Does Technology Adoption Save Regulatory Compliance Costs?

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ABSTRACT

We study whether digital technology streamlines the regulatory process and reduces the costs of complying with regulation. To identify the effect of digital technology on regulatory compliance costs, we leverage a quasi-experimental policy change which mandates the use of an internet-based flow management tool that enables insurers and regulators to exchange policy form and rate filing information. We find that digitization lowers the costs of complying with regulation. The average insurer per line of business and year in the highest quartile regarding the proportion of business under the mandate saves 5.4 percent of general expenses. Our results also suggest a fixed cost of adopting the technology, with larger cost-saving accruing to firms that adopt the new technology more widely.

Keywords: Technology Adoption; Financial Regulation; Insurance Regulation; Government Policy and Regulation
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1 Introduction

In the past decades, digitization and the internet have impacted almost all economic activities and reduced a variety of economic costs. Besides the commercial world, government regulators are increasingly adopting digital technology to make the regulatory process more efficient. Yet new technology requires additional investment in human capital for both the regulator and the regulated entity, and it remains an open question whether technology adoption reduces the cost of regulation, at least in the short term. In this study, we estimate the impact of technology adoption on the costs of complying with product regulation in the U.S. property-liability (P/L) insurance market by exploiting quasi-experimental variation in when states adopt the technology.

The U.S. insurance industry provides an ideal laboratory to study the effects of regulation. The industry is large – with $534 billion of direct premiums written in 2016 (it comprises 2.88% of U.S. GDP[1]) – and heavily regulated – about half of the lines of insurance are subject to product regulation.[2] In contrast to other financial sectors that are subject to federal regulation, the insurance industry is primarily regulated at the state level and states experiment with different forms of regulation. A major action by state insurance regulators is the review and approval of insurance rates and policy forms, and there are substantial costs associated with complying with these regulations (Leverty and Liu 2019). As part of the National Association of Insurance Commissioners (NAIC)'s "Speed to Market" initiative, the NAIC developed an online platform for regulatory compliance, the System for Electronic Rate and Form Filing (SERFF). SERFF is a web-based flow management tool that enables insurers and regulators to exchange policy form and rate filings and review information within the application.[3] The objective of SERFF is to standardize the form and rate filing process,

[1]Data source: Federal Insurance Office (2017); Bureau of Economic Analysis (2017).

[2]Authors' calculation based on the U.S. insurer data (1992-2014). A line of insurance is classified as regulated if the insurer is required to obtain regulatory approval of their rating plans or policy forms prior to using them.

[3]SERFF also houses other Speed to Market tools, including the Uniform Product Coding Matrices and Uniform Transmittal Documents.

improve regulatory efficiency, and save financial and human resources for both regulators and insurers. Twenty-eight states mandated the adoption of SERFF, at different times, between 2007 and 2014.

This study exploits the variation in when and if states mandate the use of SERFF for insurer product (i.e. policy form and rate) filings to cleanly identify the effect of technology on the costs of complying with regulation. While there may be heterogeneity in regulatory compliance costs across insurers, lines of business, states, and years, we argue that the adoption of SERFF is plausibly exogenous to other factors along these dimensions. Our empirical strategy uses fixed effects regression models to isolate the compliance costs from other operating expenses incurred by firms over 23 years, 1992-2014. As insurance firms may be heterogeneous in their ability to minimize compliance costs, firm fixed effects control for the average compliance costs of each firm. Compliance costs may also vary by line of business (e.g., auto liability or homeowners insurance), and line fixed effects control for the average compliance costs of each line. Finally, compliance costs may vary over time, and year fixed effects control for the average compliance costs for each year. Our results suggest that digitization reduces the costs of complying with regulation with statistical and economic significance. The average insurer in the highest quartile regarding the proportion of business under a SERFF mandate saves 5.4 percent of general expenses, which translates to about $442,000 per year and line of business. We also find evidence suggesting a fixed cost of technology adoption, as firms adopting the new technology more widely show larger cost-saving.

This study makes three contributions to the literature. First, while there is extensive research on how regulation affects the regulated entity's technology adoption in environmental economics and financial economics (Popp et al. 2010; Böhme et al. 2015), little research has been conducted on how the adoption of technology by regulators impacts market participants. This study provides empirical evidence on whether a mandate to use technology for regulatory purposes reduces the costs of complying with regulation. Second, this study adds

to the literature on the costs of insurance regulation. Several studies document substantial costs associated with state insurance regulation (Grace and Klein 2000; Pottier 2011; Leverty 2012). We extend this literature by estimating how the introduction of digital technology affects the costs of complying with regulation. Finally, this study also joins the broad literature on the economics of digitization (e.g., Goldfarb et al. 2015; Goldfarb and Tucker 2019) and provides additional evidence on whether the adoption of information technology reduces firm's operating costs in an economically important industry.

2 Institutional Background

2.1 Policy Form and Rate Filing System

In this section, we discuss the institutional features of the U.S. P/L insurance industry that make it an ideal environment to study the compliance costs of regulation and technology adoption.[4] In the U.S., insurance is regulated at the state level. Each state has an insurance department that oversees the regulation of insurance. A substantial part of insurance regulation focuses on the rates and policy forms of insurance policies to ensure they comply with state laws and are reasonable and fair for consumers.

The regulation of policy forms and rates is conducted through a filing system in each state. The process starts with a filer (an insurer or third-party consultant) submitting the proposed rates and policy form to the regulator. Then the insurance department will review the rate and form filing information and decide whether to approve the filing or request further information. The state insurance commissioner has the ultimate authority.

An important covariate to be controlled for is the regulatory stringency, i.e. the different timelines of filing and approval by state, as it is closely related to insurer compliance costs (Leverty and Liu 2019). In states with a prior-approval (stringent) system, the insurer must receive the regulator's approval before the policy can be used in the market. In states with

[4]See Klein (2005) for an extensive discussion on insurance regulation in the U.S.

a file-and-use system, a policy can be used in the market without the regulator's approval, but the insurer must file the rates and forms a certain number of days prior to using the policy. In states with a use-and-file system, the filing only needs to be done after the use of the policy. In almost every state, a filing is required for a policy to be used.

The stringency of form and rate regulation also differs within a state at the line of business level. In general, personal lines are more stringently regulated than commercial lines. In addition, within a state-line, regulatory stringency varies over time. For example, twenty-two states deregulated their form filing system from prior approval to other types of regulation, for at least one line of insurance within our sample period. Tables A.1 to A.4 report the distribution of stringent form and rate regulation by state and year for personal and commercial lines of insurance.[5]

Figure 1 shows the cross-sectional and time-series variation in the stringency of form regulation in our sample. It documents the number of lines under stringent form regulation at the beginning (1992) and end (2014) of our study period. A line-year observation is defined as under stringent form regulation if the state requires the prior approval of policy forms. The variation in colors across the U.S. in a given year shows the cross-sectional heterogeneity in stringent form regulation among states. A comparison between 1992 and 2014 shows the time-series variation, as many states change how they regulate forms over time. For example, in 1992, Wisconsin required prior approval of policy forms in 14 lines of insurance, while Illinois did not require policy form regulation for any lines of insurance. In 2014, Wisconsin required prior approval of policy forms in only one line, while Illinois still did not require policy form regulation for any lines of insurance. Similarly, Figure 2 displays the number of lines under stringent rate regulation in 1992 and 2014.

Traditionally, the state filing system is paper-based and it creates substantial compliance costs and inefficiency. Numerous documents need to be copied and mailed between the

[5]The state form and rate filing system can be different for each line of business, including worker's compensation, medical professional liability, inland marine, and ocean marine. For simplicity, Tables A.1-A.4 report the systems for personal and commercial lines. But even within personal or commercial lines, some lines (e.g. personal auto insurance) may be under more scrutiny than others.

filer and the regulator. This is especially true for multi-state insurers who need to make a separate filing in each state in which they operate for the same policy.

2.2 SERFF

To improve the efficiency of insurer filing the policy forms and rates with regulators, state regulators and the NAIC started a "Speed to Market for Insurance Products" initiative in the mid-1990s. The initiative led to the establishment of the System for Electronic Rate and Form Filing (SERFF) in 1998. SERFF is an internet platform designed to streamline the rate and form filing and review process. The NAIC has promoted SERFF as a major Speed to Market tool since its first product release.

SERFF replaces the traditional paper-based system by digitizing the entire filing process. Filers log onto SERFF, identify the filing requirements promulgated by each state, and submit an electronic filing to the regulator with all supporting documents uploaded in a digital format. The regulator receives the filing on SERFF and can start reviewing them instantly. In the case where a change is needed, the regulator can contact the filer using a messaging system in SERFF, and the filer can make changes and submit a revised filing in SERFF. In short, SERFF provides a one-stop interface for regulators and insurers to exchange information and complete rate and form filings electronically.

When the first version of SERFF was released in 1998, eight states and sixteen insurers participated. A total of 294 filings were made in 1998. In 2000, an enhanced version of SERFF was released and it quickly expanded across the states in the early 2000s. By the end of 2004, SERFF was accepted in 49 states and the District of Columbia and over 1,400 insurers were licensed to use SERFF. Many states have mandated the use of SERFF for insurance rate and form filings. Under a SERFF mandate, insurers can no longer make paper filings and must file their proposed rates and forms via SERFF. Between 2007 and 2016, 31 states have enacted SERFF mandate in P/L insurance. Florida is the only state that does not accept SERFF, as it adopts its own electronic filing system named I-File (later

replaced by the Insurance Regulation Filing System (IRFS)).

On the one hand, SERFF has several advantages over the traditional filing system. First, SERFF improves the efficiency of the information exchange by providing a single online platform for insurers and regulators to communicate, manage, and store policy form and rate filings electronically. Insurers no longer need to mail hard copies of product information to the regulator and wait for a response in the mail. Second, SERFF makes insurer compliance more manageable, as insurers have easy access to the current filing requirements promulgated by the state, which helps insurers submit more accurate and complete filings. Moreover, SERFF is particularly helpful to multi-state insurers, as they can comply with the regulations in different states in a much easier fashion and even use a single filing if it meets the regulatory requirements of those states. Industry reports suggest that the adoption of SERFF leads to considerable cost savings, including a reduction in internal IT and database maintenance costs and product filing worker hours (NAIC 2016).

On the other hand, insurers incur fixed and variable costs when they transition from the traditional filing method to SERFF. For an insurer to implement SERFF, it needs to spend resources on staff training and possibly upgrade its technology. Also, insurers pay a filing fee for each filing they make, either on a pay-as-you-go basis or paying for a "block" of filings at a lower price in advance.[6] Insurers vary in when (and to what extent) they transfer to SERFF from the traditional method. Some insurers (e.g., the sixteen original participating firms) implement SERFF as soon as it becomes available and well before SERFF is mandated, while other insurers implement SERFF when it is mandated. Some multi-state insurers that are subject to a SERFF mandate in some states but not others may implement SERFF in the states with mandates, but not in the others, while other multi-state insurers completely transfer to SERFF once they are subject to a SERFF mandate in one state.

[6] As of May 2019, the pay-as-you-go rate is \$13.50 per filing, and the prepaid rate is \$9.50/\$8.00/\$6.50 per filing for a block of 500/1,000/1,500 filings.

3 Data and Sample

3.1 Regulation and SERFF Data

We obtain information on which states mandate SERFF and the effective dates of the mandate from the official NAIC-SERFF website.[7] Table 1 shows the states that mandate SERFF and the year of enactment. To be consistent with our annual insurer data, we classify the SERFF mandate at the year level; if the mandate comes into effect in the middle of year t, we define the first year of the mandate to be t+1. The classification at the year level may introduce measurement error, which would bias us against finding any significant SERFF effect on insurers.

The first mandated use of SERFF was in 2007, with South Dakota and Georgia. Additionally, eight states in 2008, eight in 2009, five in 2010, three in 2011, two in 2012, one in 2015, and two states in 2016 mandated SERFF. By 2016 a total of 31 states required insurers to use SERFF for the rate and form filing of property-liability insurance policies.

3.2 Insurer Data

We compile a data set of all U.S. property and liability insurers from the National Association of Insurance Commissioners (NAIC) statutory annual report database over 23 years, 1992-2014. This database is the most comprehensive source of insurer information available for the U.S. insurance market. For each year, we collect the firm-line level premium and expense data from the Insurance Expense Exhibit and firm-line-state level premium data from the Exhibit of Premiums and Losses ("State Page"). The Exhibit of Premiums Written (Schedule T) is used to identify whether an insurer is licensed in a state. Unlicensed insurers are exempt from policy form and rate regulation and thus not affected by SERFF mandate.

[7] https://www.serff.com/documents/serff_participation_mandates.pdf.

3.3 Measuring Regulatory Compliance Costs

The direct costs of regulatory compliance under form and rate regulation for insurers include the expenses, salaries, and consulting fees associated with making form and rate filings to the state (Grace and Klein 2000; Leverty 2012).

The ideal data for studying compliance costs of product regulation would be insurer expenses associated with regulatory compliance at the firm-line-state-year level since the SERFF mandate is applied at the state-year level. The NAIC database, however, does not provide a separate category of expenses for regulatory compliance, nor does it break down expenses at the firm-line-state-year level. We address these challenges in two ways.

First, while we do not have a single expense item dedicated to regulatory compliance, all compliance-related expenses are contained in the Acquisitions, Field Supervisions, and Collection(AFSC) expenses and the general expenses reported by insurers. The AFSC expenses consist of all expenses incurred in the production of new and renewal insurance business, including operating costs of agencies and branches, writing new policy forms, data processing, clerical, secretarial, office maintenance, supervisory, and executive duties. General expenses are also relevant because they include all expenses that are not assigned to other expense groups per the NAIC statutory accounting principles. Therefore, the combination of the AFSC and general expenses captures all the expenses related to an insurer's general operation, including compliance costs.

To measure the compliance costs, we use the NAIC expense data to construct a general expense ratio, which is the dependent variable in our regressions. This ratio is defined as:

$$\textit{General Expense Ratio} = \frac{\text{General Expenses Incurred + Other AFSC expenses Incurred}}{\text{Net Premiums Written}}.$$

Note that these expenses also include costs that are not linked to regulatory compliance, such as advertising, employee welfare, rent, and equipment. This does not impact the measurement of compliance costs in the fixed effects models, as the models identify the *change*

in expenses, rather than the expenses themselves. To accurately measure the compliance costs, we rely on an assumption: changes in the expenses (e.g., rent) that are unrelated to complying with product regulation across firms, lines, and time are uncorrelated with the SERFF mandate enforced by the state, which is plausibly true.

Second, since we estimate the costs of complying with product regulation at the firm-year and firm-line-year level, we measure an insurer's exposure to treatment, the SERFF mandate at both levels. *SERFF Proportion* is the proportion of an insurer's direct premiums written in states with SERFF mandate.

We note that using the SERFF mandate rather than the actual insurer usage of SERFF will likely bias the estimated effect of SERFF towards zero. This is because an insurer may start using SERFF voluntarily before the mandate, and over 1,400 insurers were licenced to use SERFF before any state mandated SERFF. In this case, the mandate will not impact this insurer, and our estimates will be biased against finding a significant influence of SERFF on insurer expenses, even if they exist.

3.4 Sample and Descriptive Statistics

Our final sample is an unbalanced panel of 2,813 insurers from 1992 to 2014. All lines, except reinsurance and financial lines, are included in the sample.[8] We then combine lines with similar characteristics to obtain a total of 14 lines of business in the analysis.[9]

In constructing the sample, we exclude firms with negative assets or liabilities and those with policyholder surplus less than $1 million. Risk retention groups are also excluded because they are mostly exempt from regulation by nondomiciliary states (Born et al. 2009;

[8]We include the following lines: aircraft, auto physical damage, boiler and machinery, burglar and theft, commercial auto liability, commercial multiperil, earthquake, farmowners, fire and allied lines, glass, homeowners, inland marine, medical professional liability, ocean marine, other liability, personal auto liability, products liability and workers' compensation. Financial lines (accident and health, credit, fidelity, financial guaranty, mortgage guaranty, surety, and warranty), considered nontraditional property-liability insurance lines (Deng et al. 2017), are excluded.

[9]The 14 combined lines are: commercial auto liability, commercial auto physical damage, commercial multi peril, homeowners and farmowners, inland marine, medical professional liability, ocean marine, other liability, private passenger auto liability, private passenger auto physical damage, products liability, special liability, special property, and workers' compensation. The categorization of lines is shown in Table A.5.

Leverty 2012). At the firm-line-year level, we require net premiums written to be at least $100,000 and that total expenses and general expenses are positive. Expense ratios are winsorized at the first and ninety-ninth percentile to reduce the effect of outliers.

Table 2 presents the summary statistics. Panel A shows the summary statistics at the firm-year level, and Panel B shows the summary statistics at the firm-line-year level. At the firm-year level, 21 percent of the observations have at least some business under a SERFF mandate, and the average proportion of SERFF business (measured by direct premiums written) is 0.08. The average loss ratio is 0.67, and the average total expense ratio is 0.35. The loss ratio and total expense ratio are adjusted by present value factors to ensure comparability across lines (Cummins and Danzon 1997; Phillips et al. 1998).[10] At the firm-line-year level, 20 percent of the observations have at least some business under SERFF mandate, and the average proportion of SERFF business is 0.08. The average loss ratio is 0.76, and the average general expense ratio is 0.19, indicating that about one-fifth of premiums represent insurer operating expenses, including regulatory compliance costs.

4 Empirical Design

Ensuring compliance with product regulation can be costly to insurers, and a stated goal of technology adoption in regulation is to improve efficiency and reduce costs (NAIC 2016). It remains an open question of whether technology adoption reduces regulatory compliance costs. On the one hand, a new system with more advanced technology may streamline the regulatory process and reduce the human and financial resources spent on regulatory compliance. On the other hand, the regulated entity may need to spend resources on learning and adjusting to the new system. We provide empirical evidence on whether the mandated use of SERFF in the insurance market reduces regulatory compliance costs.

[10]Specifically, we apply the Taylor separation (Taylor 1977) to estimate yearly proportions of loss development for each line, using loss data from the A. M. Best Aggregates and Averages and risk-free interest rates from the FRED database of the Federal Reserve Bank of St. Louis.

4.1 Empirical Strategy

The identification strategy exploits the quasi-experimental shock of the mandated use of SERFF for insurance product regulation (rate and form filings). Twenty-eight states mandated SERFF in the P/L insurance market from 2007 to 2014. In a given year, some states have SERFF mandate while others do not, providing cross-sectional variation. There is also time-series variation as different states implemented the mandate at different times. In addition, multi-state insurers can do business in some states on a licensed basis and in other states on an unlicensed basis, and only licensed business is subject to product regulation. As a result, unlicensed business does not involve using SERFF at all, providing additional variation in an insurer's exposure to SERFF. These variations, combined with the exogenous nature of the mandates, establish causality.

An empirical challenge for identification is that we do not know how multi-state insurers adopt SERFF when only part of the insurer's business is subject to a SERFF mandate. Suppose an insurer operates in Georgia and Kansas. Georgia mandated the use of SERFF in 2007, while Kansas mandated it in 2009. In 2007, the insurer could use SERFF for its filings in both states or use SERFF in Georgia only. Insurers will adopt different strategies for implementing SERFF.

To address this challenge, we construct two independent variables, *Any SERFF* and *SERFF Proportion* to measure the impact of the SERFF mandate on insurers. *Any SERFF* captures the effect when an insurer has at least some business under a SERFF mandate, while *SERFF Proportion* measures the proportion of an insurer's business under a SERFF mandate.

An insurers's implementation of SERFF may also vary by the line of business. For example, insurers operating in lines with greater regulatory scrutiny may transition to SERFF sooner than those in lines with less stringent regulation. Therefore, we analyze the effect of the SERFF mandate on insurer expenses at two levels, the firm-year level and the firm-line-year level. At the firm-year level, an insurer is treated as a whole and the estimation is

based on the assumption that the insurer does not adopt different strategies for implementing SERFF across lines. At the firm-line-year level, the unit of analysis is a firm-line observation, and the estimation is based on the assumption that an insurer's strategy for implementing SERFF in one line is independent of its strategy in another line. We recognize that neither assumption holds perfectly in the real world, and the reality may lie somewhere in between. Therefore, these two frameworks complement each other and when combined, they provide an upper and a lower bound of the estimate of SERFF's effect on insurer expenses.

Our coefficient estimates on the effect of technology adoption may be biased towards zero for two reasons. First, insurers can transition to SERFF before the SERFF mandate is enacted. Second, insurers in Florida may use other digital platforms to file rates and policy forms, but our measures of technology adoption only captures the use of SERFF. In both cases, there will be measurement errors that would bias us against finding any significant effect of technology adoption on insurer expenses.

4.1.1 Firm-Year Level Analysis

First, we conduct the analysis at the firm-year level, using fixed effects regression models to isolate the impact of the SERFF mandate on insurer's costs of complying with product regulation. As there can be heterogeneity in insurer ability to minimize compliance costs, we include firm fixed effects to control for the average costs of each firm and year fixed effects to control for yearly shocks on compliance costs in the industry. We estimate the following regression:

$$Y_{it} = \beta_1 Any\ SERFF_{it} + \gamma X_{it} + \lambda_i + \theta_t + \epsilon_{it}, \tag{1}$$

where Y_{it} is the general expense ratio of firm i in year t. $Any\ SERFF_{it}$ is an indicator variable of whether firm i has any business in a state that mandates SERFF in year t; X_{it} is a vector of control variables including the proportions of business subject to stringent (prior-approval) form and rate regulation, size (natural logarithm of net premiums written by firm i in year t) and entry and exit behavior for firm i in year t; λ_i, θ_t are firm and year

fixed effects, respectively; and ϵ_{it} is the error term. The standard errors are clustered at the firm level to allow within-firm correlations.

The variable of interest is *Any SERFF*. It is possible that a SERFF mandate forces an insurer to fully adopt SERFF in all the states where it writes business, and thus this variable captures the primary effect of the SERFF mandate. A positive coefficient β_1 is consistent with the hypothesis that technology adoption increases compliance costs, and a negative coefficient β_1 would imply that technology adoption reduces compliance costs. If the coefficient β_1 is not significantly different from zero, it suggests that either SERFF mandate does not have a significant impact on the compliance costs, or the cost-saving effects are canceled out by the additional learning and adjusting costs for SERFF adoption.

It is also possible that multi-state insurers do not adopt SERFF all at once, but rather gradually switch to SERFF as it is mandated in the states in which they operate. To investigate whether this is the case, we estimate the following regression with the variable of interest to be *SERFF Proportion*.

$$Y_{it} = \beta_2 SERFF\ Proportion_{it} + \gamma X_{it} + \lambda_i + \theta_t + \epsilon_{it}, \tag{2}$$

where $SERFF\ Proportion_{it}$ measures the proportion of business that is subject to SERFF mandate for firm i and year t; all other variables are defined in the same way as in Regression (1).

A positive coefficient β_2 is consistent with the hypothesis that technology adoption increases compliance costs, and a negative coefficient β_2 would imply that technology adoption reduces compliance costs. If the coefficient β_2 is not significantly different from zero, we would conclude that the proportion of business under SERFF mandate does not affect the compliance costs for insurers.

4.1.2 Firm-Line-Year Level Analysis

While the firm-year level analysis captures the SERFF effect on compliance costs for an insurer as a whole, a multi-line insurer may implement SERFF differently across lines. To explore the cross-line heterogeneity within a firm, we use the firm-line-year level data to estimate the following regressions, adding line fixed effects to control for the average compliance costs within each line of business:

$$Y_{ilt} = \beta_1 Any\ SERFF_{ilt} + \gamma X_{ilt} + \lambda_i + \delta_l + \theta_t + \epsilon_{ilt}, \tag{3}$$

$$Y_{ilt} = \beta_1 SERFF\ Proportion_{ilt} + \gamma X_{ilt} + \lambda_i + \delta_l + \theta_t + \epsilon_{ilt}, \tag{4}$$

where Y_{ilt} is the general expense ratio of firm i in line l and year t. $Any\ SERFF_{ilt}$ is an indicator variable of whether firm i has any business in a state that mandates SERFF in line l and year t; X_{ilt} is a vector of control variables including the proportions of business subject to stringent (prior-approval) form and rate regulation, size (natural logarithm of net premiums written by firm i in line l and year t) and entry and exit behavior for firm i in line l and year t; λ_i, δ_l, and θ_t are firm, line, and year fixed effects, respectively; and ϵ_{ilt} is the error term. The standard errors are clustered at the firm level to allow within-firm correlations.

5 Effects of Technology Adoption on Regulatory Compliance Costs

5.1 Firm-Year Level Results

Table 3 shows the results of the firm-year level regressions. The primary finding is that SERFF reduces insurer expenses. In Regression (1), the coefficient on *Any SERFF* is negative and statistically significant at the 5 percent level. Given that the average expense

ratio in the sample is 0.205, the coefficient (-0.013) implies that a SERFF mandate in at least one state in which an insurer operates lowers the average insurer's expense ratio by 6.34% (-0.013/0.205 = -6.34%). For the average firm in our sample, which has net premiums written of $206.34 million, the cost savings associated with a SERFF mandate is $2,682,000 per year. In Regression (2), the coefficient on *SERFF Proportion* (-0.022) is negative and statistically significant at the 5 percent level, suggesting a negative relationship between the proportion of business subject to a SERFF mandate and insurer expenses. For the average insurer, a 50% increase in *SERFF Proportion* translates to a reduction of $2,270,000 in general expenses per year.

To explore the possibility of a nonlinear effect of *SERFF Proportion*, we include *SERFF Proportion Squared* in Regression (3). The coefficients on *SERFF Proportion* and *SERFF Proportion Squared* are -0.098 and 0.081 respectively, and both coefficients are statistically significant at the 5 percent level. The fitted quadratic function of *SERFF Proportion* is a U-shaped curve, which achieves a minimum at 0.605 (0.098/(2*0.081) = 0.605). Thus, the expense saving effect of SERFF is the strongest when an insurer's *SERFF Proportion* equals 0.605.

In Regression (4), we further explore the effects of different proportions of SERFF business by regressing the general expense ratio on quartile indicator variables of *SERFF Proportion*, and the reference group is the insurers who have no business that is subject to a SERFF mandate. The coefficients on the second, third, and fourth quartile of *SERFF Proportion* are -0.016, -0.025, and -0.020, and statistically significant at the 10, 1, and 5 percent levels, respectively. Pairwise F-tests show that the coefficients on Q2, Q3, and Q4 are statistically significantly different from Q1 at the 5 percent level, while these three coefficients are not significantly different from each other. If an insurer's *SERFF Proportion* is in the second quartile of the distribution, its expenses are, on average, lower than an insurer that has no business that is subject to a SERFF mandate by 0.016, an effect size of 7.80%. The effect sizes for the third and fourth quartile are 12.20% and 9.76%, respectively. For the average

insurer, moving from no business subject to a SERFF mandate to the second quartile translates to a reduction of $3,301,000 in expenses per year. The corresponding economic effects for the third and fourth quartile are $5,159,000 and $4,127,000.

In Regressions (5)-(8), we add the proportions of business in each line of insurance to control for possible heterogeneity across lines within a firm-year. The results are robust to the inclusion of insurer business mix. We also find evidence of economies of scale in regulatory compliance, as the coefficient on *Firm Size* is negative and statistically significant. Also, we find that insurer expenses increase with the number of states in which it does business, which is consistent with previous literature on the costs of complying with multiple insurance regulators (Grace and Klein 2000; Leverty 2012).

5.2 Firm-Line-Year Level Results

Table 4 shows the results of the firm-line-year level regressions. SERFF reduces regulatory compliance costs when an insurer writes a large proportion of business in states with a SERFF mandate. In Regression (1), after controlling for differences in the strategy for implementing SERFF by line, the coefficient on *Any SERFF* is not statistically different from zero, which suggests that the SERFF mandate in at least one state in which an insurer operates does not have a significant effect on its compliance costs. In Regression (2), the coefficient of *SERFF Proportion* is -0.014 and statistically significant at the 1 percent level, suggesting a negative relationship between the proportion of business under SERFF mandates and insurer expenses. For the average insurer with annual net premiums written of $44.24 million per line of business, a 50% increase in *SERFF Proportion* translates to a reduction of $310,000 in general expenses per line and year.

To explore the possibility of a nonlinear effect of proportion, we include *SERFF Proportion Squared* in Regression (3). The coefficients on *SERFF Proportion* and *SERFF Proportion Squared* are -0.026 and 0.013, respectively. While neither of them is statistically significant (possibly due to their correlation), a joint F-test rejects the hypothesis that both

coefficients are equal to zero (p-value = 0.02), suggesting that the inclusion of these two variables provides power in explaining the general expense ratio.

In Regression (4), which includes the four quartiles of *SERFF Proportion*, the coefficient on the indicator of the first quartile (*SERFF Proportion* between 0 and 0.10) is 0.008 and statistically significant at the 5 percent level. The coefficient on the indicator of the fourth quartile (*SERFF Proportion* between 0.64 and 1) is -0.010 and statistically significant at the 5 percent level. Pairwise F-tests show that the coefficient on the first quartile indicator is significantly different from other quartiles at the 1 percent level, and the second, third, and fourth quartile indicators do not differ from each other. Compared to an insurer who does not have any business under a SERFF mandate, the general expense ratio of the average insurer with a proportion of SERFF business that is in the fourth quartile (*SERFF Proportion* between 0.64 and 1) is lower by 0.010, an effect size of 5.35% (0.010/0.187 = 5.35%). This translates to $442,000 per year for an average firm-line observation in the fourth quartile.

In Regressions (5)-(8), we add the square of *Number of States* to control for possible nonlinear effects of the number of states on compliance costs. The results are largely unchanged, except that the coefficient on *SERFF QT=1* is not significantly different from zero in Regression (8). Overall, the results suggest that there are fixed costs associated with adopting the technology, but cost savings emerge as SERFF is implemented more widely by the insurer.

6 Conclusion

This study examines a quasi-natural state-level experiment of technology adoption in product regulation in the U.S. P/L insurance industry. We find evidence suggesting that mandated use of an internet application, SERFF, reduces insurer expenses. The effect of SERFF mandate seems to be nonlinear: it imposes additional costs when the insurer starts using SERFF for policy form and rate filings, and the expense savings appear after the insurer

applies SERFF on a sufficiently large proportion of business.

At the firm-year level, the estimated cost savings of SERFF for an average firm in the fourth quartile of the distribution of business subject to a SERFF mandate is 9.76%, and on the firm-line-year level the estimate is 5.35%. A possible explanation of the difference between these two estimates is that we do not know to what extent insurers implement SERFF differently across lines. If insurers always implement SERFF simultaneously across all the lines that they write in, the estimate of 9.76% might be closer to the real effect size, but if insurers implement SERFF differently across lines, the estimate of 5.35% would be more reliable. Importantly, since we only observe the years when SERFF was mandated by the states rather than the time of SERFF implementation by the insurers, both estimates might be understating the actual cost-saving effect of SERFF due to the measurement error. In summary, our findings indicate that digitization significantly reduces the costs of complying with regulation.

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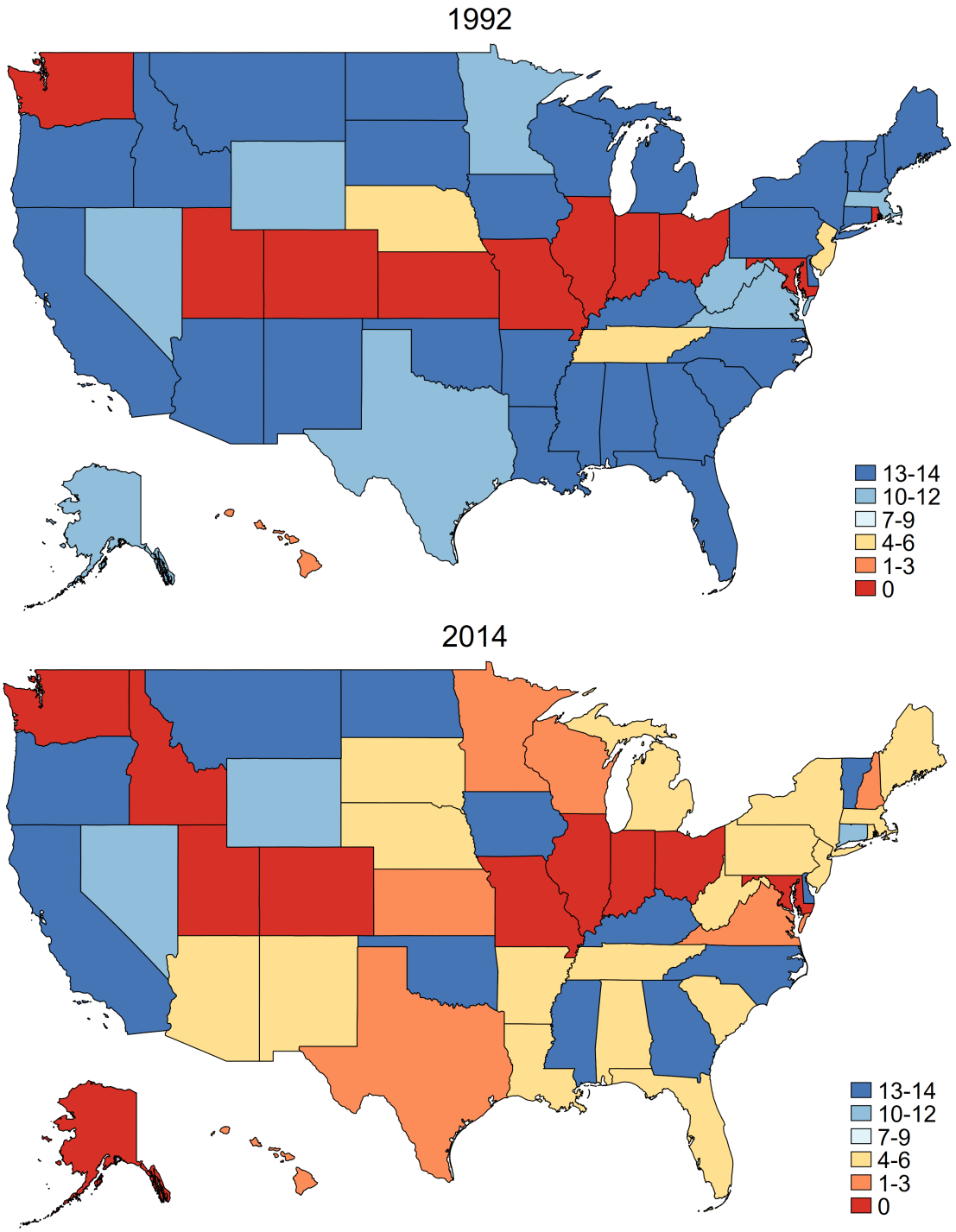
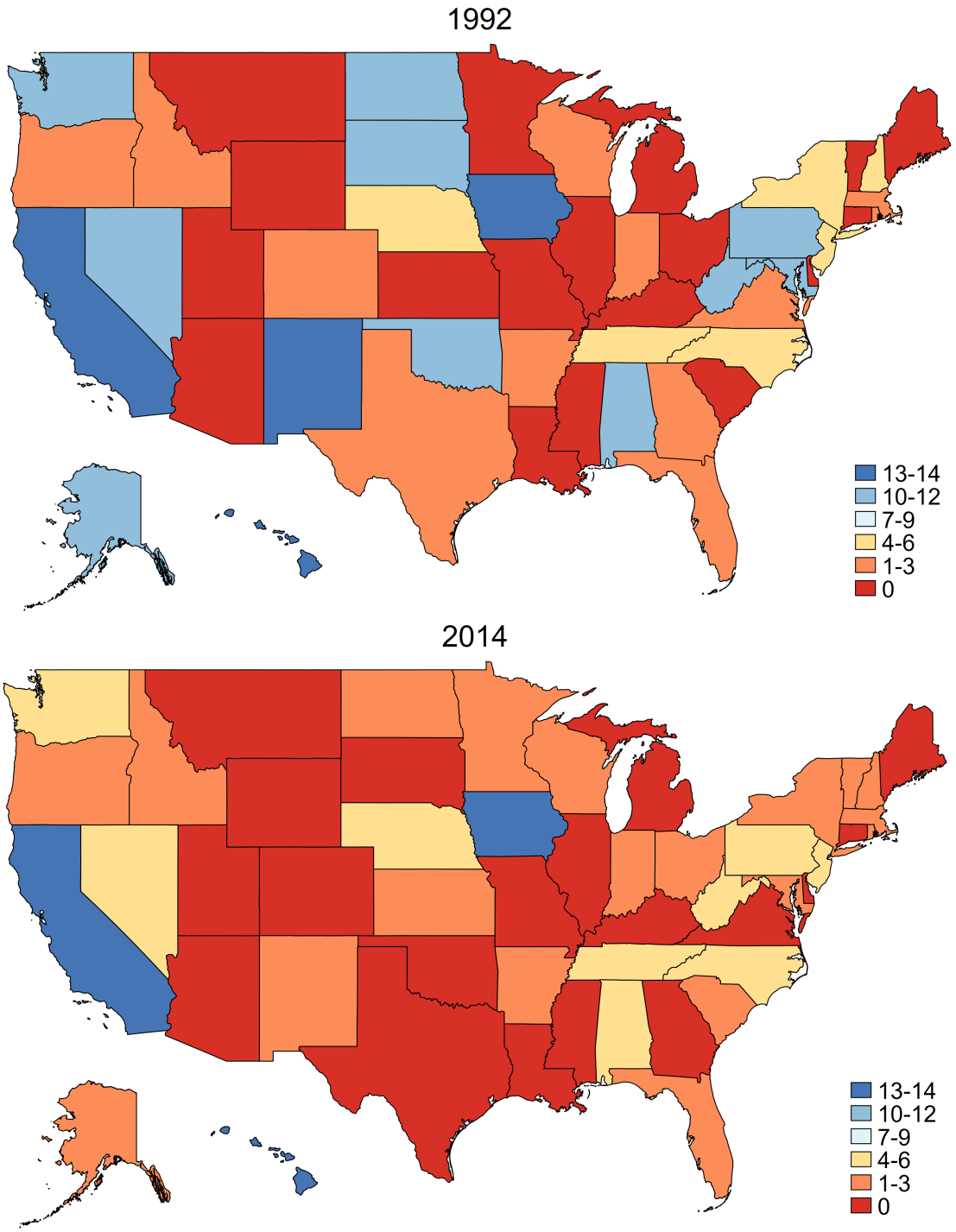
Figure 1: Number of Lines under Stringent Form Regulation, 1992 and 2014



Notes: The figure shows the number of lines under stringent form regulation by state in 1992 and 2014. Data sources: NAIC (1992-2014) and state statutes.

Figure 2: Number of Lines under Stringent Rate Regulation, 1992 and 2014



Notes: The figure shows the number of lines under stringent rate regulation by state in 1992 and 2014. Data sources: NAIC (1992-2014) and state statutes.

Table 1: SERFF Mandate Year for P/L Insurance by State

State	Mandate Year
AL	2008
AR	2011
AZ	2016
CA	2015
CO	2009
CT	2011
DC	2008
DE	2008
GA	2007
IA	2008
IL	2012
KS	2009
MA	2009
ME	2010
MI	2009
MN	2008
MO	2016
NE	2010
NH	2008
NJ	2009
NM	2010
NV	2011
OH	2010
OK	2010
RI	2008
SC	2012
SD	2007
UT	2008
VT	2009
WA	2009
WV	2009

Notes: The table shows the year when SERFF is mandated for property-liability insurance product filing across states that have mandated SERFF by April 2018. Data Source: NAIC (2018)

Table 2: Summary Statistics

Panel A: Firm-Year Level

	Mean	SD
Any SERFF	0.21	0.40
SERFF Proportion	0.08	0.22
Net Premiums Written (MN)	206.34	1115.33
Loss Ratio	0.67	0.19
Total Expense Ratio	0.35	0.17
General Expense Ratio	0.20	0.21
Firm-Year Observations	35,440	

Panel B: Firm-Line-Year Level

	Mean	SD
Any SERFF	0.20	0.40
SERFF Proportion	0.08	0.22
Net Premiums Written (MN)	44.24	329.85
Loss Ratio	0.76	2.75
Total Expense Ratio	0.34	0.15
General Expense Ratio	0.19	0.17
Firm-Line-Year Observations	157,531	

Notes: Panel A shows the mean and standard deviation of main variables at firm-year level (1992-2014). *Any SERFF* is an indicator of whether the insurer writes business under SERFF mandate. *SERFF Proportion* is the proportion of premiums written under SERFF mandate. *Total Expense Ratio* is the ratio of all underwriting expenses (excluding loss adjustment expenses) to net premiums written. *General Expense Ratio* is the ratio of general expenses to net premiums written. *Entry 1st Year (2nd Year)* equals one if an insurer is in its first (second) year of entry; *Exit Last Year (2nd Last Year)* equals one if an insurer is in its last (second last) year before exiting.

Panel B shows the mean and standard deviation of main variables at firm-line-year level (1992-2014). Entry 1st Year (2nd Year) equals one if an insurer is in its first (second) year of entry into a line; Exit Last Year (2nd Last Year) equals one if an insurer is in its last (second last) year before exiting a line. Data sources: NAIC (1992-2018).

Table 3: Effects of SERFF Mandate on General Expense Ratio: Firm-Year Level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any SERFF	-0.013**				-0.013**			
	(0.006)				(0.006)			
SERFF Proportion		-0.022**	-0.098***			-0.020**	-0.098***	
		(0.009)	(0.036)			(0.009)	(0.036)	
SERFF Proportion Sq.			0.081**				0.084**	
			(0.036)				(0.036)	
SERFF QT=1				-0.001				-0.002
				(0.007)				(0.007)
SERFF QT=2				-0.016*				-0.018**
				(0.009)				(0.009)
SERFF QT=3				-0.025***				-0.025***
				(0.009)				(0.009)
SERFF QT=4				-0.020**				-0.018**
				(0.008)				(0.008)
Stringent Form Prop	0.027**	0.028**	0.027**	0.027**	0.023*	0.023*	0.023*	0.023*
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Stringent Rate Prop	0.019*	0.018	0.018	0.018	0.015	0.014	0.015	0.015
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Firm Size	-0.117***	-0.117***	-0.117***	-0.117***	-0.118***	-0.118***	-0.118***	-0.118***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Number of States	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of Business in Each Line	No	No	No	No	Yes	Yes	Yes	Yes
Entry & Exit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dependent Variable	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205
R-squared	0.646	0.647	0.647	0.647	0.649	0.649	0.649	0.649
Firm-Year Observations	35,540	35,540	35,540	35,540	35,540	35,540	35,540	35,540

Notes: The table shows the results of fixed effect regressions of the general expense ratio with firm-year level observations (1992-2014). *Any SERFF* is an indicator of whether the insurer writes business under SERFF mandate. *SERFF Proportion* is the proportion of premiums written under SERFF mandate. *Stringent Form (Rate) Proportion* is the proportion of premiums written under prior-approval form (rate) regulation. *Firm Size* is the natural logarithm of the net premiums written by an insurer in a year. *Number of States* counts the number of states where a firm makes product filings. Robust standard errors are clustered at the firm level and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Effects of SERFF Mandate on General Expense Ratio: Firm-Line-Year Level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any SERFF	-0.001				-0.002			
	(0.004)				(0.004)			
SERFF Proportion		-0.014***	-0.026			-0.014***	-0.032*	
		(0.005)	(0.018)			(0.005)	(0.018)	
SERFF Proportion Sq.			0.013				0.019	
			(0.017)				(0.017)	
SERFF QT=1				0.008**				0.006
				(0.004)				(0.004)
SERFF QT=2				-0.003				-0.005
				(0.005)				(0.005)
SERFF QT=3				-0.005				-0.006
				(0.005)				(0.005)
SERFF QT=4				-0.010**				-0.011**
				(0.005)				(0.005)
Stringent Form Prop	0.016***	0.017***	0.017***	0.017***	0.016***	0.017***	0.017***	0.017***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Stringent Rate Prop	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Firm-Line Size	-0.035***	-0.035***	-0.035***	-0.035***	-0.035***	-0.035***	-0.035***	-0.035***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of States	0.002***	0.002***	0.002***	0.002***	0.003***	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of States Sq.					-0.000***	-0.000***	-0.000***	-0.000***
					(0.000)	(0.000)	(0.000)	(0.000)
Entry & Exit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Line Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dependent Variable	0.187	0.187	0.187	0.187	0.187	0.187	0.187	0.187
R-squared	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447
Firm-Line-Year Observations	157,531	157,531	157,531	157,531	157,531	157,531	157,531	157,531

Notes: The table shows the results of fixed effect regressions of the general expense ratio with firm-line-year level observations (1992-2014). *Any SERFF* is an indicator of whether the insurer writes business under SERFF mandate. *SERFF Proportion* is the proportion of premiums written under SERFF mandate. *Stringent Form (Rate) Proportion* is the proportion of premiums written under prior-approval form (rate) regulation. *Firm-Line Size* is the natural logarithm of the net premiums written by an insurer in a line and year. *Number of States* counts the number of states where a firm makes product filings in a line. Robust standard errors are clustered at the firm level and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.1: Classification of State Form Regulation Stringency in Personal Lines, 1992-2014

State	Stringent Form Regulation	Non-stringent Form Regulation	State	Stringent Form Regulation	Non-stringent Form Regulation
Alabama	1992-2014		Montana	1992-2014	
Alaska	1992-2005	2006-2014	Nebraska	1992-2014	
Arizona	1992-2014		Nevada	1992-2014	
Arkansas	1992-2014		New Hampshire	1992-2014	
California	1992-2014		New Jersey	1992-2014	
Colorado		1992-2014	New Mexico	1992-2014	
Connecticut	1992-2014		New York	1992-2014	
Delaware	1992-2014		North Carolina	1992-2014	
District of Columbia		1992-2014	North Dakota	1992-2014	
Florida	1992-2014		Ohio		1992-2014
Georgia	1992-2014		Oklahoma	1992-2014	
Hawaii		1992-2014	Oregon	1992-2014	
Idaho	1992-1994	1995-2014	Pennsylvania	1992-2014	
Illinois		1992-2014	Rhode Island[1]	1998-2014	
Indiana		1992-2014	South Carolina	1992-2014	
Iowa	1992-2014		South Dakota	1992-2014	
Kansas		1992-2014	Tennessee	1992-2014	
Kentucky	1992-2014		Texas	1992-2014	
Louisiana	1992-2014		Utah		1992-2014
Maine	1992-2014		Vermont	1992-2014	
Maryland		1992-2014	Virginia	1992-2014	
Massachusetts	1992-2014		Washington		1992-2014
Michigan	1992-2014		West Virginia	1992-2014	
Minnesota	1992-2014		Wisconsin	1992-2008	2009-2014
Mississippi	1992-2014		Wyoming	1992-2014	
Missouri		1992-2014			

1. Data missing during 1992-1997.

Notes: The table shows the classification of state policy form regulation stringency in personal lines, 1992-2014. Personal lines are: homeowners/farmowners, private passenger auto liability, and private passenger auto physical damage. Stringent form regulation is identified by a prior approval form filing system. Data sources: NAIC (1992-2014) and state statutes.

Table A.2: Classification of State Form Regulation Stringency in Commercial Lines, 1992-2014

State	Stringent Form Regulation	Non-stringent Form Regulation	State	Stringent Form Regulation	Non-stringent Form Regulation
Alabama	1992-2001	2002-2014	Montana	1992-2014	
Alaska	1992-2004	2005-2014	Nebraska		1992-2014
Arizona	1992-1998	1999-2014	Nevada	1992-2014	
Arkansas	1992-1999	2000-2014	New Hampshire	1992-1998	1999-2014
California	1992-2014		New Jersey		1992-2014
Colorado		1992-2014	New Mexico	1992-2005	2006-2014
Connecticut	1992-2014		New York	1992-2011	2012-2014
Delaware	1992-2014		North Carolina	1992-2014	
District of Columbia		1992-2014	North Dakota	1992-2014	
Florida	1992-2014		Ohio		1992-2014
Georgia	1992-2014		Oklahoma	1992-2014	
Hawaii		1992-2014	Oregon	1992-2014	
Idaho	1992-1994	1995-2014	Pennsylvania	1992-1995	1996-2014
Illinois		1992-2014	Rhode Island[1]	1998	1999-2014
Indiana		1992-2014	South Carolina	1992-2002	2003-2014
Iowa	1992-2014		South Dakota	1992-2004	2005-2014
Kansas		1992-2014	Tennessee		1992-2014
Kentucky	1992-2014		Texas	1992-2006	2007-2014
Louisiana	1992-1999	2000-2014	Utah		1992-2014
Maine	1992-1999	2000-2014	Vermont	1992-2014	
Maryland		1992-2014	Virginia	1992-2000	2001-2014
Massachusetts	1992-2004	2005-2014	Washington		1992-2014
Michigan	1992-2002		West Virginia	1992-2005	2006-2014
Minnesota	1992-1994		Wisconsin	1992-2008	2009-2014
Mississippi	1992-2014		Wyoming	1992-2014	
Missouri		1992-2014			

1. Data missing during 1992-1997.

Notes: The table shows the classification of state policy form regulation stringency in commercial lines, 1992-2014. Commercial lines are: special property, commercial multiple peril, other liability, products liability, commercial auto liability, commercial auto physical damage, and special liability. Stringent form regulation is identified by a prior approval form filing system. Data sources: NAIC (1992-2014) and state statutes.

Table A.3: Classification of State Rate Regulation Stringency in Personal Lines, 1992-2014

State	Stringent Rate Regulation	Non-stringent Rate Regulation	State	Stringent Rate Regulation	Non-stringent Rate Regulation
Alabama	1992-2014		Montana		1992-2014
Alaska	1992-2005	2006-2014	Nebraska	1992-2014	
Arizona		1992-2014	Nevada	1992-2014	
Arkansas[1]		1994-2014	New Hampshire	1992-2003	2004-2014
California	1992-2014		New Jersey	1992-2014	
Colorado		1992-2014	New Mexico	1992-2007	2008-2014
Connecticut		1992-2014	New York		1992-2014
Delaware		1992-2014	North Carolina	1992-2014	
District of Columbia		1992-2014	North Dakota	1992-2007	2008-2014
Florida		1992-2014	Ohio		1992-2014
Georgia		1992-2014	Oklahoma		1992-2014
Hawaii	1992-2014		Oregon		1992-2014
Idaho		1992-2014	Pennsylvania	1992-2014	
Illinois		1992-2014	Rhode Island		1992-2014
Indiana		1992-2014	South Carolina[3]	1995-2004	2005-2014
Iowa	1992-2014		South Dakota	1992-2004	2005-2014
Kansas[2]	1997-1999	2000-2014	Tennessee	1992-2014	
Kentucky		1992-2014	Texas		1992-2014
Louisiana		1992-2014	Utah		1992-2014
Maine		1992-2014	Vermont		1992-2014
Maryland	1992-1997	1998-2014	Virginia		1992-2014
Massachusetts		1992-2014	Washington	1992-2014	
Michigan		1992-2014	West Virginia	1992-2014	
Minnesota		1992-2014	Wisconsin		1992-2014
Mississippi		1992-2014	Wyoming		1992-2014
Missouri		1992-2014			

1. Data missing during 1992-1993.
2. Data missing during 1992-1996.
3. Data missing during 1992-1994.

Notes: The table shows the classification of state rate regulation stringency in personal lines, 1992-2014. Personal lines are: homeowners/farmowners, private passenger auto liability, and private passenger auto physical damage. Stringent rate regulation is identified by a prior approval rate filing system. In a few states, auto insurance is sometimes regulated differently from other personal lines. Data sources: NAIC (1992-2014) and state statutes.

Table A.4: Classification of State Rate Regulation Stringency in Commercial Lines, 1992-2014

State	Stringent Rate Regulation	Non-stringent Rate Regulation	State	Stringent Rate Regulation	Non-stringent Rate Regulation
Alabama	1992-2001	2002-2014	Montana		1992-2014
Alaska	1992-2005	2006-2014	Nebraska		1992-2014
Arizona		1992-2014	Nevada	1992-1993	1994-2014
Arkansas[1]		1994-2014	New Hampshire		1992-2014
California	1992-2014		New Jersey		1992-2014
Colorado		1992-2014	New Mexico	1992-2007	2008-2014
Connecticut		1992-2014	New York		1992-2014
Delaware		1992-2014	North Carolina		1992-2014
District of Columbia	1991-2000	2001-2014	North Dakota	1992-2007	2008-2014
Florida		1992-2014	Ohio		1992-2014
Georgia		1992-2014	Oklahoma	1992-1999	2000-2014
Hawaii	1992-2014		Oregon		1992-2014
Idaho		1992-2014	Pennsylvania	1992-1998	1999-2014
Illinois		1992-2014	Rhode Island		1992-2014
Indiana		1992-2014	South Carolina[3]	1995-1999	2000-2014
Iowa	1992-2014		South Dakota	1992-2004	2005-2014
Kansas[2]		1997-2014	Tennessee		1992-2014
Kentucky		1992-2014	Texas		1992-2014
Louisiana		1992-2014	Utah		1992-2014
Maine		1992-2014	Vermont		1992-2014
Maryland	1992-1997	1998-2014	Virginia		1992-2014
Massachusetts		1992-2014	Washington	1992-1996	1997-2014
Michigan		1992-2014	West Virginia	1992-2005	2006-2014
Minnesota		1992-2014	Wisconsin		1992-2014
Mississippi		1992-2014	Wyoming		1992-2014
Missouri		1992-2014			

1. Data missing during 1992-1993.
2. Data missing during 1992-1996.
3. Data missing during 1992-1994.

Notes: The table shows the classification of state rate regulation stringency in commercial lines, 1992-2014. Commercial lines are: special property, commercial multiple peril, other liability, products liability, commercial auto liability, commercial auto physical damage, and special liability. Stringent rate regulation is identified by a prior approval rate filing system. In a few states, auto insurance is sometimes regulated differently from other commercial lines. Data sources: NAIC (1992-2014) and state statutes.

Table A.5: Line of Insurance Category

Line Group	Line of Insurance in the Sample	Orignial Line in NAIC Data	Note
Personal	Homeowners/ Farmowners	Farmowners multiple peril	
		Homeowners multiple peril	
	Private Passenger Auto Liability	Private passenger auto no-fault (personal injury protection)	
		Other private passenger auto liability	
	Private Passenger Auto Physical Damage	Privatepassenger auto physical damage	
Commercial	Special Property	Fire	
		Allied lines	
		Earthquake	
		Glass	
		Burglary and theft	
	Commercial Multiple Peril	Commercial multiple peril (non-liability portion)	
		Commercial multiple peril (liability portion)	
	Financial /Mortgage Guaranty	Mortgage guaranty	Not used
		Financial guaranty	Not used
	Other Liability	Other liability	
		Other liability - occurrence	
		Other liability - claims made	
	Products Liability	Products Liability	
	Commercial Auto Liability	Commercial auto no-fault (personal injury protection)	
		Other commercial auto liability	
	Commercial Auto Physical Damage	Commercial auto physical damage	
	Fidelity/Surety	Fidelity	Not used
		Surety	Not used
	Special Liability	Aircraft (all perils)	
		Boiler and machinery	
	Credit	Credit	Not used
	Warranty	Warranty	Not used
Workers' comp	Workers' compensation	Workers' compensation	
Med Mal	Medical Professional Liability	Medical Professional Liability	
Ocean Marine	Ocean Marine	Ocean Marine	
Inland Marine	Inland Marine	Inland Marine	

Notes: The table shows the categorization of lines of insurance in this study.