Paying for Expertise:
The Effect of Experience on Insurance Demand

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Abstract

Mayers and Smith (1982) argue that one of the main reasons why corporations buy insurance is because insurers have a comparative advantage in providing real services, such as claims administration, monitoring, and loss prevention. We use the rich data available on the purchase of insurance by insurers to test the real services efficiency hypothesis. By exploiting within-insurer differences in line of business experience, we find that the demand for real-services is greatest when a firm enters a new line of business, and this demand decreases as the firm gains experience. We also find that the demand for real-services differs by line of business.

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1. Introduction

A recurrent puzzle in the financial economics literature is why risk-neutral corporations purchase insurance on actuarially unfair terms. Several theories have emerged to explain this puzzle: access to the real-services provided by insurers (Mayers and Smith, 1982); reduction of expected tax liabilities (e.g., Main, 1982; Mayers and Smith, 1982); mitigation of agency and underinvestment problems (e.g., Smith, 1986; MacMinn, 1987; Mayers and Smith, 1987; Garven and MacMinn, 1993); and reduction of the costs of financial distress (Mayers and Smith, 1982). Several studies find empirical support for the tax, agency, and financial distress cost motivations for the purchase of insurance (e.g. Main, 1983; Smith and Stulz, 1985; Shapiro and Titman, 1986; Stulz, 1996; Dionne and Garand, 2003). There is, however, little direct empirical evidence for the hypothesis that corporations purchase insurance because insurers have a comparative advantage in providing real-services, such as claims administration, monitoring, and loss prevention.

The real-service efficiencies hypothesis is difficult to test. First, corporations do not report the purchase of insurance in their annual accounting statements (Mayers and Smith, 1990; Yamori, 1999). Second, it is difficult to estimate the comparative advantage that insurers hold relative to corporations in the production of real-services. Finally, it is challenging to decouple the demand for real-services from the other incentives to purchase insurance.

We surmount these difficulties by testing the real-service efficiency hypothesis in the property-liability insurance industry. First, insurers are statutorily required to report detailed information about their annual purchases of reinsurance. In fact, insurers must report their reinsurance purchases for each line of business (e.g., personal auto liability, homeowners, or medical professional liability). Second, insurer experience in a line of business provides an estimate of the comparative advantage that reinsurers hold relative to insurers in the production of real services:

inexperienced insurers will demand the specialized knowledge and expertise of reinsurers to a greater degree than will experienced insurers. Third, since many insurers operate multiple lines of business and have different amounts of experience in each line, it is possible to separate the demand for real-services from other firm-level motivations for reinsurance (e.g., cost of financial distress, underinvestment incentives, tax structure, diversification, or organizational structure).[1]

We construct a panel data set of reinsurance purchases at the firm-line-year level. We then use firm-year and line fixed effects regression models to exploit within-firm differences in experience at the line of business level. The firm-year fixed effects sweep out the variation between firms in a year, making the estimates based on the variation within each firm-year, which only occurs when an insurer operates in two or more lines in the same year. The line fixed effects control for constant line-level unobserved heterogeneity over time. Since firm-year and line level incentives for reinsurance are fixed, we identify the demand for real-services using the differences in line of business experience within a firm-year.

We first examine differences in line-of-business experience using an indicator of whether it is an insurer's first year in a given line of insurance. An insurer is more likely to value the expertise and specialized knowledge of reinsurers when it first enters a line of business. The empirical strategy uses new lines as the treatment group and existing lines as the control group to isolate the demand for reinsurance for real services. The new line indicator estimates the within firm difference in the demand for reinsurance for lines in which it has no experience relative to lines in which the insurer has some experience. We find that insurers purchase 10.0 to 12.1 percent more reinsurance in new lines relative to existing lines of insurance.

[1] Mayers and Smith (1990), Cole and McCullough (2006), Powell and Sommers (2007), and Lei and Schmit (2010) analyze the firm-level determinants of the demand for reinsurance.

We also examine within firm differences in reinsurance demand using the number of years an insurer has written in each line. We find that insurer demand for reinsurance declines as it gains experience in a line. For each year of experience in a line of business, the average insurer reduces its reinsurance purchased by 1.9 percent.

To verify that our results are unique to reinsurers' comparative advantage in providing real services, we perform a set of falsification tests. Many insurance firms are organized as a group of firms under common ownership. As such, a line of business may be new to a subsidiary but not to the group. Since the subsidiary can rely upon the group's experience in that line, a new line for a subsidiary is a placebo treatment, i.e., a new line that has experience. We find that the estimated placebo treatment effect is statistically indistinguishable from zero. The demand for reinsurance is similar for lines in which the subsidiary has experience and for lines that are new to the subsidiary but for which the group has experience. Thus, experience (or lack thereof) drives the demand for reinsurance, confirming our conclusion that the within firm demand for reinsurance stems from the reinsurer's comparative advantage in providing real services.

We further explore the validity of potential alternative explanations of our results. One potential alternative explanation of our results is that the size of an insurer's risk pool within a line of business increases as the insurer's experience in the line of business increases, and it is the pooling effect that drives the reduction in the reinsurance purchased. We confirm all of our results after controlling for the size of the risk pool. Another potential alternative explanation is that it is the riskiness of lines, not the firm's relative experience in those lines that generates the results. All of our results are robust to the inclusion of measures of the riskiness of a line of business. In summary, we find strong evidence in support of the real-service efficiency hypothesis: the demand

for reinsurance is greatest when an insurer first enters a line of business, and this demand decreases as the insurer gains experience in that line.

This study contributes to the literature on the corporate demand for insurance. Prior studies find that firm level financial, operational, and organizational characteristics affect the corporate demand for insurance. The cost of financial distress increases the demand for insurance (Core, 1997; Aunon-Nerin and Ehling, 2008). Smaller firms, firms with diversified ownership, and more strictly regulated firms demand more insurance (Yamori, 1999, Regan and Hur, 2007). Prior research also finds that firms purchase insurance to mitigate investment disincentives and agency conflicts (Zou and Adams, 2006; Aunon-Nerin and Ehling, 2008). We find that the access to real-services provided by insurers is another motivation for the corporate demand for insurance.

This study also contributes to the literature examining firm-level rationales for the demand for reinsurance. Prior studies find that firm characteristics such as size, profitability, and business and geographic diversification are negatively associated with reinsurance usage (Mayers and Smith, 1990; Cole and McCullough, 2006). These studies also find that ownership structure affects the demand for reinsurance; however, the results are ambiguous. Mayers and Smith (1990) find stocks use less reinsurance than mutuals, while Cole and McCullough (2006) find the opposite. Powell and Sommers (2007) find that firms with higher leverage purchase more reinsurance. Since Mayers and Smith (1990), several studies have examined the real-service efficiency hypothesis using insurer size and diversification.[2] These studies argue that smaller and more diversified insurers are more likely to value reinsurers' specialized knowledge and expertise (Mayers and Smith, 1990; and Cole and McCullough, 2006). Smaller insurers, however, also demand more reinsurance in

[2] Shortridge and Avila (2004), Cole and McCullogh (2006), Powell and Sommer (2007), Lei and Schmit (2010), Lee and Lee (2012), Lin et al. (2015), Upreti and Adams (2015), and Yanase and Limpaphayom (2017).

order to reduce the cost of distress. Recent studies also argue that less diversified insurers may purchase more reinsurance to increase diversification (Cole and McCullough, 2006). We extend this research by examining the line-level incentives for reinsurance, and we provide direct evidence that insurers demand reinsurance for real-service reasons.

The remainder of the paper is organized as follows. We discuss our data in Section 2. Section 3 presents our identification strategies and the empirical results. In Section 4, we perform a set of falsification tests to check the robustness of our results. In Section 5, we examine if the real services efficiencies are line of business specific. We conclude in Section 6.

2. Data

We use data from the National Association of Insurance Commissioners (NAIC) annual statement database for property and liability insurers from 1991 to 2014. The database contains underwriting and financial information for all U.S. property and liability insurers. We include in our sample all stock and mutual insurers that report positive values for assets, premiums, surplus, and losses incurred in a given year.[3]

We analyze the demand for reinsurance at two levels. The first level of analysis is at the firm-year level. We use this level of analysis to examine the traditional motives of reinsurance demand and to compare the findings of our sample period with those in prior studies. The second level of analysis, which pushes beyond the first level and what has been done in prior studies, is at the firm-line-year level. This level of analysis allows us to exploit the variation in experience and

[3] We exclude reinsurers from our analysis. We define a reinsurer as an insurer that assumes total reinsurance from nonaffiliated firms in excess of the total direct premiums written.

reinsurance usage across lines of business within a firm-year to identify the effect of experience on reinsurance usage.

In the firm-year level analysis, we measure the demand for reinsurance at the group and unaffiliated single insurer level using the total reinsurance ceded to non-affiliated firms divided by the direct premiums written, the *Reinsurance Ratio*.[4] This approach ensures that our measure for reinsurance demand does not include internal capital market transactions. We also collect insurer level information including total assets, leverage, tax-exempt investment income, loss reserve development, business and geographic diversification, organizational form, and whether the insurer is affiliated with a group of insurers. The sample includes 18,189 insurer-year observations and 1,796 insurers (673 groups and 1,123 unaffiliated insurers). Table 1 shows the summary statistics. Mutual insurers comprise 40.4% of the sample, the mean insurer size is $44 million in total assets, and the average return on assets (ROA) is 2.9%. These values are in alignment with those reported in Cole and McCullough (2006).

For the firm-line-year level analyses, we observe the direct premiums written, the amount of reinsurance assumed, and the amount of reinsurance purchased (measured as the *Reinsurance Ratio*) for all groups and unaffiliated single insurers in each line of business. The data allow us to track each insurer's business activity within each line, as well as the number of years of experience the insurer has in each line from 1991 to 2014. We assume an insurer is actively writing in a line of business if the direct premiums written or the reinsurance assumed from non-affiliates exceeds $100,000 in a year. Using this information, we identify the lines that are new to the insurer in a

[4] The Reinsurance Ratio, defined as the ratio of reinsurance premiums ceded to premiums written, is a common measure of the amount of reinsurance an insurer purchases. See for example: Mayers and Smith (1990), Berger et. al. (1992), and Cole and McCullough (2006).

year. Specifically, we define *New Line* as equal to 1 if the insurer has not operated in that line since 1991, and 0 otherwise. Although our data begin in 1991, our regression sample includes firm-line-year observations from 1994 to 2014 to reduce the chances of counting a firm-line as new if it simply is not reported in our data from 1991-1993. We also use other definitions of *New Line* and find our results are robust to these alternative definitions.[5]

The firm-line-year sample includes 80,156 observations (1,640 insurers; 621 groups and 1,019 unaffiliated insurers). We identify 3,576 of these observations as new firm-lines. Table 2 Panel A shows the summary statistics. To test the real-service efficiency hypothesis, we exploit line-level variation in reinsurance usage and experience within a firm-year. This variation is present when insurers operate in multiple lines of business and have different levels of experience across those lines. The average number of lines for a firm-year is 7.9, with a standard deviation of 4.1. The mean *Reinsurance Ratio* is 0.239 for existing lines and 0.314 for new lines.

Figure 1 shows the distribution of the *Reinsurance Ratio* for existing and new lines. The distribution for new lines is more skewed to the right than the distribution for existing lines. The *Reinsurance Ratio* is between 0 and 0.05 for approximately 30% of our firm-line-year observations. This holds for both existing and new lines. The use of reinsurance across the two segments, however, diverges beyond that point. The percentage of firm-line-year observations in which the insurer cedes premiums in excess of 50% is 32.9% for new lines, but only 15.3% for existing lines. In excess of 80%, it is 20.6% for new lines and 5.6% for existing lines.

[5] See footnote 8 for a description of these alternative definitions and Appendix A.1 for the results.

We also measure the experience of an insurer in a line of business (*Age Line*) as the number of years the insurer has operated in the line prior to and including the observation year.[6] Since our data begin in 1991, we are not able to track whether a firm has been writing business in a line prior to 1991; therefore, *Age Line* is left-censored. Accordingly, we estimate the effect of experience by including only those firm-line observations that are reported for the first time in year 1992 or later. Our results are robust to other definitions of *Age Line*.[7]

Table 2, Panel B shows the summary statistics of the regression sample we use to estimate the effect of line experience on reinsurance demand. The sample includes 29,753 firm-line-year observations across 1,425 insurers (559 groups and 866 unaffiliated insurers). Average experience for a firm-line-year is 6.6 years, with a standard deviation of 4.0 years. Figure 2 shows the arithmetic average of the *Reinsurance Ratio* for each year of experience. The average *Reinsurance Ratio* falls from 0.314 to 0.211 as the experience of a firm in a line increases from 1 to 10 years.

3. Empirical design and results

In this section, we describe our empirical strategy and discuss the results for the firm and firm-line level analyses of reinsurance demand. We present the firm-level analyses in Section 3.1 and the firm-line-level analyses in Section 3.2.

3.1 Firm Level Analysis

We first examine the demand for reinsurance at the firm-level. This analysis is a replication of prior studies (e.g., Mayers and Smith, 1990; Cole and McCullough, 2006; Powell and Sommer, 2007) using our sample period. We estimate the association between firm-level characteristics and the amount of reinsurance purchased using the following:

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[6] *Age Line* is equal to one the first year that an insurer operates in the line of business.
[7] See footnote 11 for a description of these alternative definitions and Appendix A.1 for the results.

$$y_{it} = \beta Q_{it} + \gamma X_{it} + \alpha_i + \tau_t + \varepsilon_{it} \quad (1)$$

where y_{it} is the *Reinsurance Ratio* (for firm i in year t); $\boldsymbol{Q}$ is the proportion of premiums written in each line of business; $\boldsymbol{X}$ is a vector of firm-level control variables; α_i and τ_t are firm and year fixed effects; and ε_{it} is an error term. We adjust the standard errors for clustering at the firm level.

The control variables are variables identified by prior studies (e.g., Mayers and Smith, 1990; Cole and McCullough, 2006; Powell and Sommer, 2007) as the key determinants of insurer demand for reinsurance: *Size* (log of total assets), *ROA* (net income divided by total assets), *Leverage* (direct premiums written over policyholder surplus), *Tax-Exempt Income* (tax exempt investment income divided by gross investment income), *Reserve Development* (2-year development in loss reserves divided policyholder surplus), *LOB Concentration* (the sum of the squares of the proportions of direct premiums written in each line), *Geographic Concentration* (the sum of the squares of the proportions of direct premiums written in each state), and *Mutual* (an indicator that equals 1 if the insurer is organized as mutual insurer, and zero otherwise). The firm fixed effects account for unobserved, time-invariant differences across firms. The year fixed effects control for unobserved differences across time.

Table 3 reports the results of estimating Equation (1). To compare our results with prior studies (e.g., Mayers and Smith, 1990; Cole and McCullough, 2006; Powell and Sommer, 2007), Column (1) reports the results without the inclusion of the firm-fixed-effects. The results for our sample period, 1994-2014, are consistent with the findings in prior studies. The demand for reinsurance is greater for smaller firms (Mayers and Smith, 1990; Cole and McCullough, 2006), less profitable firms (Cole and McCullough, 2006), and more diversified firms (Mayer and Smith, 1990; Cole and McCullough, 2006). The demand is also greater for stock insurers, which is consistent with the results in Cole and McCullough (2006) but not with the findings of Mayers and Smith (1990).

We also find that the reinsurance demand is greater for firms with higher 2-year reserve development (Cole and McCullough, 2006) and for firms with lower income from tax-exempt investments. After the inclusion of the firm fixed effects in Column (2) of Table 3, only firm size and diversification are significantly associated with the demand for reinsurance. The results suggests that after controlling for unobserved but fixed firm backgrounds, only small insurers and firms that operate in a lot of states and lines demand have a greater demand for reinsurance. Prior studies argue that smaller and more diversified insurers are more likely to value reinsurers' specialized knowledge and expertise (Mayers and Smith, 1990; and Cole and McCullough, 2006).

3.2 Firm-Line Level Analysis

The real-service efficiency hypothesis suggests insurers buy reinsurance because reinsurers have a comparative advantage in specialized knowledge and expertise. Reinsurers often underwrite multiple lines of business and operate across multiple geographic areas. Given the scale and specialization of their operations, reinsurers often maintain in-house research facilities and employ experts such as structural engineers, geophysicists, scientists, and medical doctors to support underwriting and claims handling (Carter, 1983). Reinsurers share their expertise with ceding insurers. Reinsurers may set up or review an insurer's systems and processes, train staff, review policy documents, and help develop risk modeling, pricing, and loss forecasting functions (Carter, 1983; Bickelhaupt, 1983).

To test the real-service efficiency hypothesis we estimate reinsurance usage by line of business experience using the sample of firm-line-year observations:

$$y_{ilt} = \gamma Experience_{ilt} + \beta X_{it} + \delta Z_{ilt} + \varepsilon_{ilt} \qquad (2)$$

where y_{ilt} is the line-level *Reinsurance Ratio* for insurer *i* in line *l* in year t. *Experience* is a measure of insurer *i*'s experience operating line *l* in year *t* (we discuss these measures in detail below). *X* is the vector of firm level control variables used in Section 3.1. *Z* is a vector of firm-line level control variables: *LOB Share* (the proportion of insurer *i*'s direct premiums written in line *l* and year *t*) and *LOB Geographic Concentration* (the sum of the squares of the proportions of firm *i*'s premiums written in state *s*, line *l*, and year *t*). The standard errors, ε_{ilt}, are robust and clustered at the firm-year.

To exploit the within firm-year variation in line of business experience that occurs when an insurer operates in two or more lines in a year, we can further control for unobserved firm-year and line effects. Lines within a firm-year have similar but largely unobserved firm backgrounds for the year. We can therefore control for their common firm backgrounds for each year by including a firm-year fixed effect. Moreover, lines within the insurance industry have similar but largely unobserved backgrounds. We can therefore control for their common line backgrounds by including a line fixed effect. These fixed effects together with Equation (2) implies:

$$y_{ilt} = \gamma Experience_{ilt} + \delta Z_{ilt} + \alpha_{it} + \lambda_l + \varepsilon_{ilt} \qquad (3)$$

where α_{it} and λ_l are firm-year and line fixed effects, respectively. Since the firm-level characteristics (X_{it}) only vary between years and remain constant within a year for a firm, X_{it} is subsumed by the firm-year fixed effects. The firm-year fixed effects not only control for all existing firm-level motivations for reinsurance demand, but also any firm-level motivations for reinsurance not yet explored.

The line fixed effects control for time-invariant line-level unobserved heterogeneity. The firm-year fixed effect sweeps out the variation between firms in a year, making the estimates based on

only the variation within a firm-year and across lines. The estimation compares how experience effects reinsurance usage between different lines within the same firm-year, controlling for fixed differences in reinsurance usage at the line of business level. Because there are multiple lines of insurance from each firm-year, the fixed effect regression is similar to regressing differences in reinsurance usage within a firm-years' lines on differences in experience.

In Equation (3), γ measures the effect of experience on the demand for reinsurance. The identifying assumption is that experience is as good as randomly assigned conditional on covariate Z and the firm-year and line fixed effects. The estimate of γ gives the treatment effect of experience on reinsurance usage.

We first examine the effect of experience on reinsurance demand using an indicator of whether it is an insurer's first year in a given line of insurance. We hypothesize that the demand for the real services provided by reinsurers is greatest when insurers first enter a line of business. Using the sample of firm-line-year observations from 1994 to 2014, we define $New\ Line_{ilt}$ as equal to one if insurer *i* in year *t* has not operated in line l since 1991, and zero otherwise. All of our results are robust to alternative definitions of *New Line*.[8] The results from estimating Equation (3) using *New Line* as the measure of experience are reported in Table 4.

The results in Table 4 show that the insurer demand for reinsurance is greater for new lines relative to existing lines. In Column (1), which includes only *New Line* and the firm-year and line fixed effects, the coefficient on *New Line* is 0.029 and it is statistically significant at the 1 percent

[8] We assess the robustness of our results using two alternative definitions of *New Line*. With the first, we define a line as a *New Line* if insurer *i* has not operated in line *l* in the 3 years prior to the observation year *t*. With the second, we define a line as a *New Line* if insurer *i* has not operated in line *l* in the 5 years prior to the observation year *t*. The results, reported in Appendix Table A2, are robust to these alternative definitions.

level. The coefficient implies that insurers purchase 2.9 percentage points more reinsurance for their new lines of insurance relative to existing lines in the same calendar year. Since the average insurer in the sample cedes 23.9 percent of its direct premiums written to reinsurers, the coefficient on *New Line* suggests that insurers cede 12.1 percent more of their premiums written to reinsurers in new lines relative to existing lines.

Column (2) shows that the estimate of the new line effect is robust to the inclusion of line characteristics. The size of the new line effect falls slightly (0.024 compared with 0.029); however, the effect size remains economically and statistically significant. The firm-line controls suggest that as the proportion of total premiums in a line (*LOB Share*), and likely the degree of specialization of the insurer in a line, increases, the demand for reinsurance decreases. The negative and statistically significant coefficient of *LOB Geographic Concentration* suggests that the demand more reinsurance is greater in lines in which they are more geographically concentrated.

Columns (3)-(5) show that the estimate of the new line effect is also robust to alternative explanations. The first alternative explanation is that it is the underwriting risk associated with new lines and not the lack of experience that drives the demand for reinsurance. We control for the underwriting risk of each firm-line-year by including *LOB Loss Ratio*, the ratio of direct losses incurred to direct premiums written for insurer *i* in line *l* and year *t*. Columns (3) and (5) show that higher loss ratios are associated with greater reinsurance usage. The coefficient of *New Line*, however, remains positive, has a magnitude that is similar to previous regressions, and is statistically significant. This result indicates that the demand for reinsurance for new lines is different from any effect that underwriting risk has on reinsurance demand. A second alternative explanation is that it is the size of the risk pool underwritten by the insurer and not the lack of

experience that drives the demand for reinsurance, and new lines have smaller risk pools. Columns 4 and 5 show that this is not the case. The coefficient on *LOB Size* (the log of direct premium written by insurer i, in line l and year t) is not statistically significant. In contrast, the coefficient on New Line remains positive and statistically significant coefficient with an effect size similar to previous estimates. The implication is that the greater demand for reinsurance for new lines is not a result of the size of the underwriting risk pool.

We next investigate the effect of experience on reinsurance demand using the number of years of experience an insurer has in each line of insurance. As an insurer gains experience in a line, the insurer will accumulate loss data, acquire specialized knowledge, and develop internal expertise on the marketing, underwriting, and claims handling of the product. As a result, we hypothesize that the comparative advantage of the reinsurer's real-services will decrease over time. Using a sample of firm-line-year observations from 1994 to 2014, we define $Age\ Line$ as the number of years of experience insurer i has in line l as of year t. To be certain we are capturing the true age of a line, we restrict the regression sample to observations for which firm-line pairs are not present in the NAIC dataset in 1991. As a result, the regression sample includes only firm-line-year observations that are introduced at some point between 1992 and 2014.[9] We cap *Age Line* at 10 years.[10] We place this upper limit on *Age Line* because there are diminishing marginal returns to experience in a line and the capped variable pools the effect of reinsurance usage over multiple high experience observations to increase statistical power. Our results are robust to alternative

[9] Our results are robust to not restricting the sample to the firm-line pairs that are not present in the NAIC dataset in 1991 (see footnote 11 and Appendix Table A3 for additional details).

[10] Our results are robust to not capping *Age Line* (see footnote 11 and Appendix Table A3 for additional details).

measures of *Age Line*.[11] The results from estimating Equation (3) using *Age Line* as the measure of experience are reported in Table 5.

The results in Table 5 show that the demand for reinsurance decreases with insurer experience. In Column (1), which includes only *Age Line* and the firm-year and line fixed effects, the coefficient on *Age Line* is -.006 and it is statistically significant at the 1 percent level. The coefficient indicates that within the same calendar year insurers purchase 0.6 percentage points less reinsurance for lines with one more year of experience. The estimate of this effect is robust to the inclusion of line characteristics (Column 2) and the controls for alternative explanations (Columns 3-5). Since the average insurer in the regression sample cedes 31.4 percent of its premiums to reinsurers the first year it enters a line, each year of experience reduces reinsurance usage by 1.9 to 2.2 percent.

Figure 3 shows that as the insurer gains experience in a line, the demand for reinsurance falls. The plot corresponds to the regression in Column 2 of Tables 5 and uses the same sample, variable definitions, and fixed effects (firm-year and line). The only difference is that we replace the continuous *Age Line* variable with indicator variables; an indicator for each year of experience from 2 to 10+ (with 1 year of experience as the reference group). The y-axis of Figure 3 shows

[11] We assess the robustness of our results using four alternative measures of *Age Line*. The first alternative uses the same definition of *Age Line*; however, we include all firm-line observations from 1994 to 2014 in the regression sample (i.e., we do not restrict the observations to only those firm-line pairs that are not present in the NAIC dataset in 1991). The second alternative does not cap *Age Line*. The third alternative caps *Age Line* at 6 years; however, the regression sample includes all firm-line observations from 1996 to 2014. We use the pre-sample years, 1991-1995, to observe the years of experience prior to the regression sample period. The fourth and final alternative uses *Age Line* and all firm-line observations from 1994 to 2014 in the regression sample (i.e., we do not restrict the observations to only those firm-line pairs that are not present in the NAIC dataset in 1991). We, however, include another variable, *Suppressed Age* (an indicator that equals 1 if the firm-line is reported in 1991) to capture the firm-line year observations that are left-censored. We also include the interaction of *Suppressed Age* with *Age Line*. All of our results are robust to these alternative measures. The results, reported in Appendix Table A3, are robust to these alternative definitions.

the estimated *Reinsurance Ratio*. The bars depict 95% confidence intervals on each estimate. The x-axis displays the years of experience in a line. For the first year in a line, the estimated reinsurance ratio is 30.3%. The estimated *Reinsurance Ratio* then almost monotonically falls in each subsequent year. By the sixth year, the reinsurance ratio is 28.0%. With more ten or more years of experience the ratio is 24.7%. In sum, we find a downward trend in the demand for reinsurance as the insurer gains experience in a line, evidence consistent with the real services efficiency hypothesis.

4. Reinsurance Demand for Affiliated Single Insurers

In this section, we perform a falsification test to verify that our results are driven by reinsurers' comparative advantage in providing real services. Many property-liability insurers are affiliated with other insurers under an insurance holding group structure. As a result, an affiliated insurer has access to the expertise and the specialized knowledge of the other insurers within its group. Access to this expertise would reduce a subsidiaries demand for the real-services provided by a reinsurer. To test for the effect of intra-group experience on the demand for reinsurance, we replicate our analyses from Section 3.2 using the sample of individual insurers that are members of an insurance holding group. The sample includes all affiliated single insurers, i.e., it includes the subsidiaries of insurer groups and excludes unaffiliated single insurers. In contrast to Section 3.2, where we analyze the reinsurance demand at the insurer group level, in this section we analyze the reinsurance demand at the individual insurer level.

Using this sample, we re-estimate Equation (3). Similar to Section 3.2, we first examine the effect of experience on reinsurance demand using an indicator of whether it is an insurer's first year in a given line of insurance. We separate *New Line* into two variables: *New Line with*

Experience and *New Line without Experience*. *New Line with Experience* is set equal to one if line *l* is new to affiliated single insurer *i* but not new to one of the affiliated insurers in its group, and zero otherwise. *New Line with Experience* is a placebo treatment: a line that is new to a single insurer but for which there is experience available within its group of affiliated insurers. If the estimated effect for a *New Line* in Section 3.2 is due to the comparative advantage of the reinsurer in providing real services, then the coefficient on the placebo treatment will not be significantly different from zero. *New Line without Experience* equals one if line *l* is new to single insurer *i* and it is also new to all the other affiliated insurers in its group, and zero otherwise. The coefficient on *New Line without Experience* is the treatment effect of inexperience on the demand for real services. Table 6, Column (1) presents the results.

The results in Table 6, Column (1) show that the new line effect is tied to experience (or lack thereof). The coefficient on *New Line without Experience* is 0.019 and it is statistically significant at the 1 percent level. The coefficient implies that subsidiaries purchase 14.6 percent more reinsurance for lines that are new to the subsidiary and to its group relative to existing lines in the same calendar year. The coefficient on *New Line with Experience*, however, is statistically indistinguishable from zero, indicating that the amount of reinsurance purchased for a line that is new to subsidiary but not to its group is not significantly different from that purchased by the subsidiary in existing lines in the same calendar year. Thus, the demand for reinsurance is similar for new and existing lines when the insurer has access to the expertise of its group, i.e. when the reinsurer has less of a comparative advantage in providing real-services.

We also re-estimate Equation (3) separating *Age Line* into *Age Line Insurer* and *Age Line Group*. *Age Line Insurer* is the number of years of experience subsidiary insurer *i* has in line *l*, while *Age Line Group* is the number of years of experience the group has in line *l*. Table 6, Column (2)

shows the regression results. The coefficient on *Age Line Group* is -0.005 and it is statistically significant at the 1 percent level. The coefficient implies that each year of group-level experience reduces the demand for reinsurance by 3.1 percent. The coefficient on *Age Line Insurer*, however, is statistically indistinguishable from zero, indicating that the subsidiary's own experience in a line does not affect the demand for reinsurance. Overall, the results in this section suggest that experience (or lack thereof) drives the demand for reinsurance, confirming our conclusion that the within firm demand for reinsurance stems from the reinsurer's comparative advantage in providing real services.

5. Effect of Line of Business

As an insurer gains experience in a line, it will acquire specialized knowledge and develop internal expertise. However, the pace and extent of this learning may be line of business specific. Thus, it is likely that the demand for real-services evolves differently by line of business. To examine if the demand for real-services varies by line, we estimate:

$$y_{ilt} = \delta Z_{ilt} + \phi\left(NewLine_{ilt} \text{ x } \lambda_l\right) + \alpha_{it} + \lambda_l + \varepsilon_{ilt} \qquad (4)$$

The coefficient ϕ measures the incremental effect of newly entering line *l* on the demand for reinsurance, relative to existing lines of business. For this analysis we group lines-of-business based on the categorization in Schedule P of NAIC annual statements.

Figure 4 shows the estimated average Reinsurance Ratio for new and existing lines for each line-of-business in a graph, with bars representing the 95% confidence intervals. We find that the level of average reinsurance demand in both new and existing lines vary by lines-of-business. Moreover, the reinsurance demand is significantly higher in the first year of operations for all lines-of-business except special property, other liability, and special liability. Table 7, Column 2

and 3 show the estimated average Reinsurance Ratio for new and existing lines for each line-of-business. Column 4 shows the difference between the Reinsurance Ratio in new and existing lines, measure by subtracting the latter from the former. We find that the difference is positive and statistically significant at the 5% level for auto physical damage, personal auto liability, commercial auto liability, commercial multiple peril, homeowners/farmowners, medical professional liability, and workers compensation. The difference is significant at the 10 percent level for products liability. The difference is not significant for special liability, special property and other liability. Among all the lines-of-business, these three lines also have the highest reinsurance demand in existing lines. It is likely that while the demand for real services is higher in these lines, insurers fail to develop expertise and specialized knowledge with experience. As a result, insurer demand for reinsurance does not decrease in these lines.

6. Conclusion

The real-service efficiency hypothesis suggests that corporate demand for insurance stems from the insurer's comparative advantage in providing real services. We investigate the real-service efficiency hypothesis by examining insurer demand for reinsurance over the life cycle of a line of business. We exploit the within firm variation in reinsurance usage and experience at the line level to isolate the real-service driven reinsurance demand. We find strong evidence for the real-service efficiency hypothesis.

We observe that insurers value the expertise and specialized knowledge of reinsurers. This knowledge and expertise contribute to the demand for real-services, and thus the demand for reinsurance. We find that the demand for reinsurance is greatest when an insurer enters a new line in which it has no prior experience. As insurers gain experience in a line, they develop internal expertise and specialized knowledge. This drives the reinsurance demand down with experience

in the line. Our estimates suggest that insurers purchase 10.0 - 12.1 percent more reinsurance when entering a new line. We find that the amount of reinsurance purchased decreases by 1.9 percent for each year of experience in a line.

We also find that affiliated insurers benefit from the internal expertise of the group if other affiliates within the group have experience in the line, and thus demand less reinsurance. We also find evidence that real-service efficiencies are line specific.

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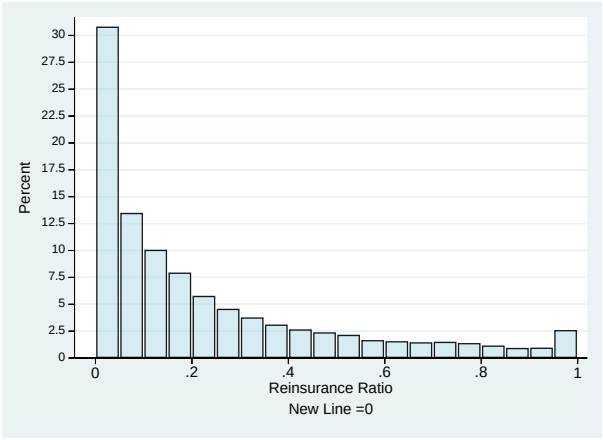
Figure 1
Distribution of Reinsurance Ratio

The figure shows the distribution of *Reinsurance Ratio* (reinsurance ceded to non-affiliates divided by the sum of direct premiums written and reinsurance assumed in a line). Panels A and B show the distribution of *Reinsurance Ratio* for existing lines of business and new lines of business, respectively.

Panel A



Panel B

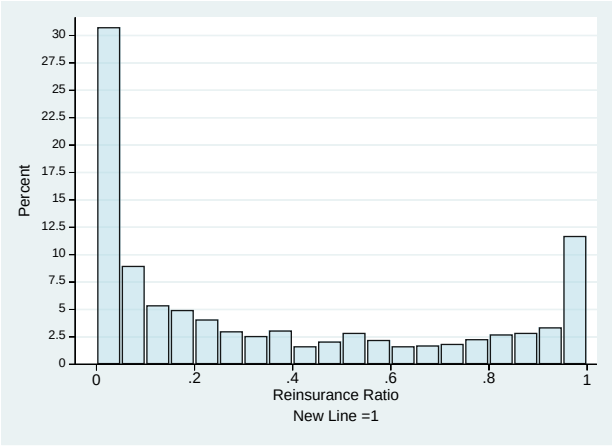


Figure 2
Average Reinsurance Ratio and Experience

The figure shows the arithmetic average of *Reinsurance Ratio* (reinsurance ceded to non-affiliates divided by the sum of direct premiums written and reinsurance assumed in a line) for each value of *Age Line*. The *Age Line* is defined as the years of experience a firm has been operating in a line of business. The bars represent the 95 percent confidence intervals.

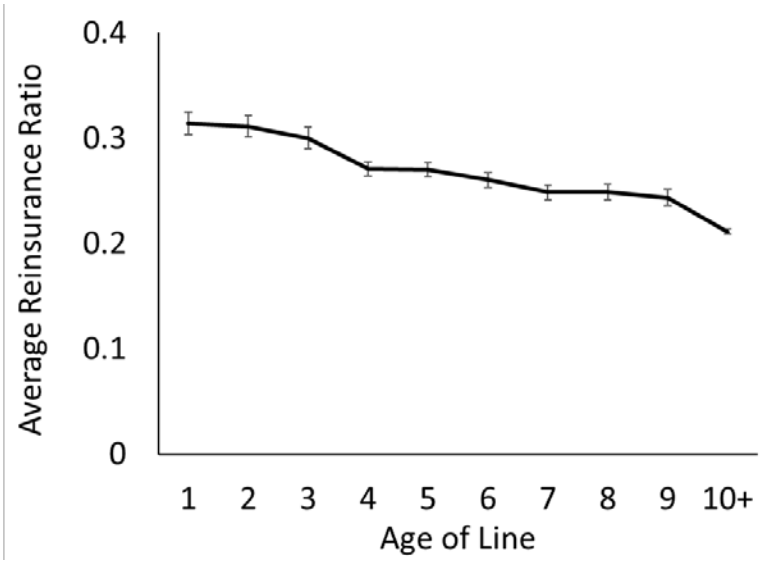


Figure 3

Predicted Reinsurance Ratio and Line of Business Experience

The figure plots the predicted *Reinsurance Ratio* for each year of experience in a line. We predict the *Reinsurance Ratio* by estimating Equation (3) using *Age Line* indicator variables, i.e., 1, 2, …, 9 and 10+ , for each year of experience an insurer has in a line. The regression sample includes observations for only those firm-line pairs that are not present in the NAIC dataset in 1991 The dependent variable is the Reinsurance Ratio and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. The line-level control variables are: LOB Share (the proportion of insurer i's total direct premiums written in the line) and LOB Geographic Concentration (the sum of the squares of the proportions of direct premiums written in each state within a line. The constant, and the fixed effects are omitted from the table to conserve space. Robust standard errors are clustered at the firm-year level. The bars represent 95% confidence intervals.

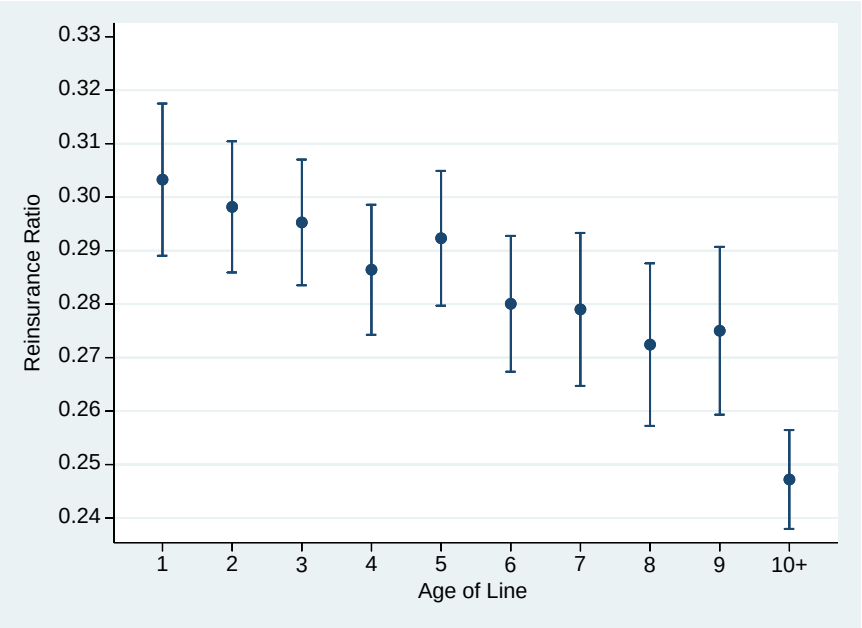


Figure 4

Estimated Reinsurance Ratio by Line-of-Business

The table presents predicted Reinsurance Ratio in new and existing lines by line-of-business, by estimating Equation (4). The regression sample includes all firm-line observations from 1994 to 2014. The dependent variable is the Reinsurance Ratio and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. New Line is an indicator variable that is equal to 1 if the insurer did not operate in the line in any year between 1991 and the observation year. The Reinsurance Ratios in new and existing lines are estimated using the coefficient on the interaction term between the line-of-business indicator and *New Line* indicator. The firm-line-level control variables are: *LOB Share* (the proportion of insurer i's total direct premiums written in the line) and *LOB Geographic Concentration* (the sum of the squares of the proportions of direct premiums written in each state within a line). Special Liability includes Ocean, Aircraft, Boiler and Machinery. Special Property includes Fire & Allied, Inland, Earthquake, and Burglary and Theft. We include firm-year and line fixed effects in the specification. Robust standard errors are clustered at the firm-year level. The bars show 95% confidence intervals.

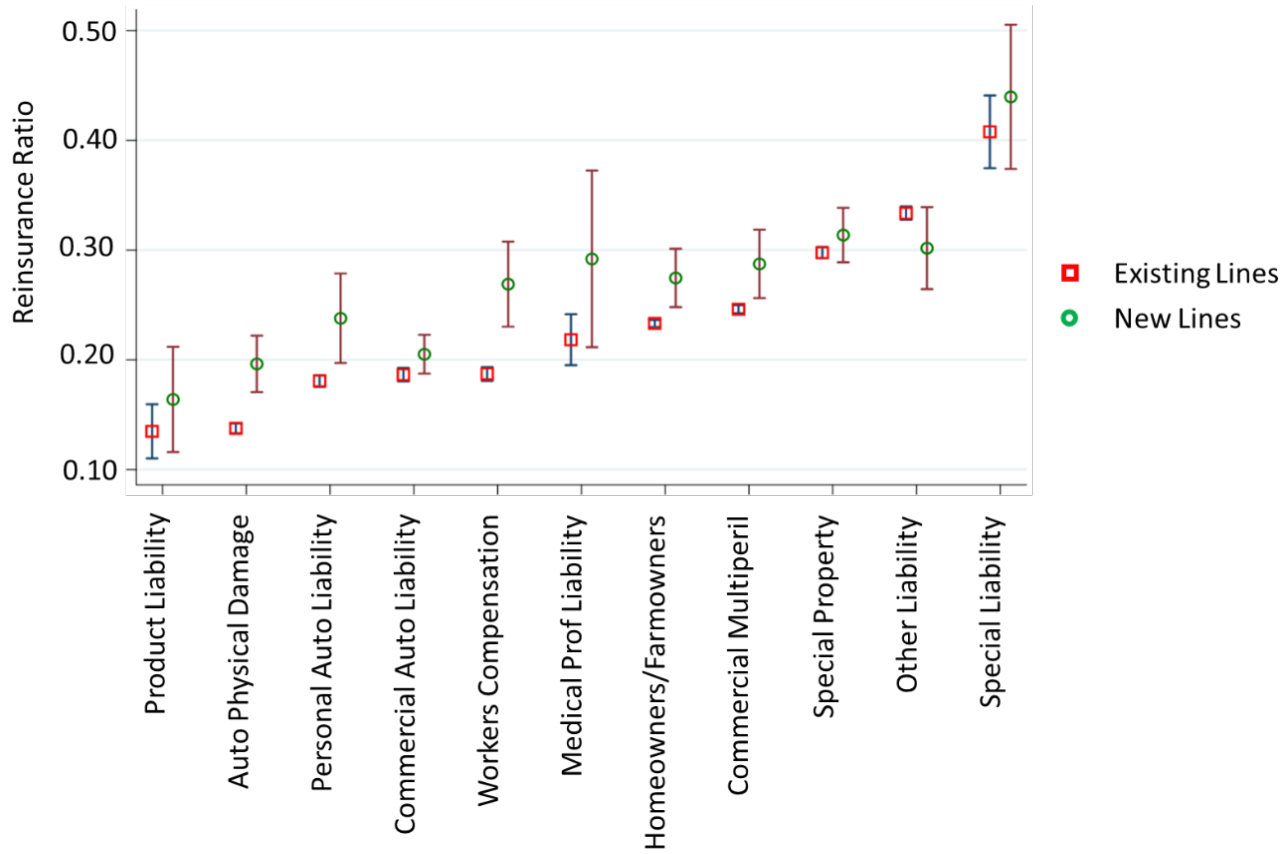


Table 1
Firm-Year Summary Statistics

The table presents the summary statistics for the firm-year-level regression sample. The sample includes firm-year observations from 1994-2014. *Reinsurance ceded* is measured as reinsurance premiums ceded divided by the direct premiums written. *Affiliated* is an indicator which is equal to 1 if the insurer is affiliated to a group, and 0 otherwise. *Geographic Concentration* is sum of the squares of the proportions of premiums written in each state. *Leverage* is direct premiums written over policyholder surplus. *LOB Concentration* is sum of the squares of the proportions of premiums written in each line. *Mutual* is an indicator equal to 1 if the insurer is organized as mutual, and 0 otherwise. *ROA* is net income before dividends divided by total net admitted assets. *Reserve Development* is the 2-year development in loss reserves divided by policyholder surplus. *Size* is log of total net admitted assets. *Tax Exempt Income* is tax exempt investment income divided by gross investment income.

Variables	Mean	Standard Deviation
Firm-level Reinsurance ceded		
Reinsurance Ceded to non-affiliates	0.237	0.233
Reinsurance Ceded (total)	0.322	0.274
Firm level Characteristics		
Group	0.369	0.482
Geographic Concentration	0.693	0.366
Leverage	1.601	6.226
LOB Concentration	0.607	0.314
Mutual	0.404	0.491
ROA	0.029	0.118
Reserve Development	-0.031	0.506
Size	17.644	2.235
Tax Exempt Income	0.156	0.212
Number of observations	18,189	
Years in sample	1994-2014	

Table 2
Firm-Line-Year Summary Statistics

The table presents the summary statistics for the firm-line-year level regression sample. Panel A includes all firm-line-year observations from 1994-2014. Panel B includes only those firm-line observations from 1994-2014 which are reported for the first time in 1992 or later. *Reinsurance Ratio* is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. *Affiliated* is an indicator which is equal to 1 if the insurer is a group, and 0 if it is a single insurer. *Geographic Concentration* is sum of the squares of the proportions of premiums written in each state. *Leverage* is direct premiums written over policyholder surplus. *Lines written by firm-year* is the count of lines of business written by a firm in a given year. *LOB Concentration* is sum of the squares of the proportions of premiums written in each line. *Mutual* is an indicator equal to 1 if the insurer is organized as a mutual, and 0 otherwise. *ROA* is net income before dividends divided by total net admitted assets. *Reserve Development* is the 2-year development in loss reserves divided by policyholder surplus. *Size* is log of total net admitted assets. *Tax Exempt Income* is tax exempt investment income divided by gross investment income. *LOB Share* is the proportion of the line level premiums in insurer's total direct premium written. *LOB Geographic Concentration* is the sum of the squares of the proportions of direct premiums written in each state. *LOB Experience in years* is the number of years of experience in the insurer has in the line.

	Panel A Firm-lines reported since 1991		**Panel B** Firm-lines reported for the first time in 1992 or later	
	Mean	Standard Deviation	Mean	Standard Deviation
Line-level Reinsurance ratio				
Reinsurance ratio	0.242	0.263	0.279	0.293
Reinsurance ratio in new lines	0.314	0.322	0.314	0.322
Reinsurance ratio in existing lines	0.239	0.259	0.274	0.288
Firm level Characteristics				
Affiliated	0.596	0.491	0.492	0.500
Geographic Concentration	0.535	0.390	0.604	0.384
Leverage	1.637	4.445	1.855	5.193
Lines written by firm-year	7.927	4.129	6.588	3.996
LOB Concentration	0.355	0.225	0.423	0.251
Mutual	0.467	0.499	0.356	0.479
ROA	0.027	0.089	0.023	0.094
Reserve Development	0.005	1.190	0.010	0.953
Size	19.17	2.433	18.511	2.207
Tax Exempt Income	0.19	0.201	0.170	0.203
Line level Characteristics				
LOB Share	0.196	0.264	0.224	0.305
LOB Specific Geographic Concentration	0.595	0.381	0.676	0.365
LOB Experience in years	10.296	6.252	6.574	4.826
Number of observations	80,156		29,753	
Years in sample	1994-2014		1994-2014	

Table 3
Firm Level Demand for Reinsurance

The table presents the regression estimates for Equation (1). The dependent variable is the *Reinsurance Ratio* and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written. *Geographic Concentration* is sum of the squares of the proportions of premiums written in each state. *Leverage* is direct premiums written over policyholder surplus. *LOB Concentration* is sum of the squares of the proportions of premiums written in each line. *Reserve Development* is 2-year development in loss reserves to policyholder surplus. *ROA* is net income before dividends divided by total net admitted assets. *Size* is log of total net admitted assets. *Mutual* is an indicator equal to 1 if the insurer is organized as mutual, and zero otherwise. *Tax Exempt Income* is tax exempt investment income divided by gross investment income. The regressions also include the proportion of premiums written in each line-of-business, a constant, and firm and year fixed effects. These variables are omitted from the table to conserve space. Robust standard errors, clustered at the insurer level, are in parentheses. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

	(1)	(2)
Geographic Concentration	-0.036**	-0.044**
	(0.016)	(0.022)
LOB Concentration	-0.087***	-0.113***
	(0.021)	(0.030)
Leverage	0.004	0.001
	(0.003)	(0.001)
Reserve Development	0.011**	0.003
	(0.005)	(0.003)
ROA	-0.127**	0.010
	(0.052)	(0.034)
Size	-0.022***	-0.029***
	(0.003)	(0.006)
Mutual	-0.060***	0.012
	(0.011)	(0.014)
Tax Exempt Income	-0.037*	-0.005
	(0.019)	(0.014)
Constant	0.308***	0.315***
	(0.055)	(0.115)
Firm Fixed Effects	No	Yes
Year Fixed Effects	Yes	Yes
Number of Observations	18,189	18,189
R-squared	0.164	0.056

Table 4
New Line and the Demand for Reinsurance

The table presents fixed effects regression estimates of reinsurance usage using the sample of firm-line observation for the years 1994 to 2014. The dependent variable is the *Reinsurance Ratio* and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. *New Line* is an indicator variable that is equal to 1 if the insurer did not operate in the line in any year between 1991 and the observation year. The firm-line-level control variables are: *LOB Share* (the proportion of insurer *i*'s total direct premiums written in the line), *LOB Geographic Concentration* (the sum of the squares of the proportions of direct premiums written in each state within a line), *LOB Loss Ratio* (line-level losses incurred divided by line-level direct premiums written), and *LOB Size* (log of direct premiums written in the line, then divided by 100 to scale up the coefficients). The constant and the fixed effects are omitted from the table to conserve space. Robust standard errors, clustered at the firm-year level, are in parentheses. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

Variable	(1)	(2)	(3)	(4)	(5)
New Line	0.029***	0.024***	0.026***	0.024***	0.026***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
LOB Share		-0.017***	-0.016***	-0.016**	-0.018**
		(0.005)	(0.005)	(0.007)	(0.007)
LOB Geographic Concentration		0.029***	0.028***	0.029***	0.029***
		(0.007)	(0.007)	(0.007)	(0.007)
LOB Loss Ratio			0.018***		0.018***
			(0.002)		(0.002)
LOB Size				-0.018	0.045
				(0.095)	(0.096)
Line Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.249	0.250	0.252	0.250	0.252
Number of Observations	80,156	80,156	80,156	80,156	80,156

Table 5
Experience and the Demand for Reinsurance

The table presents fixed effects regression estimates of reinsurance usage for the years 1994 to 2014. The regression sample includes observations for only those firm-line pairs that are not present in the NAIC dataset in 1991 The dependent variable is the *Reinsurance Ratio* and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. *Age Line* is the number of years of experience insurer *i* has in line *l* as of year *t*. We cap *Age Line* at 10. The line-level control variables are: *LOB Share* (the proportion of insurer *i*'s total direct premiums written in the line), *LOB Geographic Concentration* (the sum of the squares of the proportions of direct premiums written in each state within a line), *LOB Loss Ratio* (line-level losses incurred divided by line-level direct premiums written), and *LOB Size* (log of direct premiums written in the line, then divided by 100 to scale up the coefficients). The constant, and the fixed effects are omitted from the table to conserve space. Robust standard errors, clustered at the firm-year level, are in parentheses. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

Variable	(1)	(2)	(3)	(4)	(5)
Age Line	-0.006***	-0.006***	-0.006***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LOB Share		0.012	0.013	-0.046***	-0.047***
		(0.009)	(0.009)	(0.011)	(0.011)
LOB Geographic Concentration		0.041***	0.040***	0.057***	0.058***
		(0.012)	(0.012)	(0.012)	(0.012)
LOB Loss Ratio			0.019***		0.020***
			(0.004)		(0.004)
LOB Pool Size				1.244***	1.310***
				(0.187)	(0.186)
Line Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.304	0.304	0.307	0.305	0.305
Number of Observations	29,753	29,753	29,753	29,753	29,753

Table 6

Reinsurance Demand by the Affiliated Single Insurers

The table presents fixed effects regression estimates of reinsurance usage for the years 1994 to 2014. Specification 1 includes all observations, and Specification 2 includes observations for only those firm-line pairs that are not present in the NAIC dataset in 1991. The dependent variable is the *Reinsurance Ratio* and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. *New Line without Experience* is an indicator that equals 1 if the line is new to the affiliated insurer and to the group to which the insurer belongs, and zero otherwise. A line is new if the group has never operated in line since 1991. *New Line with Experience* is an indicator that equals 1 if the line is new to the affiliated insurer only, and zero otherwise. A line is new if the affiliate has never operated in line since 1991. *Age Line Group* is the number of years of experience the affiliate group has in the line as of year t. *Age Line Insurer* is the number of years of experience the affiliated insurer has in the line as of year t. We cap *Age Line* at 10. The line-level control variables are: *LOB Share* (the proportion of insurer *i*'s total direct premiums written in the line) and *LOB Geographic Concentration* (the sum of the squares of the proportions of direct premiums written in each state within a line). The line-level controls, the constant, and the fixed effects are omitted from the table to conserve space. Standard errors, clustered at the firm-year level, are reported below the coefficients in parentheses. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

Variable	(1)	(2)
New Line without Experience	0.019***	
	(0.006)	
New Line with Experience	0.004	
	(0.004)	
Age of Line Group		-0.005***
		(0.001)
Age of Line Insurer		0.000
		(0.001)
Firm-Line level controls	Yes	Yes
Line fixed effects	Yes	Yes
Firm-Year fixed effects	Yes	Yes
R-squared	0.099	0.108
Number of Observations	160,754	59,650

Table 7
Reinsurance Demand in New and Existing Lines by Line-of-Business

The table presents predicted Reinsurance Ratio in new and existing lines by line-of-business, by estimating Equation (4). The regression sample includes all firm-line observations from 1994 to 2014. The dependent variable is the Reinsurance Ratio and is measured as reinsurance premiums ceded to non-affiliates divided by direct premiums written in a line. New Line is an indicator variable that is equal to 1 if the insurer did not operate in the line in any year between 1991 and the observation year. The Reinsurance Ratios in new and existing lines are estimated using the coefficient on the interaction term between the line-of-business indicator and *New Line* indicator. The firm-line-level control variables are: *LOB Share* (the proportion of insurer i's total direct premiums written in the line) and *LOB Geographic Concentration* (the sum of the squares of the proportions of direct premiums written in each state within a line). Special Liability includes Ocean, Aircraft, Boiler and Machinery. Special Property includes Fire & Allied, Inland, Earthquake, and Burglary and Theft. We include firm-year and line fixed effects in the specification. Robust standard errors are clustered at the firm-year level. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

	Reinsurance Ratio		
Line of Business	**New Line**	**Existing Line**	**New - Existing**
Product Liability	16.4%	13.5%	2.9% *
Auto Physical Damage	19.6%	13.8%	5.8% ***
Personal Auto Liability	23.8%	18.1%	5.7% ***
Commercial Auto Liability	20.5%	18.6%	1.9% **
Workers Compensation	26.9%	18.7%	8.2% ***
Medical Professional Liability	29.2%	21.8%	7.4% **
Homeowners/Farmowners	27.5%	23.3%	4.1% **
Commercial Multiperil	28.7%	24.6%	4.1% ***
Special Property	31.4%	29.8%	1.6%
Other Liability	30.2%	33.4%	-3.2%
Special Liability	44.0%	40.8%	3.2%

Appendix

A.1 Robustness to Alternative Definitions of New Line and Age Line

We examine whether our estimate of the effect of experience on the demand for reinsurance is robust to alternative definitions of *New Line* and *Age Line*. We use two alternative definitions of *New Line*. The first definition is a line in which the insurer has not operated in the 3 years prior to the observation year. The second uses 5 years prior to the observation year. The results are robust to these alternative definitions. In Table A1, we present the results of re-estimating Equation (3). The coefficient on *New Line* ranges from 2.1 – 2.9 percentage points and is significant at the 1 percent level.

We also examine the robustness of our results to alternative measures of *Age Line.* Since we are not able to determine whether a firm has been writing business in a line prior to 1991, our primary regression sample includes only those firm-line observations that are reported for the first time in 1992 or later. We use four alternative measures of *Age Line* that allow us to relax this selection criterion. In the first, we include all firm-line observations from 1994-2014 in our regression sample, and cap *Age Line* at 10 years. Thus, some of our firm-line observations will have left-censored line experience. In the second measure, we include all firm-lines from 1996 to 2014 in our regression sample, and we cap the *Age Line* at 6 years. In this sample, none of the firm-line observations has its line experience censored on the left. The cap ensures that any firm-line with experience of more than 6 years is assigned a value of 6 in our sample. In the third alternative measure, we keep all firm-line observations from 1994 to 2014 in our regression sample, but in our regression model, we include an indicator variable, *Suppressed Age,* which is equal to 1 if the firm-line is reported in 1991. Specifically, we add the indicator and its interaction with *Age Line*

to our regression models in Equation (3). We also use an uncapped measure of *Age Line* as a fourth alternative measure. Table A2 presents the results of re-estimating Equation (3). Across all the alternate measures of *Age Line*, the coefficient on *Age Line* ranges from -0.4 to -1.0 percentage points and is significant at 1 percent level. These findings suggest that our estimation of the effect of experience on reinsurance demand is robust to alternative definitions of *Age Line*.

Table A1

Alternative Definitions of New Line

The table presents the results of estimating equation (3) using alternative definitions of *New Line*. In Column (1) and Column (2), *New Line* is equal to 1 if the insurer has not operated in line in the 3 years prior to the observation year. In Column (3) and Column (4), *New Line* is equal to 1 if the insurer has not operated in line in the 5 years prior to the observation year. The constant and the fixed effects are omitted from the table to conserve space. The standard errors are clustered at the firm-year level and are reported below the coefficients in parentheses. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

Variable	(1)	(2)	(3)	(4)
New Line	0.029***	0.024***	0.027***	0.021***
	(0.007)	(0.007)	(0.008)	(0.008)
LOB Specific Geographic Concentration		0.029***		0.027***
		(0.007)		(0.007)
LOB Share		-0.017***		-0.020***
		(0.005)		(0.005)
Line Fixed Effects	Yes	Yes	Yes	Yes
Firm-Year Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.249	0.250	0.257	0.258
Number of Observations	80,156	80,156	72,527	72,527

Table A2

Alternative Definitions of Age Line

The table presents the result of robustness check on *Age Line*. The regression is similar to that presented in Table A2, except for the regression sample and the definition of *Age Line*. In Columns (1) and (2), *Age Line* is capped at 10, and the regression sample includes all firm-line observations from 1994 to 2014. In Columns (3) and (4), *Age Line* is not capped, and the regression sample includes those firm-line observations from 1994 to 2014 that are reported for the first time in 1992 or later. In Columns (5) and (6), *Age Line* is capped at 6, and the regression sample includes all firm-line observations from 1996 to 2014. In Columns (7) and (8), we include *Suppressed Age* (an indicator that equals 1 if the firm-line is reported in 1991) as a control and its interaction with Age Line. *Age Line* is capped at 10, and the regression sample includes all firm-line observations from 1994 to 2014. The constant and the fixed effects are omitted from the table to conserve space. Standard errors are clustered at the firm-year level and are reported below the coefficients in parentheses. ***, **, and * indicate two-tailed statistical significance at the 0.01, 0.05, and 0.10 levels.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age Line	-0.008***	-0.007***	-0.005***	-0.005***	-0.010***	-0.009***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LOB Specific Geographic Concentration		0.024***		0.040***		0.023***		0.023***
		(0.007)		(0.012)		(0.007)		(0.007)
LOB Share		-0.007		0.013		-0.014***		-0.002
		(0.005)		(0.009)		(0.005)		(0.005)
Line fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.251	0.252	0.305	0.306	0.258	0.259	0.253	0.253
Number of Observations	80,156	80,156	29,753	29,753	72,527	72,527	80,156	80,156