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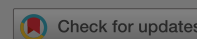
Feature Articles

It's About Time: An Examination of Loss Reserve Development Time Horizons

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The authors would like to thank two anonymous referees for their helpful comments that greatly improved the article.

1 An insurer's earnings are based (at least partially) on the losses the insurer reports. Increases (decreases) in loss reserves, therefore, decrease (increase) an insurer's earnings during the reporting period. We would consider any intentional altering of reserves to affect insurer earnings to be "earnings management."

3 We apply the model to the data

[illegible]

6 Researchers have often used different scaling variables (premiums, reserves, incurred losses) to measure the relative amount of error between insurers. In our multivariate tests, we will scale by the developed reserve for our tests on the individual lines of business and by total assets for our tests on aggregate reserves.

7 Anderson used a one-year development, though, subsequently, most research has utilized a longer development horizon.

8 Schedule P has been completely redesigned since the time that Anderson conducted his study and now includes much greater reporting detail, more lines of business, and a full 10 years of development history (originally, Schedule P included only five years of development). Even with all the reporting changes, these two basic approaches—the AYD and the CYD—continue to appear in the literature today. Moreover, the one-year and two-year CYD measures are now incorporated into Schedule P Part 2 for each of the major lines of business.

9 Subsequent researchers have often labeled development from AY to AY + 4 as “five-year development” because there is some loss development during the accident year itself. However, Forbes specifically defined loss reserve development in the statement year as “no development” and referred to development from AY to AY + 4 as four-year development (Forbes [1970](#), 531). We consistently use the terminology of Forbes and Anderson as the more descriptive term for the development horizon.

10 Schedule P was redesigned in 1992 to the current format. The current Schedule P was all that was available at the time.

11 It is important to note that the aggregate reserves are not included in the AYD or CYD measures.

12 These measures are calculated on either the AYD or CYD basis.

13 Petro and others (1998) found that the AYD and CYD measures may not be the best way to measure development, but of this



article for parsimony, but interested readers can contact the authors for an illustrative case.

14 The hypothesis is written such that rejecting the null would be in support of the Forbes Standard.

15 For the CYD calculation, the reserves are summed for each accident year within a calendar year; that is, the t subscript represents the sum of all reserves set in year t .

16 There are data limitations to the KFS study, particularly related to the lack of consistency in defining the ultimate losses; that is, instead of using $AY_t + 9$ for ultimate losses, KFS were forced to use the latest year available. That means that for certain accident years, the “ultimate” developed reserves were established as early as $AY_t + 3$. The KFS data set was also relatively small, with between 48 and 67 observations in each of the 10 available accident years from 1977 to 1987. Additionally, only three of those accident years (1977, 1978, and 1979) had a full 10 years of loss history, and hence we see the relaxation of the definition of “ultimate” in their research. Therefore, each of the other accident years in their study (1980–1987) had fewer than 10 years of development, and the ultimate losses were probably misstated. By contrast, we examine thousands of observations (depending on the line of business), and each of our 10 accident years is fully developed to $AY_t + 9$.

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the errors show up relatively quickly. Arguably, a one-, two-, or three-year horizon is sufficient to detect deliberate manipulations.

26 While we do not use the reserve error metric in Grace and Leverty (2012), we use their model as an overview of commonly cited reserve error-based incentives. See Barth and Eckles (2018) for a further discussion on the reserve error used in Grace and Leverty (2012).

27 We define the following lines as long-tailed: farm multiperil, homeowners, commercial, medical malpractice, workers compensation, products liability, auto liability, and other liability. This is consistent with the definition found in Hoyt and McCullough (2010), Eckles and Halek (2010), and Carson, Eastman, and Eckles (2018).

28 The Wald test allows testing the significance of coefficients across models. See Judge et al. (1985) for further discussion.

29 We appreciate an anonymous reviewer for this observation.

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