringently regulated states, and by a greater percentage than the reduction in the total number of firms.[9]

Similar to the findings on numbers of firms, direct writers also exhibit lower market shares in regulated and stringently regulated states. The largest market share reductions are for auto specialists and the Big Four, however. This is consistent with the hypothesis that low-cost producers have the greatest incentive to shift resources out of a market in response to regulatory profit restrictions.

Interestingly, the national categories of firms do not exhibit significantly

8. The same is true if market size is measured by the number of car years insured or the number of automobiles registered in the state.

9. This is due largely to the fact that Farmers writes auto insurance only in 32 states, spanning six census divisions; thus, by our definition, Farmers is not a national auto insurer. Farmers does not write in many eastern states, and these states are more likely to be regulated than those in other regions. This leaves open the question of whether Farmers' entry decisions are motivated by regional issues or by regulation; this is addressed further in the regression analysis below.

lower market shares in regulated states, and national firms as a group actually have a significantly larger market share in regulated and stringently regulated states than in unregulated states. This result at first appears to contradict our theory, since a national distribution system should make it easy to reduce market share in response to regulation. However, many of the national firms (57 of 78) use the independent agency system of selling, and these firms tend to be high-cost producers of automobile insurance. Expense ratio evidence also shows that national firms on the whole are not low-cost producers of automobile insurance (Tennyson 1996). Hence, national firms may have less incentive than other firms to reduce market share in response to profit restrictions. In addition, many independent agency firms write a significant fraction of their business in lines other than automobile insurance and hence may be constrained to offer auto insurance as a condition of keeping customers and agents satisfied. Nonetheless, neither national direct writers nor national auto specialists exhibit significantly lower market shares in regulated states.

4.5 The Effect of Regulation on Market Structure

This section of the paper uses regression analysis to further investigate the effects of rate regulation on insurance market structure. This approach allows us to more precisely isolate regulatory effects by controlling for other features of the state that might be related to market structure. In addition, it allows us to pool data over several years in order to estimate the effect of regulation on average over time rather than using data for a single year. This may be important if there is noise in the data in any given year, or if there are systematic effects on market structure by year (e.g., the insurance cycle) that may imply that a single year is unrepresentative of true regulatory effects. The regression analysis is undertaken using annual data for all 50 states over the time period 1987–92.[10]

As in the previous section, several different features of market structure are analyzed. The basic hypothesis that regulation reduces incentives to sell in the state is tested by examining the total number of firms writing automobile insurance in the state. We also estimate the effects of regulation on both the numbers and the market shares of several different types of firms to investigate the effects of regulation on the relative incentives to operate in the market. We estimate models for the numbers and market shares of national firms, direct writers, national direct writers, national auto specialists, and the Big Four auto insurers.

To test for regulatory effects on market structure, we define a regulation dummy variable that is equal to one if the state uses prior approval regulation,

10. We treat California as a regulated state beginning in 1989. The estimation results are not sensitive to changing the effective date of regulation in this state or to the elimination of California from the sample. The results are also similar if only those states that maintained consistent regulatory regimes throughout the sample period are included in the sample.

state-made rates, or mandatory bureau rates. To test whether there are differences in regulatory effects between regulated states in general and those most stringently regulated, we include a dummy variable equal to one if a state has stringent regulation of rates.[11] Stringent regulation is defined as in the previous section to include those states for which the residual market constituted more than 20 percent of the total insurance market throughout the decade of the 1980s.

In addition to other control variables, discussed in more detail below, each regression model includes dummy variables for eight of the nine census divisions in the country to control for potentially omitted regional influences on insurance market structure. Of particular concern is the possibility that regional differences in the tendency of states to regulate insurance markets, coupled with locational factors that may influence firms' entry decisions (e.g., distance from the firms' headquarters), may lead to spurious inferences regarding the effects of regulation on insurance markets. Including the regional variables in the model assures that the estimated regulatory effects are net of such locational influences. The models also include dummy variables for the years 1988–92, to allow for year-specific fixed effects on insurance market structure. Summary statistics for all of the variables included in the regression analysis are reported in the data appendix.

4.5.1 The Effect of Regulation on the Number of Sellers

We first estimate the effect of regulation on the total number of firms, and on the numbers of firms of several specific types, operating in the state automobile insurance market. Several variables other than rate regulation are included in the models to control for insurance market characteristics that may affect the number of firms operating. Key among these is the size of the automobile insurance market. All else equal, we expect to observe a larger number of firms writing in larger insurance markets. The potential size of the automobile insurance market in a state is measured by the natural logarithm of the number of registered automobiles in the state.

The percentage of the population that moved into the state during the decade of the 1980s is included in the model as an indicator of state growth and economic dynamism. We expect this variable to be positively related to the number of firms in the market since high growth should attract entrants into the market. State per capita income is included as a measure of the demand for insurance and insurance services in the state. Income should be positively related to insurance demand and hence to the number of insurers in the market.

11. In an earlier version of the paper we also tried a continuous index of regulatory stringency, based on Conning and Company surveys of insurance and regulatory executives that assign an index number of competitive freedom to each state insurance market (Suponcic and Tennyson 1995). Previous analysis has shown this index to be highly correlated with indicators of the type of regulatory system in a state (Suponcic 1994). The estimation results using this alternative measure of regulation are similar to those using the two regulation dummy variables.

However, previous studies have argued that the demand for insurance services will vary with income (Pauly et al. 1986), and this could have confounding effects on the number of firms if there are scale economies in service provision. We therefore have no strong priors about the effect of this variable.

The degree of market segmentation by risk categories may also influence market structure. The primary rating factor used for automobile insurance is the geographic location of the insured vehicle, with different locations in the state assigned to different rating territories. We therefore include the number of standard rating territories per registered car in the state (territory density) as a measure of market segmentation. We expect to observe more insurance firms operating in more segmented markets, implying a positive coefficient on the territory density variable. The relative locational density of the consuming population in the state may also help to determine the number of sellers in the market; this possibility is controlled for by including each state's population density, defined as resident population divided by land area, in the regression model. This variable should also be positively related to the number of firms in the market since greater customer density should support greater numbers of firms.

The ordinary least squares estimation results are reported in table 4.3. As hypothesized, the total number of firms operating is significantly lower in regulated states, and lower still in stringently regulated states. The marginal effect of regulation is to lower the number of firms in the market by 3.8; in stringently regulated states the average reduction in the number of firms is 29.6. This amounts to a 3.5 percent reduction in the number of firms in regulated states, and a 27.3 percent reduction in stringently regulated states, relative to the unregulated state average.

Regulation also significantly reduces the number of each distinct type of firm in the market, and as expected, the reductions are much larger in stringently regulated states. The effects of regulation are greatest for national auto specialists, relative to the mean number of these firms writing in unregulated states. After controlling for other market features, on average there are 6.2 percent fewer national specialist firms in regulated markets, and 23.9 percent fewer in stringently regulated states, relative to the unregulated state average. The magnitude of regulatory effects on the numbers of firms are similar for national direct writers, national firms overall, and direct writers overall. The results for the Big Four are of only marginal statistical significance and of economically insignificant magnitude, presumably because of the small number of firms in this category.

4.5.2 The Effect of Regulation on Market Shares

The effect of regulation on the number of firms in the market reflects regulatory effects on firms' entry and exit decisions. As argued earlier, however, reductions in output are the more likely short-run response to regulatory profit restrictions, as they are less costly and easier to implement than market exit

Table 4.3 **Number of Firms, 1987–92 Data by State (ordinary least squares estimation)**

Variable	Total Firms	Direct Writers	National Firms	National Direct Writers	National Auto Specialists	Big Four
Intercept	−230.5620***	−36.2962***	−30.7778***	0.0496	−1.8279	1.7264***
	(14.4840)	(4.7576)	(5.9068)	(2.2310)	(2.1041)	(0.3774)
Log registered autos	23.3443***	4.6129***	6.5034***	1.3929***	1.4549***	0.1533***
	(0.9697)	(0.3185)	(0.3954)	(0.1494)	(0.1409)	(0.0253)
Per capita income	−0.0026***	−0.0005***	−0.0008***	−0.0003***	−0.0004***	−3.0E-5***
	(0.0005)	(0.0001)	(0.0002)	(0.0000)	(0.0001)	(1.2E-5)
Population density	11.3278**	2.5141	4.7095**	1.5297**	0.9874	0.0943
	(5.0084)	(1.6451)	(2.0425)	(0.7714)	(0.7276)	(0.1305)
Territory density	120.9282***	32.8396***	34.4123***	13.1611***	10.5495***	1.1220*
	(25.4305)	(8.3531)	(10.3709)	(3.9170)	(3.6942)	(0.6626)
Percent movers	1.1734***	0.1355*	0.1947**	0.0239	0.0857***	0.0062
	(0.2375)	(0.0780)	(0.0969)	(0.0366)	(0.0345)	(0.0062)
Rate regulation	−3.7808**	−1.1983**	−2.9247***	−1.0332***	−1.0933***	−0.0717*
	(1.6908)	(0.5554)	(0.6895)	(0.2604)	(0.2456)	(0.0441)
Stringent regulation	−25.8056***	−5.7404***	−10.6182***	−3.2061***	−3.1360***	−0.1234**
	(2.4537)	(0.8060)	(1.0007)	(0.3779)	(0.3564)	(0.0639)
Adjusted R^2	0.8135	0.7069	0.7046	0.5206	0.5674	0.7158

Notes: Numbers in parentheses are standard errors. The model also includes year and census division dummy variables not reported here.

*Significantly different from zero at the 10 percent confidence level, two-sided test.

**Significantly different from zero at the 5 percent confidence level, two-sided test.

***Significantly different from zero at the 1 percent confidence level, two-sided test.

decisions. Accordingly, this section of the paper examines the effect of rate regulation on the state market shares of large, national and low-cost automobile insurance producers. As in previous sections, we focus on direct writers, national writers, national direct writers, national auto specialists, and the Big Four. The market share of each category of firm is measured as the percentage of total state automobile insurance premiums written by firms included in that category. Because market shares of necessity lie between zero and one, the dependent variables used here are the log-odds ratios of market shares ln(share/(1 – share)) for each category of firm. This transformation ensures that the predicted values of market shares from the least squares regressions lie between zero and one.

Our empirical models of the determinants of the state market shares are similar to those for the numbers of firms operating in the state. The control variables included in the market share models are state per capita income, state population density, the proportion of the population that moved into the state between 1980 and 1990, and the ratio of automobile bodily injury claims to property damage claims in the state.

To the extent that higher per capita income indicates a higher level of insurance demand, income should be positively related to the market shares of low-cost firms since they should devote more resources to relatively attractive markets; however, if the demand for services increases with income, low-price, low-service firms may have lower market shares in high-income states (Pauly et al. 1986). Population density and the percentage of the population that recently moved into the state may be negatively related to market shares since these variables positively affect the number of firms in the market. Alternatively, higher population density and a more mobile population may give direct writer and national insurers a marketing advantage since these firms are more likely to use mass advertising to obtain customers.[12]

The bodily injury claims variable is added to this set of models as a measure of the relative riskiness of auto insurance in the state. Since bodily injury liability claims are the most expensive and unpredictable component of auto insurance claims, a higher rate of bodily injury claims may lead insurers to reduce their exposure in the market. The impact of these claims on relative output levels across insurers will depend on their relative expertise in underwriting and settling these claims. This makes strong predictions difficult at the level of aggregation in this study. However, if there are economies of scale with respect to underwriting and settlement of liability claims this would imply that the market shares of the largest firms should be positively related to the rate of bodily injury claims.

The parameter estimates from ordinary least squares estimation are reported in table 4.4. The results indicate relatively weak effects of regulation on the

12. See Marvel (1982) for a theoretical analysis of why direct writers are more likely to use mass advertising than are independent agency writers.

Table 4.4 **Log-Odds Market Shares, 1987–92 Data by State (ordinary least squares estimation)**

Variable	Direct Writers	National Firms	National Direct Writers	National Auto Specialists	Big Four
Intercept	−0.2057	−0.1509	−0.5150**	−0.6676***	−0.4321***
	(0.2176)	(0.4048)	(0.2540)	0.2430)	(0.0358)
Per capita income	3.2E-5***	8.0E-5***	1.2E-5	1.1E-5	−5.2E-7
	(1.2E-5)	(2.3E-5)	(1.5E-5)	(1.4E-5)	(2.1E-6)
Population density	0.0622	−0.0259	0.1817	−0.0732	−0.0610***
	(0.1378)	(0.2564)	(0.1609)	(0.1539)	(0.0227)
Percent movers	0.0262***	0.0344***	0.0325***	0.0344***	0.0030***
	(0.0064)	(0.0119)	(0.0074)	(0.0071)	(0.0010)
Bodily injury claims	0.4587***	−0.5457**	−0.1949	−0.1678	−0.0133
	(0.1396)	(0.2598)	(0.1630)	(0.1559)	(0.0230)
Rate regulation	−0.1095**	0.2366***	−0.0296	−0.0456	−0.0059
	(0.0516)	(0.0960)	(0.0603)	(0.0576)	(0.0085)
Stringent regulation	−0.3080***	−0.8069***	−0.4097***	−0.4090***	−0.0675***
	(0.0747)	(0.1391)	(0.0873)	(0.0835)	(0.0123)
Adjusted R^2	0.6270	0.5388	0.5298	0.4695	0.6880

Notes: Numbers in parentheses are standard errors. The model also includes year and census division dummy variables not reported here.

*Significantly different from zero at the 10 percent confidence level, two-sided test.

**Significantly different from zero at the 5 percent confidence level, two-sided test.

***Significantly different from zero at the 1 percent confidence level, two-sided test.

market shares of the five groups of firms studied. The regulatory dummy variable is not significantly related to the market shares of national direct writers, national auto specialists, or the Big Four. For national firms as a group, the regulation dummy variable has the opposite sign from that expected. This latter finding may be due to the fact that most of the national insurers market through independent agents. Thus, we expect that their reduction in output in response to regulation will be lower than that of direct writers or other low-cost producers. This implies an increase in net market share in regulated states for these firms.

All five groups of firms exhibit significantly lower market shares in the most stringently regulated states, as expected. The estimated magnitude of market share reduction in these states is similar for national firms, national direct writers, and national auto specialists. These estimates range from 20 percent for national firms to 24 percent for national auto specialists, relative to their respective average market shares in unregulated states. These results are consistent with the argument that insurers with national distribution systems will respond to profit-reducing regulation by reducing output in the state.

These findings notwithstanding, there are two unexpected results in the table. First, the results for the Big Four are not entirely consistent with our theory. While these firms' aggregate market share is significantly reduced under stringent regulation, they exhibit the smallest percentage reduction in market share (4 percent) of all the categories of firms examined. In addition, direct writers are the only firms with a significantly lower market share in all regulated states. This latter finding is consistent with previous studies and may reflect other features of regulation that place direct writers at a disadvantage (e.g., Pauly et al. 1986; Gron 1995).

Alternatively, these results may reflect problems with interpreting the effects of regulation in a static analysis if insurance market structure influences a state's choice of regulatory regime. For example, if states with higher automobile insurance premiums are more likely to enact rate regulation, then the regulatory regime and insurance market structure are likely to be jointly determined.[13] To provide stronger evidence that rate regulation influences the structure of the insurance market rather than the reverse, the next section of the paper examines the impact of rate regulation on changes in insurance market structure over time.[14]

13. Cummins, Phillips, and Tennyson (1997) find that states with higher auto accident rates, higher auto claims severity, and higher proportions of young drivers are more likely to regulate auto insurance rates. However, they find no independent effect of a state's average unit price for auto insurance on the propensity to regulate.

14. Previous empirical work supports the view that both the choice of regulatory regime and the stringency of rate regulation in regulated states are affected by variables measuring the potential political influence of the insurance industry in the state (Cummins et al. 1997). We attempted two-stage least squares analysis of market shares, treating rate regulation and stringent rate regulation as endogenous. However, the results were extremely sensitive to model specification and yielded poor statistical fit overall. Nevertheless, these models usually produced results similar to those found in the first-differences regressions presented in the next section.

Table 4.5 **Private Passenger Automobile Insurance Market Structure Changes by State Regulatory Status, 1987–92 (percentage change)**

	Unregulated		Regulated		Stringent	
Statistic	Mean	S.D.	Mean	S.D.	Mean	S.D.
Total premiums	43.1	9.4	47.5	22.7	50.8	43.6
Number of firms						
Total	−3.9	6.6	−8.0**	6.9	−10.5	10.7
Direct writers	−10.6	8.8	−8.3	13.1	−3.9*	8.8
National firms	−1.4	5.0	−5.8**	7.8	−11.0*	10.9
National direct writers	1.5	9.5	0.3	11.6	2.7	12.3
National auto specialists	−1.1	6.6	−4.0	9.7	−8.0*	9.4
Big Four	1.7	11.0	−4.2*	10.8	−6.7	14.9
Market shares						
Direct writers	7.7	5.3	8.8	10.3	6.5	16.7
National firms	0.8	4.5	−0.4	8.8	−6.0	16.3
National direct writers	9.3	6.6	10.6	9.8	7.3	15.9
National auto specialists	13.3	8.0	16.5	11.0	11.0	11.8
Big Four	8.6	7.0	6.1	23.7	−4.1	49.3

*Significantly different from unregulated states at the 10 percent confidence level, one-sided test.
**Significantly different from unregulated states at the 5 percent confidence level, one-sided test.
***Significantly different from unregulated states at the 1 percent confidence level, one-sided test.

4.6 Regulation and Market Structure Change

Our theoretical argument is that persistently restricted rates of return should cause large, low-cost insurance sellers to reduce their market presence relative to that which would occur in an unregulated market environment. The strongest test of this argument rests on the dynamic implications of regulation for insurance market structure. If regulation affects the output choices of firms in the manner hypothesized, we should observe that the market presence of large, low-cost firms has declined, or has grown less rapidly, in regulated states than in unregulated states.

Table 4.5 presents summary statistics on the net percentage changes in our measures of market structure over the period 1987–92 for unregulated, regulated, and stringently regulated states. To preserve comparability of statistics across years, and to avoid picking up transitional effects of regulatory regime change, this analysis excludes several states that changed regulatory regimes during or just prior to our sample period. The table shows that the changes in market structure over the period are very similar for regulated and unregulated states overall. Except for a greater decline in the total number of firms and in the number of national firms and the Big Four in regulated states, there are no statistically significant differences in market trends across regulated and unregulated states. Both groups of states exhibit consolidation of the insurance

market: the average number of firms declined over the period, but the aggregate market shares of direct writers and national sellers increased.

There are also few statistically significant differences in market trends between stringently regulated states and unregulated states. However, this is due to the large variance in the experiences of stringently regulated states. There are some noticeable differences in the patterns of change for these states. The percentage decline in the number of firms overall is much greater than that in unregulated states, as is the decline in the number of national firms, national auto specialists, and the Big Four. The mean percentage change in market shares for national firms and the Big Four are also different in stringently regulated states, where these two sets of firms actually lost market share over the time period.

The patterns of market structure change in stringently regulated states are not inconsistent with the hypothesis that national insurance sellers have decreased their market presence in response to regulation. However, the generally mixed findings and the lack of statistical significance make the relationship between stringent regulation and market structure difficult to ascertain. To control for other features of state insurance markets that might influence changes in market structure, table 4.6 presents a regression analysis of annual changes in market structure for the years 1988–92. Because annual changes in the number of firms and market shares are relatively small, the dependent variables used in the analysis are annual change in premium volume for each category of firm.[15] The premium data are transformed into logarithms to reduce heteroscedasticity. The control variables included in the regression model are those in the market share models estimated previously, along with the annual change in the (logarithm of) statewide automobile insurance premiums.

The regression results are generally consistent with the results obtained in the static analysis of market shares. There are no significant effects of regulation overall, but stringent rate regulation is negatively and significantly related to annual changes in premium volume for national direct writers, national auto specialists, and the Big Four. This confirms that our earlier findings are not simply an artifact of states' endogenous choices of regulatory regime.

Relative to overall state auto insurance premium growth, the table shows that the Big Four and national auto specialists have increased their market presence over time, once other factors are controlled for. The market shares of direct writers, national firms as a whole, and national direct writers are declining. The findings for stringently regulated states thus mean that the writings of the Big Four and national auto specialists have increased less over time, relative to the growth in state automobile insurance premiums, in states that stringently regulate automobile insurance rates. The writings of national firms and

15. The models were also run on market share changes, with similar results. The models for changes in the numbers of firms showed no significant effects, and the overall fit was very poor.

Table 4.6 **First-Difference of Log Premiums, 1988–92 Data by State (ordinary least squares estimation)**

Variable	Direct Writers	National Firms	National Direct Writers	National Auto Specialists	Big Four
Intercept	0.0046	0.0438**	0.0104	0.0052	−0.0639
	(0.0211)	(0.0197)	(0.0204)	(0.0348)	(0.0801)
First-difference of log state auto premiums	0.9649***	0.9535***	0.9473***	1.0755***	1.4393***
	(0.0440)	(0.0412)	(0.0426)	(0.0727)	(0.1671)
Per capita income	4.4E-7	−1.4E-6	4.3E-7	1.3E-7	−1.6E-7
	(1.1E-6)	(1.1E-6)	(1.1E-6)	(1.9E-6)	(4.3E-6)
Population density	−0.0367***	−0.0075	−0.0379***	−0.0284	−0.1253***
	(0.0128)	(0.0120)	(0.0124)	(0.0212)	(0.0488)
Percent movers	9.6E-5	0.0006	7.2E-5	−0.0005	0.0031
	(0.0006)	(0.0005)	(0.0006)	(0.0010)	(0.0022)
Bodily injury claims	0.0185	−0.0034	0.0311***	0.0357*	0.1218***
	(0.0127)	(0.0119)	(0.0123)	(0.0210)	(0.0483)
Rate regulation	0.0046	0.0033	0.0050	0.0066	0.0043
	(0.0049)	(0.0045)	(0.0047)	(0.0080)	(0.0184)
Stringent regulation	−0.0104	−0.0010*	−0.0120*	−0.0222**	−0.0852***
	(0.0069)	(0.0064)	(0.0067)	(0.0114)	(0.0261)
Adjusted R^2	0.6728	0.7326	0.6741	0.4843	0.2848

Notes: Numbers in parentheses are standard errors. The model also includes year and census division dummy variables not reported here.

*Significantly different from zero at the 10 percent confidence level, two-sided test.

**Significantly different from zero at the 5 percent confidence level, two-sided test.

***Significantly different from zero at the 1 percent confidence level, two-sided test.

national direct writers in stringently regulated states have decreased more rapidly, relative to the growth in state automobile insurance premiums, than in other states.

Unlike in previous regressions, the most significant effects are observed for the Big Four automobile insurance writers, and the largest percentage effects on premium volume changes are for the Big Four and national auto specialists. Rate regulation, even stringent rate regulation, is not significantly related to changes in premium volume for direct writers.[16] These findings are consistent with our theoretical predictions that low-cost firms with national distribution systems will have the greatest incentives to reduce output in regulated states.

4.7 Conclusion

This paper has argued that restrictive regulation of automobile insurance rates will distort the industrial structure of the market through its effects on insurers' entry and output decisions. The empirical evidence presented in the paper suggests that these effects are very weak in most regulated states. However, in those states that most stringently regulate automobile insurance rates, the empirical results are consistent with our theory. We find that stringent rate regulation lowers the number of firms selling in the market and lowers the numbers, market shares, and output growth of low-cost and national producers in the market. These results hold even after controlling for other factors that may influence the relative prevalence of these firms in the market, such as market size, density and growth, consumer income, and regional effects.

While normative assessments of regulatory policies lie beyond the scope of this analysis, our findings suggest that regulation could have adverse unintended effects on consumer welfare. If firms that achieve the largest size or that specialize most heavily in automobile insurance are the lowest cost producers of this insurance, then the decline in their relative market presence under regulation may raise the average price of insurance paid by consumers.

Much remains to be done to fully understand the effects of regulation on the industrial structure of auto insurance markets. One potentially fruitful approach would be to examine changes in market structure in the aftermath of changes in regulatory stringency. Further insights into the causes and consequences of market structure differences across regulated and unregulated states could also be garnered from analyzing entry, exit, and market share changes at the firm or group level. Use of this more detailed data would allow for controls related to the specific characteristics of each firm, rather than the average characteristics of generic categories of insurers. Given the great variation in size and specialization across firms identified in this paper, examining data at the

16. Interestingly, the contrast between these results and the results of the static market share analysis suggests that a larger direct writer market share reduces the probability that a state enacts rate regulation, while a larger market share for the Big Four increases the probability that a state enacts regulation.

firm level may be particularly important for assessing regulatory effects on insurance markets.

Data Appendix

This appendix provides the precise definition of and documents the data source used to obtain each explanatory variable used in the regression analysis. It also reports the mean and standard deviation of each variable over the sample period 1987–92 (see table 4A.1). All dependent variables used in the analysis were obtained from A. M. Best Company data tapes for Best's Executive Data Service. The other variable definitions and sources are as follows.

Number of registered autos: Number of privately owned motor vehicles registered in the state. Source: U.S. Department of Transportation, *Highway Statistics.*

Per capita income: Total income per capita in the state. Source: U.S. Department of Commerce, *Statistical Abstract of the United States.*

Population density: Resident population per square mile of land area in the state. Source: U.S. Department of Commerce, *Statistical Abstract of the United States.*

Table 4A.1 Summary Statistics for Regression Variables, 1987–92 Data by State

Variable	Mean	S.D.	*N*
Number of firms			
Total	99.52	24.89	300
Direct writers	27.25	6.52	300
National firms	660.52	8.07	300
National direct writers	18.57	2.39	300
National auto specialists	16.28	2.37	300
Big Four	3.54	0.525	300
Market share			
Direct writers	0.650	0.118	300
National firms	0.697	0.140	300
National direct writers	0.484	0.126	300
National auto specialists	0.442	0.114	300
Big Four	0.426	0.134	300
Other variables			
log (Registered autos)	14.36	1.03	300
Per capita income	16,993	3,107	300
Population density	0.162	0.229	300
Territory density	7.8E-6	3.8E-6	50
Percent movers 1980–90	11.36	4.68	50
Bodily injury claims	0.404	0.165	300
Rate regulation	0.493	0.501	300
Stringent regulation	0.100	0.301	300

Territory density: Number of rating territories employed by the major statistical rating agency in the state divided by the number of registered automobiles in the state. Source for rating territories: Insurance Research Council, *Trends in Auto Bodily Injury Claims* (Oak Brook, Ill., 1990).

Percent movers: Fraction of the state's resident population in 1990 who lived in a different state in 1980. Source: U.S. Department of Commerce, *Statistical Abstract of the United States.*

Bodily injury claims: Number of automobile bodily injury liability insurance claims incurred in the state divided by the number of automobile property damage liability insurance claims paid in the state. Source: National Association of Independent Insurers, FastTrack Monitoring System database.

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