

# Do Insurer Reserving Practices Explain Liability Insurance Premium Fluctuations?: An Empirical Study at the Claim Level

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## INTRODUCTION

Since at least the 1950s, liability insurance markets have alternated between “soft” periods (characterized by below-cost pricing and falling insurer profits) and “hard” periods (characterized by above-cost pricing and rising insurer profits).<sup>1</sup> The causes of these swings<sup>2</sup> are disputed. Although few doubt that changes in liability-related expected losses, including the expansion and contraction of tort liability, have led to long-term adjustments in the real cost of insurance, evidence suggests that, standing alone, such changes do not explain the sudden and dramatic shifts the market has experienced.<sup>3</sup>

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<sup>1</sup> Tom Baker, *Medical Malpractice and the Insurance Underwriting Cycle*, 54 *DePaul Law Review* 393, 396 (2005) (hereafter “*Insurance Underwriting Cycle*”). See also Tom Baker, *The Medical Malpractice Myth XX-XX* (2005). On the characteristics of hard and soft markets, see Scott E. Harrington, *Tort Liability, Insurance Rates, and the Insurance Cycle*, 97, in *Brookings-Wharton Papers on Financial Services: 2004 (Complete cite)*; Scott E. Harrington and Patricia M. Danzon, *Price Cutting in Liability Insurance Markets*, 67 *Journal of Business* 511 (1994). Ann Gron, *RAND J of Econ* at 110 (claiming that cycles were observed as early as the 1950s).

<sup>2</sup> Others have used the term “cycle” to describe premium fluctuations over time. Some have criticized this terminology by pointing out that the fluctuations should not be classified as cycles (i.e., they have no fixed period, etc.) See Martin Grace, transcript of AEI proceedings (referring to fluctuations as “things”).

<sup>3</sup> Several empirical studies, however, suggest little connection between changes in tort law and fluctuations in premiums. [add cites]

Theorists have offered several explanations for these rapid price changes.<sup>4</sup> The “capacity constraint” theory (CCT), one of the leading theories in the economics literature, posits that “shocks,” including disasters and spikes in expected losses for particular types of liability, cause insurance prices to rise quickly, partly because shocks stress insurers’ surpluses and partly because insurers find it cheaper to replenish their surpluses by increasing prices than by seeking external capital.<sup>5</sup> The reserve<sup>6</sup> manipulation theory (RMT) attributes price fluctuations to changes in insurers’ behavior.<sup>7</sup> In soft markets, insurers compete for market share by cutting prices.<sup>8</sup> To allay concerns about solvency while writing business at lower prices, they shrink their reserves, i.e., their predictions of future losses. The downward pressure on reserves, however, cannot last indefinitely. As losses develop, surpluses reach dangerously low levels and insurers are forced to recognize the inadequacy of existing reserves. Insurers then correct for previous under-reserving by increasing reserves sharply. The adjustment causes profits to plummet, reveals solvency issues, and generates a strong need for fresh capital, which

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<sup>4</sup> See Baker [DePaul article] for summary of the various theories that attempt to explain premium fluctuations.

<sup>5</sup> Capacity constraint theory is developed in Anne Gron, *Capacity Constraints and Cycles in Property-Casualty Insurance Markets*, 25 *RAND J. Econ.* 111 (1994); Anne Gron, *Evidence of Capacity Constraints in Insurance Markets*, 37 *J. L. & Econ.* 349 (1994). “Capacity” refers to having adequate surplus to underwrite new policies. “Constraint” refers to the difficulties insurers have in building up surpluses quickly, namely the inability of capital markets to react quickly to sudden increases in insurer demand.

<sup>6</sup> Solvency regulations require insurers to establish liabilities on their books when they sell policies and when claims are made against policies. These liabilities are called “reserves.” Regulation also requires insurers to have cash on hand to cover liabilities on the books, even if payments will be made well into the future. The cash on hand is referred to as the insurer’s “surplus.”

<sup>7</sup> Tom Baker, *Medical Malpractice Myth*, Chapter 3 (explaining this alternative theory in detail). See also Sean M. Fitzpatrick, *Fear is the Key: A Behavioral Guide to Underwriting Cycles*, 10 *Conn. Ins. L. J.* 255 (2004) (insurance industry insider account); Matthew Dolan, *Repeating the Sins of Market Cycles*, 2 *Insights*, Oct. 2003 at 1, (insurance industry insider account).

<sup>8</sup> Cf. Harrington & Danzon, *supra* note – at 533 (positing price cutting behavior consistent with this account and providing empirical support but remaining agnostic on whether “the alternating of soft and hard markets is in fact a self-generating cycle”).

insurers acquire by steeply increasing prices.<sup>9</sup> In the ensuing hard market, insurers' surpluses stabilize and external capital markets expand. Eventually, another round of price-cutting occurs, causing another price war.

These competing theories of market fluctuations generate divergent predictions about insurers' loss reserving practices. CCT assumes that reserves are insurers' best estimates of expected losses. Reserves may be more or less accurate (depending on the ease of estimating payments), but they should be unbiased in the aggregate and their accuracy should not vary across hard and soft markets.<sup>10</sup> RMT predicts that reserve accuracy will vary.<sup>11</sup> In soft markets, carriers face pressures to shrink reserves and, so, will under-reserve.<sup>12</sup> The extent of under-reserving should also increase as the soft market matures. Immediately prior to the shift to a hard market, we would expect to observe the largest errors. Once the hard market shift occurs (i.e., prices begin to rise), reserves are adjusted sharply upward to reflect a much more pessimistic view of the future. Therefore, as prices increase, under-reserving should disappear and possibly be replaced by over-reserving. After external capital markets adjust, prices will decrease and price wars will lead to another round of under-reserving.

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<sup>9</sup> Proponents of the theory suggest that reserving attitudes change because power within the firm switches from managers to claims adjusters once the surplus reaches a dangerously low level. Reserve manipulation theory assumes capital markets are constrained in the same way capacity constraint theory suggests they are

<sup>10</sup> This is textbook wisdom as well. See, e.g., Joseph Calandro, Jr. & Thomas J. O'Brien, A User-Friendly Introduction to Property-Casualty Claim Reserves, Risk Management and Insurance Review, 2004, Vol. 7, No. 2, 178-179 (discouraging over-reserving and under-reserving and explaining expected value calculations); Robert J. Prahla and Stephen M. Utrata, Liability Claim Concepts and Practices 462-464 (Insurance Institute of America; 1<sup>st</sup> ed. 1985) (discussing importance of accurate case reserves and encouraging use of conservative values).

<sup>11</sup> Baker, Insurance Underwriting Cycle, *supra*, at 419.

<sup>12</sup> This should be true for both case reserves and reserves for unreported claims. The latter reserves are referred to as "incurred but not reported" (IBNR) reserves.

We use two databases of bodily injury (BI) claims to test the theories' predictions. The first dataset includes Texas claims covered by five lines of commercial liability insurance that closed with payments greater than \$10,000 from 1988 to 2005. The second includes Missouri medical malpractice claims that closed with or without payments from 1986-2006. Both datasets contain carriers' initial case reserves and final claim payments, and both separate indemnity reserves from reserves for loss adjustment expenses.<sup>13</sup> Both also cover a span of years in which market conditions changed substantially.

To our knowledge, the asserted connections between market conditions and reserving practices have not previously been studied at the level of the individual claim.<sup>14</sup> In fact, scholars have rarely examined reserves at the case level for any purpose, probably for want of suitable data.<sup>15</sup> The omission may be tolerable in coverage lines where formula reserves can be set statistically because claims occur in volume, tend to close quickly, and usually entail small payments. The need for case-level analysis is more pressing in coverage lines like medical professional liability, where claims are few, coverage tails are long, and payments are often large.<sup>16</sup> Given these features, aggregate

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<sup>13</sup> Loss adjustment expense reserves are used to estimate at the claim level the expenses associated with settling the claim, including employee salaries, legal fees, court costs, expert witnesses and investigation costs.

<sup>14</sup> Reserves have often been studied at the aggregate level. See, e.g., Patricia M. Danzon, Andrew J. Epstein and Scott J. Johnson, *The Crisis in Medical Malpractice Insurance*, 63-67, in *Brookings-Wharton Papers on Financial Services: 2004* (Robert E. Litan & Richard Herring eds., 2004); Martin F. Grace and J. Tyler Leverty, *Property-Liability Insurer Reserve Error-Motive, Manipulation, or Mistake* (May 31, 2007). Available at SSRN: <http://ssrn.com/abstract=964635>. [add cites]. See a review of the empirical literature in Part xx.

<sup>15</sup> Searches of JSTOR using variants of "case reserve" and "claim reserve" turned up no studies with case-level data. See also Frank A. Sloan et al. *Insuring Medical Malpractice* (1991) at 127 ("[T]here is now virtually no empirical evidence for medical malpractice insurance or other lines about how insurers actually establish loss reserves.

<sup>16</sup> Aiuppa and Trieschmann, *supra*, at 107-108 (claiming that predictions for medical malpractice coverage will differ given its unusually long tail).

level measurements are likely to generate substantial noise, making it difficult to identify time trends in errors.<sup>17</sup>

**[We will insert a paragraph here to summarize our findings. See the Hypothesis and Results section for preliminary analyses.]**

This Article proceeds as follows. Part 1 summarizes the competing theories of case reserving to be studied. Part 2 reviews the existing literature and identifies the important contributions of this study. Part 3 describes the datasets employed. Part 4 sets out empirically testable hypotheses drawn from the theories described in Part 1. Each hypothesis is followed by an empirical finding. Part 5 offers a brief discussion.

## **1. COMPETING THEORIES OF PREMIUM FLUCTUATIONS**

### **A. Capacity Constraint Theory**

CCT is an alternative theory to the perfect markets theory of insurance pricing. The perfect markets account posits that “[with] rational insurers and policyholders, competitive insurance markets, and frictionless capital markets, insurance premiums will equal the risk-adjusted discounted value of expected cash outflows for claims, sales expenses, and other costs.”<sup>18</sup> If these expectations are

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<sup>17</sup> While measuring errors at the claims level reduces noise, it has particular disadvantages not encountered when using aggregate data. See Part xx for an explanation of weaknesses of using claims level data to identify reserve errors over time.

<sup>18</sup> Scott E. Harrington, Tort Liability, Insurance Rates, and the Insurance Cycle, 98, in Brookings-Wharton Papers on Financial Services: 2004 (“The levels and changes in premium rates [] coincide with the levels and changes in discounted expected costs. Because the timing of payouts for claims incurred in a given year, nonclaim expenses, and capital costs should be comparatively stable over time, rate changes will primarily reflect changes in expected (forecast) claim and claim settlement costs and changes in interest rates.”); Scott Harrington and Robert E. Litan, Causes of the Liability Insurance Crisis, 239 Science (New Series) 737, 738 (Feb. 12, 1988) (arguing that “the most plausible explanation of the growth of liability insurance premiums during [1980-1986] [was] growth in the discounted value of expected losses.”).

“conditional on all information available at the time that premiums are established by the market[,]... the premium will be the best predictor of the discounted value of future cash flows from the policies; that is, the premium is a sufficient statistic for this value among all available information. The realized error in premiums as predictors is white noise—uncorrelated with any observables at the time that premiums are established. This is simply the efficient markets hypothesis applied to a particular securities market: the market for insurance.”<sup>19</sup>

Many believe the perfect markets theory does not account for observed premium fluctuations.<sup>20</sup> To account for these fluctuations, Ralph Winter and Ann Gron developed CCT.<sup>21</sup> The theory posits that the supply of insurance depends on the amount of insurer surplus, that negative shocks (e.g., catastrophes) tax surplus, and that capital markets are unable to replenish surplus in the short-run.<sup>22</sup> The reduction in surplus restricts carriers’ ability to write coverage, because net premium written cannot generally exceed a multiple of surplus. Therefore, in the aftermath of shocks, insurers must raise prices to

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<sup>19</sup> Ralph A. Winter, Comment on Scott E. Harrington, Tort Liability, Insurance Rates, and the Insurance Cycle, 128-129, in *Brookings-Wharton Papers on Financial Services: 2004* (**Complete cite**).

<sup>20</sup> Harrington, *Brookings Wharton 2004* at 107 (“some observers conclude that the large and abrupt increases in premiums in the mid-1980s and the larger growth in premiums compared to discounted losses, especially developed losses, cannot plausibly be explained by competitive product markets with frictionless capital.”). See also Winter, Comment on Harrington (2004) at 129.

<sup>21</sup> Look in Harrington fn 19 for cite to Winter (1988, 1991a, 1994); Gron (1994a). Others have modified the basic capacity constraint theory to achieve an even better fit with the data. (cites from Harrington p. 114).

<sup>22</sup> The theory assumes either that tapping into capital markets is a relatively high cost way to shore up the insurer’s surplus or that insurers do not have access to capital markets. See Alan J. Auerbach, *The Taxation of Capital Income*. Cambridge, MA: Harvard University Press, 1983 [**add pin cite and parenthetical**]; Stewart C. Myers, *The Capital Structure Puzzle*, *J. of Finance* 39(3):575-92 (1984) [**add pin cite and parenthetical**]; Frank A. Sloan et al. *Insurance Medical Malpractice*, New York: Oxford University Press at 46 (“The notion of capacity constraints is even more plausible in a market highly populated with nonstock and closely held stock companies that do not have access to public equity markets. Such insurers are wholly dependent on internally generated equity as a source of equity capital and...have no alternative to premium increases as a way of replacing depleted surplus.”)

acquire it.<sup>23</sup> The price increase might also be due in part to a reduction in supply caused by the dropping out of insurers that have particularly low surpluses and are unable to underwrite at the prevailing market price.<sup>24</sup> Most versions of CCT do not include an explanation of the shift from hard markets back to soft markets.<sup>25</sup>

Like the perfect markets theory, CCT predicts that case reserves will accurately estimate losses on claims given information available at the time reserves are set. If case reserves were systematically inaccurate, prices would be inefficient because expected future losses would be misstated. The perfect markets theory predicts efficient prices because reserving practices are assumed to give appropriate weight to all factors affecting potential losses on claims.

“There is no magic formula for setting individual case reserves,” which “are established essentially by the judgment and experience of the claim practitioner”<sup>26</sup> following “an investigation ... into the facts and particulars of the occurrence.”<sup>27</sup> The time at which initial reserves for BI claims are set varies “by company and by line of insurance.”<sup>28</sup> The amount of information available when initial reserves are set also varies, but tends to be skimpy. Carriers typically review and revise reserves many times before closing BI claims.

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<sup>23</sup> Shocks can tax insurer surplus directly if the insurer covers risk related to the shock. For example, earthquakes tax the surplus of insurers that cover earthquake related losses. Shocks can also tax insurer surplus indirectly, by driving up the price of reinsurance. If the price of reinsurance increases, insurers must either pay more to offload risks or reinsure less. Either way the cost of providing coverage increases, and the primary insurer must pass that cost on to its policyholders. See Froot and O’Connell (cited in Harrington, p. 117); Sloan (2008 book), at 47-48.

<sup>24</sup> cite

<sup>25</sup> See Harrington, 1994 Brookings paper at 114-15.

<sup>26</sup> Robert J. Prah and Stephen M. Utrata, *Liability Claim Concepts and Practices* 461 ((Insurance Institute of America; 1<sup>st</sup> ed. 1985).

<sup>27</sup> Calandro and O’Brien, *supra*, at 179.

<sup>28</sup> Prah and Utrata, *supra*, p. 462.

Rate and solvency regulation may limit the latitude insurers have when setting case reserves. In Texas and Missouri, regulators evaluate the accuracy of carriers' annual financial statements to determine whether these statements support the reasonableness and adequacy of the carriers' proposed rates.<sup>29</sup> This process includes an examination of carriers' case reserve setting methodology.<sup>30</sup> Despite this, there is general agreement that insurers possess considerable discretion when setting reserves for individual cases.<sup>31</sup>

Although practices for setting case reserves vary across claims personnel and companies, the canonical objective, assumed by the perfect markets theory, is to predict, as accurately as possible, the cost of resolving a pending claim.<sup>32</sup> This requires calculating the expected value of the payment. Ignoring loss adjustment expenses,<sup>33</sup> the expected payment is the sum of the probability-weighted loss scenario payments,

$$E(P) = \sum_{i=1}^n p_i S_i,$$

where  $E(P)$  is the expected payment,  $p_i$  is probability that a settlement will occur at the  $i$ th loss scenario amount, and  $S_i$  is the  $i$ th loss scenario payment.<sup>34</sup> If reserve errors are

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<sup>29</sup> Add cites to regulation

<sup>30</sup> Personal communication with Kenneth McDaniel (TDI), email dated January 29, 2008.

<sup>31</sup> Personal communication with Brent Kabler, DIPF, on March 10, 2008.

<sup>32</sup> Joseph Calandro, Jr. & Thomas J. O'Brien, A User-Friendly Introduction to Property-Casualty Claim Reserves, 7 Risk Management and Insurance Review 177, 178 (2004). Insurers also estimate the losses they will incur as a result of unreported claims covered by policies still in force, so-called "incurred but not reported" (IBNR) claims. "At any given time, the total [of] IBNR and case reserves assigned to a given set of insurance policies is supposed to constitute the best judgment of all the future loss expenses to be paid under those policies." Baker, Insurance Underwriting Cycle, *supra*, at 397. Baker ignores so-called "pipeline reserves" for claims that have been settled but not yet paid. Thomas A. Aiuppa and James S. Trieschmann, An Empirical Analysis of the Magnitude and Accuracy of Incurred-But-Not-Reported Reserves, 54 Journal of Risk and Insurance 100, 101 (1987).

<sup>33</sup> We ignore loss adjustment expenses in the remainder of this paper. Carriers report reserves for these expenses separately in the Texas Closed Claim Database.

<sup>34</sup> *Id.* The expected value calculation takes account of the fact that the insurer is uncertain about the closing year.

independent of other errors and drawn from a distribution with a mean of zero, and adjustments are made to case reserves as new information is learned, generally carriers will have sufficient funds available to cover actual payments on known claims assuming they maintain surpluses large enough to cover the sum of their case reserves.

“Because loss payments may occur years into the future, adjusting estimated reserves for the time value of money would seem to be important.”<sup>35</sup> Even so, statutory accounting principles (SAP) require carriers to refrain from discounting for the time value of money.<sup>36</sup> If carriers adhere to SAP, aggregate initial case reserves should match aggregate payments; that is, the average initial case reserve error should approach zero, when both are measured in nominal dollars.<sup>37</sup>

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<sup>35</sup> Calandro and O’Brien, *supra*, at 186.

<sup>36</sup> Karen K. Nelson, *Rate Regulation, Competition, and Loss Reserve Discounting by Property-Casualty Insurers*, 75 *The Accounting Review* 115, 117 (January 2000) (“According to the National Association of Insurance Commissioners’ [ ] Accounting Practices and Procedures Manual, ‘statutory accounting practice require that for every dollar of unpaid losses the company reserve a whole dollar for the future payment of those losses.’ More explicitly, ‘[p]resent value discounting of property and casualty loss reserves is not a generally accepted statutory accounting practice.”). In communications with personnel at the Texas Department of Insurance (TDI) and the Missouri Department of Insurance, Financial Institutions and Professional Registration (DIFP), we verified that property and casualty insurers are not supposed to discount case reserves.

<sup>37</sup> Whether carriers discount expected payments to present when setting reserves is a matter of controversy. See, e.g., Karen K. Nelson, *Rate Regulation, Competition, and Loss Reserve Discounting by Property-Casualty Insurers*, 75 *The Accounting Review* 115 (January 2000) (finding that insurers discount aggregate reserves to present value); Calandro and O’Brien, *supra*, at 179 (observing that “industry practice is often to reserve using the full claim value,” but encouraging the practice of discounting); Frank A. Sloan et al. *Insuring Medical Malpractice* (1991), at 126-27, 133. The preference for “full claim value” may reflect state insurance regulations, which aim to prevent insolvencies, or a principle of conservatism that actuaries and others often recommend to insurers.

## B. Reserve Manipulation Theory

RMT differs from CCT in two fundamental ways.<sup>38</sup> First, RMT does not require an external shock to shift a soft market into a hard market. Second, unlike some versions of CCT, RMT also offers an account of the shift from hard markets to soft markets.

Rather than rely on an external shock to trigger a shift from a soft to a hard market, RMT posits that the sharp increase in reserves that signals the start of a hard market reflects the industry's already-deteriorated financial condition, the deterioration having occurred during the soft market price war. As in other industries, insurers are able to gain market share by lowering prices. In other markets, price bottoms out when it is exactly equal to the cost of production. In insurance markets, however, the cost of production is unknown until well after insurers collect premiums. The price constraint is related to surplus adequacy instead. By maintaining an optimistic view of future expenses, insurers can lower reserves, which will decrease the need for surplus and allow price cuts.<sup>39</sup> When the market is at its most competitive, insurers have a strong incentive to maintain a highly optimistic view, albeit within the limits set by regulation. Otherwise, they will not be able to match competitor prices.

The shift from a soft to a hard market occurs when insurers collectively begin to realize they have gone too far. This realization occurs when payments made to close claims consistently exceed reserves related to the claims. As cash flows out the door to

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<sup>38</sup> Baker, *supra* note xx. Others have posited theories involving reserve manipulation. See Bradford and Logue (manipulation to maximize tax advantage created by the 1986 tax act, which corresponded with the hard markets of the mid-80s); [add others]

<sup>39</sup> Total reserves include case reserves, IBNR reserves and bulk reserves, a catchall account that allows for adjustments to aggregate case- and policy-level reserves. Case reserves make up a substantial portion of total reserves. Studying policies covering accident years 1975-1979 after 5 years of development, Auiuppa and Trieschmann found that, for all lines of liability coverage except medical malpractice, the ratio of INBR to Reserves for Reported Claims was below one, meaning that aggregate case reserves were larger than aggregate IBNR reserves. [look for something more current]

close inadequately reserved claims, surpluses shrink and claims personnel convince managers to increase reserves markedly.<sup>40</sup> The reserves adjustment causes a need for cash to cover expected losses and satisfy solvency regulations, forcing managers to raise premiums.<sup>41</sup> Increased premiums, and a possible decrease in the number of insurers able to write insurance at prevailing prices,<sup>42</sup> cause a shift to a hard market. Having thus begun, the hard market continues until surpluses recover and capacity to underwrite additional policies at lower prices expands,<sup>43</sup> at which point another round of price cutting (and reserve shrinking) begins.

Obviously, RMT is not committed to canonical case reserving. It predicts systematic differences between case reserves and payments, with the size (and possibly sign) of the reserve error depending on market conditions. Under-reserving will characterize most of a soft market period, and may grow in severity as the soft market ages and markets become hypercompetitive. The theory predicts that prices will be lowest immediately prior to a realization by insurers that they are substantially under-reserved and that their surpluses are dangerously low. This realization causes a shift in reserving practices, as insurers begin to reserve for new claims at expected cost (and possibly in excess of expected cost) shortly before a hard market begins. The need to

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<sup>40</sup> Baker Med Mal Myth p. 56. Claims personnel possibly are motivated by regulation requiring reserves to accurately predict future payments or by concern for the company's solvency.

<sup>41</sup> Like capacity constraints theory, reserve manipulation theory assumes external capital is relatively costly in the short-run; therefore, insurers are forced to increase prices to build up their surpluses.

<sup>42</sup> Some insurers might find it impossible to stay in the market once it begins a shift to a hard market. While prices increase, they will increase only as much as necessary to allow the insurers that under-reserved the least to stabilize their reserves and surpluses. Above-average under-reserving insurers might be unable to continue to underwrite at prevailing (albeit higher) prices because they require even higher prices to cover both reserves required for the new policies and adjustments to reserves for policies previously sold.

<sup>43</sup> As premiums increase, the premiums collected for a policy are sufficient to cover both the IBNR reserve for the policy sold and a portion of the reserves added to the books at the beginning of the hard market.

increase reserves causes a need to increase prices. As the price of insurance nears its apex, under-reserving will again set in, signaling the start of a new soft market.

## 2. PRIOR LITERATURE

**[note to reader: this section is currently under construction and needs to be reorganized, but it will give you a some sense of how reserves have been empirically studied in the past.]**

The prior empirical research on insurance reserving has investigated whether aggregate reserves are unbiased estimates of future losses. Prior research has consistently found that insurer reserves are serially correlated, which “implies that information has not been fully reflected in the [reserve] development adjustment since a simple conditioning on the past sequence can be used to predict the future number.”<sup>44</sup>

In seeking to identify the potential goals of reserve manipulation, the prior research has tested for a variety of associations. Petroni examined how the financial strength of insurance companies affected reserving practices and found that weaker insurers are more likely to under-reserve than stronger insurers, suggesting that one goal of reserve manipulation is to avoid solvency scrutiny by state insurance regulators.<sup>45</sup>

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<sup>44</sup> Beaver & McNichols, *supra* note – at 79. See also Stephen R. Diacon, Paul T. Fenn & Chris O’Brian, *How Accurate are the Disclosed Provisions of UK General Insurers?* University of Nottingham working paper, Nov. 2003 (reporting serial correlation among reserving errors among UK general insurers).

<sup>45</sup> See Petroni 1992. In later work Petroni and co-authors considered whether the market adjusts for this possibility and found that insurance companies with greater variation in their loss development trade at a lower earnings multiple than insurance companies with less variation and have lower “market to book” ratios. See Anthony and Petroni (1997) and Petroni, Ryan and Wahlen (1998). Beasley and Petroni also found that financially troubled insurance companies audited by Big Eight audit firms release more financially conservative reserve estimates than similarly troubled companies audited by other firms. See Kathy Petroni and Mark Beasley, *Errors in Accounting Estimates and Their Relation to Audit Firm Type*, 34 *J. Accounting Research* 151-71 (1996). Gaver and Paterson extended this result by considering audit-actuary pairs and found that “under-reserving by weak insurers is essentially eliminated when the firm uses auditors and actuaries that are both from Big Six accounting firms.” Jennifer J. Gaver and Jeffrey S.

Gaver and Paterson extended this finding using more recent reserving data and testing the association of reserving practices with solvency ratios used by insurance regulators.<sup>46</sup> Petroni and Shackelford examined how state taxation regimes affected reserving practices and found that state taxation rates are inversely correlated with the ratio of premiums to losses, particularly in multi-line insurance companies, suggesting that insurers manipulate reserves to reduce their total state taxes.<sup>47</sup> Nelson explored how the length of the tail affected reserving practices and found that insurance companies discount their reserves to reflect the time value of money, notwithstanding the statutory accounting requirement that insurers report reserves at their nominal value, and that this effect was strongest in states with relatively stringent rate regulation.<sup>48</sup>

Beaver et al examined the distribution of reported earnings by property casualty insurers and made a series of findings that are consistent with the reserve manipulation hypothesis. First they found that “P&C insurers report small positive earnings with greater frequency than expected given the relative smoothness of the remainder of the earnings distribution,” suggesting that reserves are manipulated “to avoid losses.”<sup>49</sup>

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Paterson, The Association between External Monitoring and Earnings Management in the Property-Casualty Insurance Industry, 39 *J. Accounting Research* 269-82 (2001). In a final related study, Browne, Ma, and Wang find that insurers that compensate their executives with stock options report more accurate reserve estimates, supporting the claim that the financial markets are aware of, and adjust for, reserve manipulations in their assessment of insurance firm financial statements. See Mark J. Browne, Yu-Luen Ma & Ping Wang, Stock Option Compensation and Managerial Discretion in the Insurance Industry: Are Reserves Manipulated to Enhance Profitability? (December 3, 2004). Available at SSRN: <http://ssrn.com/abstract=629383>.

<sup>46</sup> See Jennifer J. Gaver and Jeffrey S. Paterson, Do Insurers Manipulate Loss Reserves to Mask Solvency Problems?, 37 *J. Accounting Res.* 393-416 (2003).

<sup>47</sup> See Kathy R. Petroni and Douglas A. Shackelford, Managing Annual Accounting Reports to Avoid State Taxes: An Analysis of Property-Casualty Insurers, 74 *Accounting Rev.* 371-93 (1999).

<sup>48</sup> See Karen K. Nelson, Rate Regulation, Competition, and Loss Reserve Discounting by Property-Casualty Insurers, 75 *Accounting Rev.* 115-138 (2000).

<sup>49</sup> William H. Beaver, Maureen F. McNichols & Karen K. Nelson, Management of the Loss Reserve Accrual and the Distribution of Earnings in the Property-Casualty Insurance Industry, 35 *J. Accounting & Econ.* 347-376 at 348 (2003).

Second, they found that ownership form also affects reserving practices: among public and mutual firms, “small profit firms significantly understate loss reserves relative to small loss firms,” while “there is no evidence that private insurers manage reserves to avoid reporting losses.”<sup>50</sup> Third they extended Petroni’s earlier finding that the most profitable firms consistently overstate their reserves by documenting that healthy firms also understate reserves in low profit periods and that “management of reserves to avoid losses is more pronounced in the sample of healthy insurers.”<sup>51</sup> Thus, healthy firms manage their losses across the entire spectrum of the profit distribution: understating reserves in low profit periods and overstating reserves in high profit periods.

In a recently released manuscript, Grace and Leverty survey much of this literature and test insurance reserving errors for a variety of associations.<sup>52</sup> They find that tax, rate regulation and moral hazard incentives do help to explain the pattern of reserve errors. Their tax association is the same as reported earlier. Their rate regulation association is the reverse of that previously reported, however. They find that companies in strictly regulated jurisdictions are more likely to over-reserve, which is consistent with the theory that firms in strictly regulated jurisdictions over-state losses to obtain rate increases. The moral hazard association they report is consistent with the price-cutting theory developed by Harrington and Danzon. When Grace and Leverty strip out the time dimension in reserving errors (by using the sum of the errors over the total period as the independent variable), however, none of the previously reported dependent variables are

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<sup>50</sup> Id. at 348-49.

<sup>51</sup> Id. at 349.[**Consider reproducing their figure 4 on page 362, which shows how managing reserves pushes earnings from both directions closer to a slightly positive modal value**]

<sup>52</sup> See Martin S. Grace & J. Tyler Leverty, Property-Casualty Insurer Reserve Error – Motive, Manipulation, or Mistake (May 31, 2007) available on SSRN: <http://ssrn.com/abstract=964635>

significant, suggesting that, in the long run, reserve errors are unbiased. They produce their findings, however, by observing only annual aggregate reserves and losses, which introduces noise into the measurements. because they are not able to determine exactly when claims opened and closed.

In fact, *most* studies of reserve errors compare the aggregate reserves and claim payments for a given set of policies at a given point in time with a revised aggregate reserve and claim payment set for the same set of policies some number of years later.<sup>53</sup> The MMCD and the TCCD make it possible to compare the initial reserve with the amount actually paid in a particular case the year it was paid. The ability to measure errors at the claims-level eliminates the noise introduced by estimating closing dates. It also enables claim-level studies of aspects of reserve accuracy that have been ignored, such as variations in errors associated with claim size, frequency, or duration, policy limits, or line of insurance.

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<sup>53</sup> See K.R. Petroni, Optimistic Reporting in the Property-Casualty Industry, 15 J. Accounting & Econ. 485 (1992) [Paul M. Kazenski, William R. Feldhaus, and Howard C. Schneider, Empirical Evidence for Alternative Loss Development Horizons and the Measurement of Reserve Error, 59 Journal of Risk and Insurance 668 (1992). [Kazenski et al. found “evidence of significant reserve misestimation during the period from 1977 through 1987,” which immediately precedes the time series studied here.]; W.H. Beaver & M.F. McNichols, The Characteristics and Valuation of Loss Reserves of Property-Casualty Insurers, 3 Rev. of Accounting Studies 73 (1998); W.H. Beaver, M.F. McNichols, & K.K. Nelson, Management of the Loss Reserve Accrual and the Distribution of Earnings in the Property-Casualty Insurance Industry, 35 J. Accounting & Econ. 347 (2003); J.J. Gaver and J.S. Patterson, Earnings Management Under Changing Regulatory Regimes: State Accreditation in the Insurance Industry, 19 J. Accounting & Public Policy 399 (2000); J.J. Gaver & J.S. Patterson, Do Insurers Manipulate Loss Reserves to Mask Solvency Problems?, 37 J. Accounting & Econ. 393 (2004). Other studies compare the aggregate reserve and claim payment amount for a given set of policies at a given set of time with the total claim payments reported under those policies five or more years later. See M.A. Weiss, A Multivariate Analysis of Loss Reserving Estimates in Property-Liability Insurers, 52 J. Risk & Ins. 199 (1985); E. Grace, Property-Liability Reserve Errors: A Theoretical and Empirical Analysis, 57 J. Risk & Ins. 28 (1990); K.R. Petroni & M. Beasley, Errors in Accounting Estimates and Their Relation to Audit Firm Type, 34 J. Accounting Research 151 (1996); M.J. Browne, Y.L. Ma, & P. Wang, Stock Option Compensation and Managerial Discretion in the Insurance Industry: Are Reserves Manipulated to Enhance Profitability? University of Wisconsin Working Paper (2004); S.R. Diacon, P.T. Fenn, & C. O’Brien, How Accurate are the Disclosed Provisions of UK General Insurers?, Nottingham University Business School Working Paper 2004.

For present purposes, the important point is that “[i]f loss reserves were determined solely on the basis of pure insurance-accounting theory, they would reflect only [] factors that affect the size, frequency, and pattern of future claim payments ....”<sup>54</sup> Unrelated factors, such as whether the market for liability insurance is soft or hard, would not influence the size of case reserves systematically. By using “full claim values” instead of discounted values, claims personnel ignore factors they could properly consider, but they are unable to eliminate factors they ought to ignore under the canonical approach to reserve setting. Case level analyses can also help to better identify possible sources of inaccuracy in aggregate reserves.<sup>55</sup>

### **3. DATA DESCRIPTION**

#### **A. Missouri**

Carriers operating in Missouri must report open and closed claims to the Department of Insurance, Financial Institutions and Professional Registration (DIFP) for inclusion in the Missouri Malpractice Claim Dataset (MMCD). Missouri regulations state plainly that a claim opens when a written demand for payment, a lien letter, or a lawsuit is received.<sup>56</sup> Consequently, unlike states that allow carriers to define claims themselves,

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<sup>54</sup> Branford and Logue, p. 2. See also Pahl and Utrata, supra, p. 461 (identifying the following as “factors which need to be considered in setting case reserves”: [insert list]).

<sup>55</sup> E.g., Studying liability insurers that are stock companies and aggregating across companies, Kazenski et al. found statistically significant over-reserving in calendar-accident years 1978, 1979, and 1987, and statistically significant under-reserving in calendar-accident years 1983 and 1984.

<sup>56</sup> Filing requirements and instructions can be found at <http://www.insurance.mo.gov/industry/filings/stats/medmalinstr.htm>. The Missouri reporting form can be found at <http://www.insurance.mo.gov/industry/forms/375-0304.pdf>. If a claim is initiated other than by a lawsuit, a carrier must complete Items 1 through 16 of the reporting form. Otherwise, Items 1 through 17 and 20b through 20f must be completed.

Missouri should receive few incident reports, such as reports of requests for records that never lead to demands.

Missouri started collecting reports in 1986. All licensed insurers, surplus/excess lines companies, risk retention groups, and self-insured entities are required to report. Despite this, surplus lines companies and self-insured entities significantly underreported claims until 2005. Although surplus lines carriers accounted for 3.7% of total earned premium in 1991 and more than 17.3% in 2005,<sup>57</sup> they reported no malpractice claims from 1986 to 1996. They began filing reports in 1997, when the DIFP beefed up enforcement of the law, but the reporting rate “is still well below the market share of surplus lines companies.”<sup>58</sup> In 2006, DIFP estimated that “between 15 and 20 percent of Missouri malpractice claims go unreported.”<sup>59</sup>

The MMCD is sizeable, even so. As of the end of 2006, it contained almost 34,000 reports of closed claims, 81% of which were filed by licensed insurers. Self-insured entities filed about 16.5% of these.<sup>60</sup>

Open claim reports contain basic information, such as injury date, nature of malpractice alleged, and injury severity. Closed claim reports contain the same basic information plus information about payments, medical expenses, and lost wages. Unfortunately, the MMCD contains no information on jury verdicts or policy limits.

The number of claims in the MMCD reflects the number of defendants named in lawsuits. Because a single incident can involve several defendants, there are more reports

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<sup>57</sup> Memorandum from Brent Kabler, Missouri Department of Insurance, Nov. 14, 2005.

<sup>58</sup> *Id.*

<sup>59</sup> MDIFP, 2006 Missouri Medical Malpractice Insurance Report, Executive Summary (2007).

<sup>60</sup> Memorandum from Brent Kabler, Missouri Department of Insurance, Nov. 14, 2005.

than incidents. Unfortunately, until 2005, the dataset did not contain a unique incident identifier, making it impossible to match reports that are related.

The reporting form requires carriers to indicate the indemnity paid on behalf of the insured relating to three categories of damages (economic, non-economic and punitive), plus any other indemnity paid. We obtained the total paid for a given defendant by summing these entries. Although not defined, “other indemnity” was positive in xx% of the reports.

Although a significant tort reform package took effect in Missouri in August 2005, the legal environment was fairly constant from 1986 until then. Throughout the interim period, non-economic damages were limited to \$350,000, with annual adjustments for inflation. Thereafter, non-economic damages were limited to \$350,000, regardless of the number of defendants and without adjustments for inflation. Economic and punitive damages were unlimited. The 2005 statute limited punitive damages to the greater of \$500,000 or 5 times the net judgment. A provision allowing courts to deduct collateral source payments from plaintiff’s damages was in effect from July 1987 to August 2005.<sup>61</sup>

## **B. Texas**

We have described the strengths and weaknesses of the Texas Closed Claim Database (TCCD) in prior publications.<sup>62</sup> It covers 1988-2005 and contains almost 200,000 individual reports of closed BI claims covered by five lines of commercial insurance, including medical professional liability. Unlike the MMCD, it contains neither

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<sup>61</sup> For a complete description of tort regimes in Missouri and Texas, see Avraham [**complete cite to tort reform database**].

<sup>62</sup> Cite the JLS, JELS

open claims nor individual reports of closed claims resolved with payments below \$10,000 (nominal). It also contains no measure of injury severity, although it does identify injury cause and type. Importantly, the TCCD contains information about insureds' primary policy limits, a factor that is likely to influence case reserves and is known to influence payments.<sup>63</sup>

Because the TCCD contains only paid claims, when using it one cannot generalize to open claims or to all closed claims. This limitation should not affect the analyses we propose, however. If reserving practices vary across soft and hard markets, changes in the accuracy of reserves for paid claims should reflect this, especially given the enormous number of paid claims in the dataset.

### **C. Initial and Final Case Reserves**

The MMCD contains reports of carriers' initial reserves for indemnity and loss adjustment expenses. Because these reports are filed in the quarter when claims open, they necessarily contain information on reserves set early in the life of a claim. Unfortunately, the reports filed when claims close provide no information about subsequent reserves. It is therefore impossible to study the evolution of case reserves using the MMCD.

The TCCD contains both initial reserves and final reserves, also broken out by indemnity and expenses. However, because reports contained in the TCCD are filed after claims close, one cannot know how early in the life of claims initial reserves are set. TDI does not tell carriers when to establish initial reserves, and industry participants advise us that practices vary, both across insurers and across claims adjusters for a single insurer. The final reserves in the TCCD are also suspect. Many insurers appear to set their final

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<sup>63</sup> See Zeiler et al. JLS (2008).

reserves equal to their payments and loss adjustment expenses. A prior study by one of us found final reserves unreliable and ignored them.<sup>64</sup>

Neither the MMCD nor the TCCD contains a data field tying a particular claim to an identified insurance company. Consequently, we cannot study differences in reserving practices across companies.

#### **4. HYPOTHESES AND RESULTS**

To test the competing theories of the relationship between trends in market conditions, including the price of insurance, and reserving practices, we construct a number of testable hypotheses. These hypotheses predict behaviors we should expect to find when studying reserving practices at the claims level. Following each hypothesis we report our results.

##### **HYPOTHESIS 1: Relationship between initial case reserves and actual payments**

Canonical reserve setting assumes that claims personnel use all available, relevant information when setting initial case reserves and give appropriate weight to all possible outcomes. If claims personnel employ this approach, initial reserves should be unbiased estimates of payments. In individual cases, payments may differ from initial reserves for many reasons, and likely will, but in the aggregate the mean expected reserve error should be zero.

Aggregate reserve errors can be measured two ways, both of which employ the difference between the actual payment and the initial claim reserve ( $P-E(P)$ ). *Initial Reserve Error* (IRE) aggregates  $P-E(P)$  by opening year (i.e., the year the reserve is

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<sup>64</sup> Bernard Black, David A. Hyman, Charles Silver, and William M. Sage, Defense Costs and Insurer Reserves in Medical Malpractice and Other Personal Injury Cases: Evidence from Texas, 1988-2004 Amer. L. & Econ. Rev. (forthcoming 2008).

established). IRE thus measures reserve errors associated with claims that open contemporaneously but may close in different years. IRE helps compare reserving *attitudes* in year  $t$  with reserving *attitudes* in other years. *Realized Reserve Error* (RRE) aggregates  $P-E(P)$  by closing year. RRE thus measures reserve errors associated with claims that close contemporaneously, even if they open in different years. RRE may be thought of as a proxy for learning. When claims close, insurers discover whether their initial reserves were too low, on target, or too high. RRE describes the information about the adequacy of initial case reserves that becomes available to the industry in the closing year and facilitates comparisons of this information over time.

In the absence of shocks affecting primary carriers' claim related expenses, CCT, which requires canonical reserving practices, implies that both IRE and RRE should have means of zero in all years.<sup>65</sup> It also implies for RRE that significant observed deviations from zero should be corrected in later years. In other words, if claims personnel learn that initial reserves set in years before  $t$  were significantly inaccurate despite the absence of shocks, they should adjust initial reserves in years after  $t$  to correct for this.

Shocks that increase primary carriers' claim-related costs should cause both IRE and RRE to deviate from zero. In particular, for claims that open pre-shock and close post-shock, payments should be unexpectedly large, causing carriers to be under-reserved. For these claims, both IRE and RRE should be positive.

RMT makes different predictions about IRE and RRE. It asserts that claims personnel under-reserve during periods of stable or falling insurance prices, implying positive IREs for claims that open at these times. As soft markets mature, the extent of

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<sup>65</sup> Some evidence suggests that insurers discount initial reserves for the time value of money even though regulation prohibits it. [add cites] Observed positive errors might reflect this practice.

under-reserving is revealed and shown to be unsustainably large, implying that RREs become increasingly positive over the period. Specifically, RRE should be positive for claims that open and close during periods of stable or falling prices, and the extent of realized under-reserving on these claims should increase over time. Knowledge of serious under-reserving should then trigger a reaction. Shortly before a hard market sets in and prices begin to rise, reserving practices should become more conservative, as claims personnel acquire power and press for solvency. IRE should move toward zero and into negative territory, as carriers strengthen their reserves to offset past liberality. As the hard market matures, the extent of over-reserving should become clear, as measured by RRE for claims which opened and closed during the period of rising prices.

When studying reserve errors for evidence bearing on RMT, shocks affecting primary carriers' claim-related losses would also complicate the results. Again, IREs and RREs associated with claims that open pre-shock and close post-shock will be affected, with the direction depending on whether the shock causes losses to rise or fall. For claims that open and close between shocks, the predictions of RMT should hold.

Shocks affecting primary carriers' loss exposures can make attitudes toward reserving appear to have changed when, in fact, they did not. When testing the predictions of CCT and RMT, we therefore examine IRE and RRE two ways. In one set of tests, we use all closed claims. Figure 1a displays the trend in IRE, RRE and average premiums for OB-GYNs for one of Texas' largest medical malpractice insurers (TMLT) for medical malpractice closed claims only (with payments greater than \$25,000). **[results on the largest set of bodily injury claims (including claims closed between \$10,000 and \$25,000) are currently under construction]** Figure 1b displays the same

using Missouri's closed claim data (premium data is average of OB-GYN premium across county and across insurer).

Figure 1a

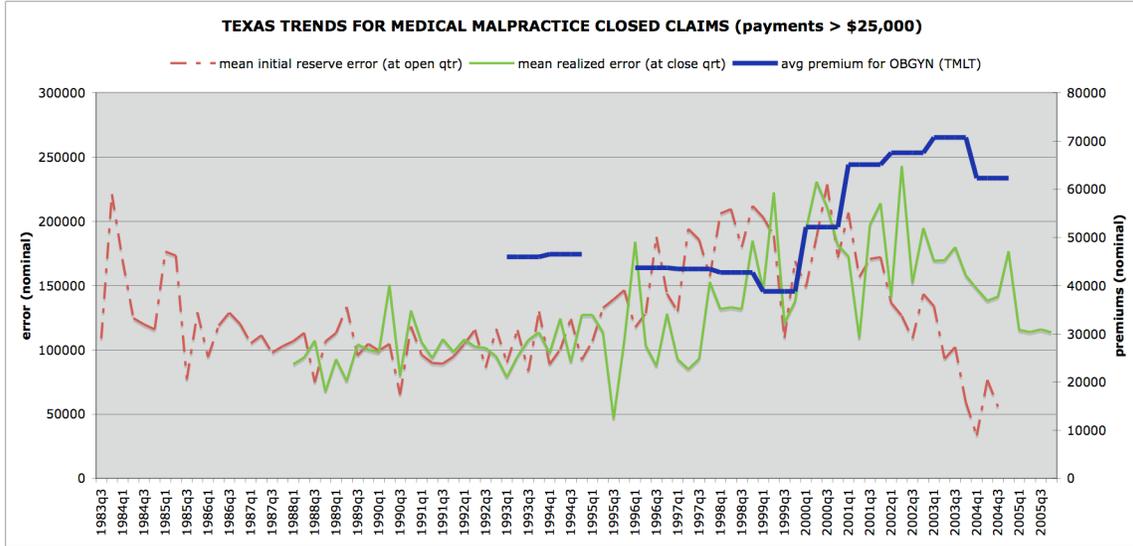
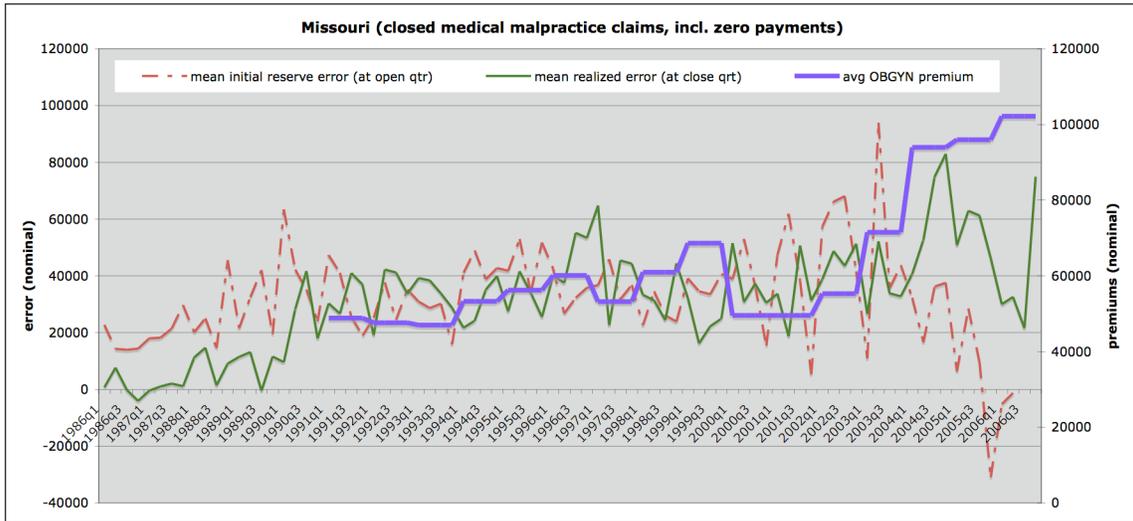


Figure 1b



Figures 2a and 2b include only claims that open and close within approximately two years. The longer a claim's life span, the more likely it is to be impacted by an

intervening shock. Therefore, we can reduce the impact of shocks by observing reserve errors associated with claims that close quickly.

Figure 2a

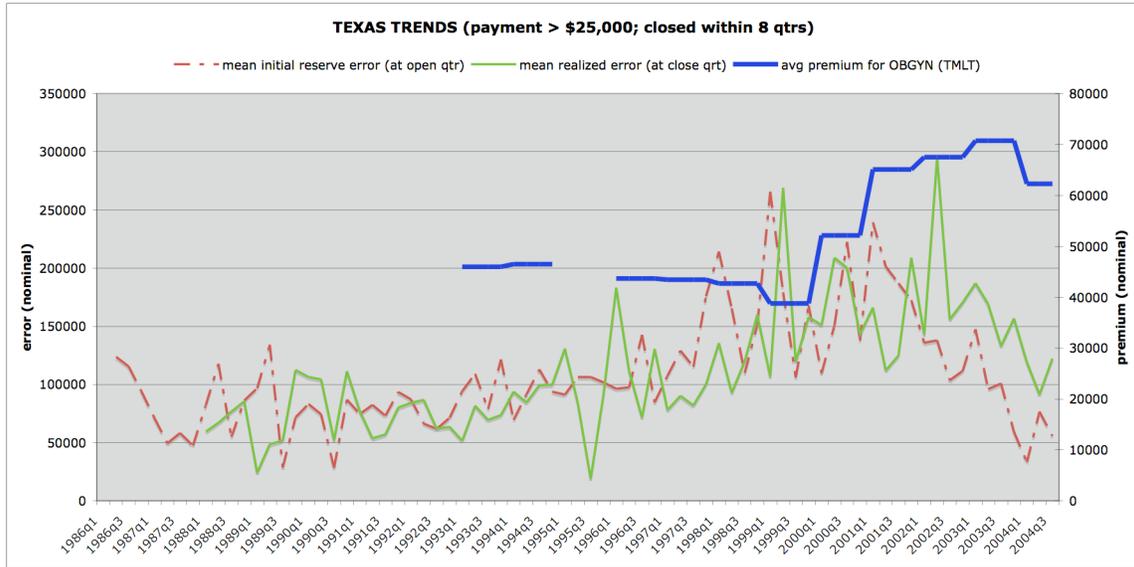
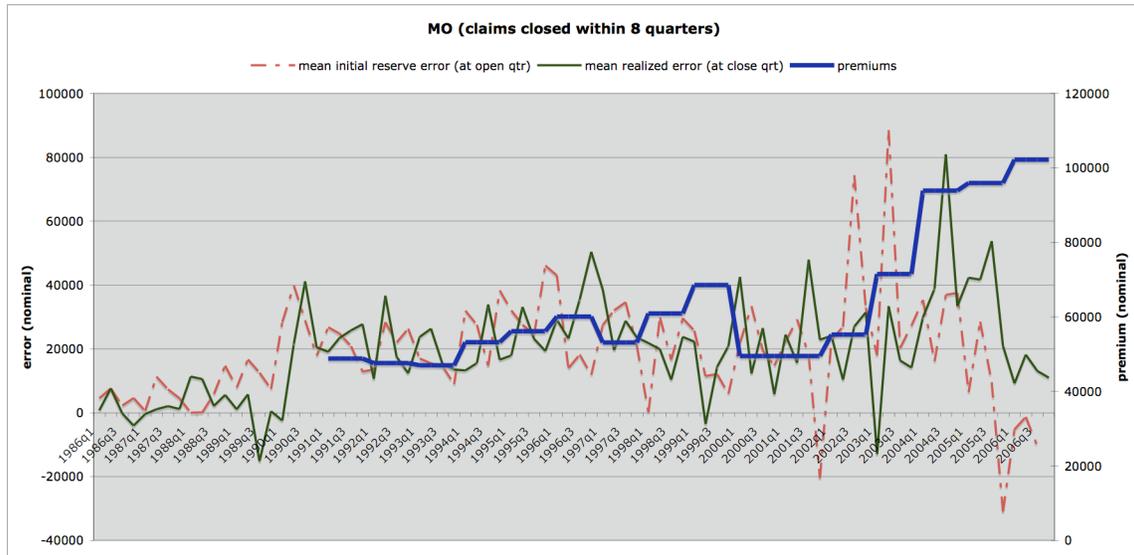


Figure 2b



It may be a mistake to look for changes in reserving practices in all bodily injury claims. Many claims may give adjusters little freedom to manipulate reserves. This may be because the injuries are small, because the payment will clearly exceed the policy limit no matter how the case turns out, or for other reasons. Non-manipulable claims may therefore hide significant reserve manipulation in other claims. We therefore identify a subset of claims in which adjusters might reasonably be thought to possess the most freedom. These claims involve more severe injuries (e.g., death) and high policy limits (\$500,000 or greater, say). Because these claims account for a disproportionately large amount of the money paid to claimants, we might expect reserve manipulation on them. Figure 3a displays trends in Texas for claims against policies with relatively large limits (at least \$500,000) that involved death.

Figure 3a

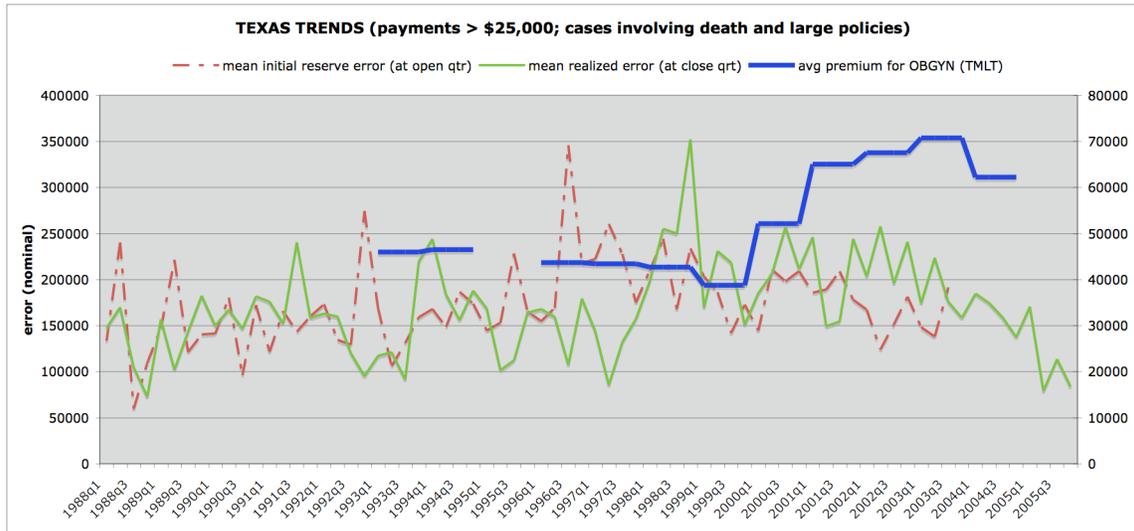
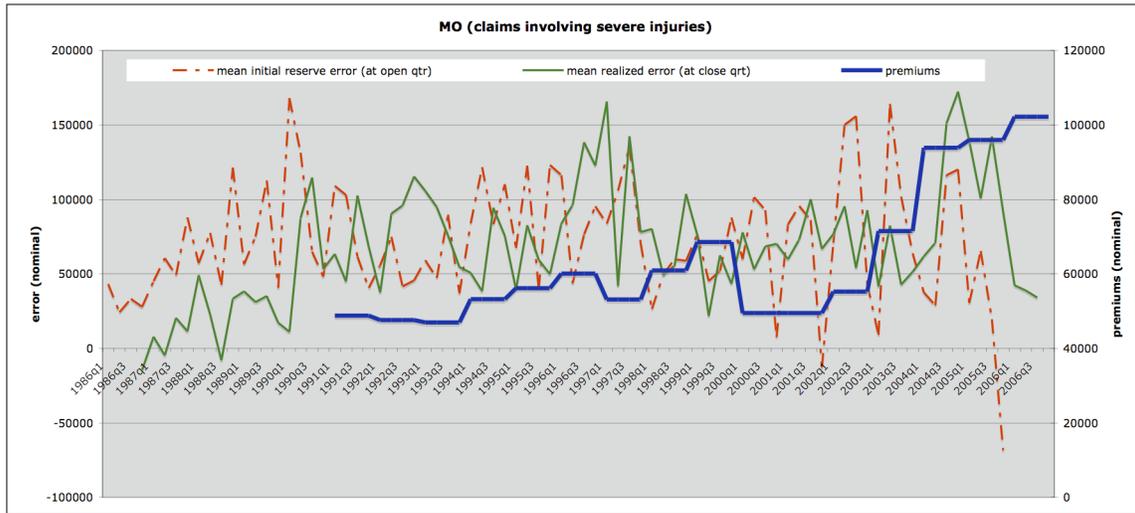


Figure 3b displays trends in Missouri for claims that involved major or grave permanent injuries or death.

Figure 3b



[The figures in this section represent our first stab at determining whether the data better support CCT or RMT. While these figures are suggestive, we are now working on more sophisticated analyses to better identify the relationship between premium trends and reserving practices.]

## 5. DISCUSSION AND CONCLUSION

[to come]