CAS RESEARCH PAPER

SOCIAL INFLATION AND LOSS DEVELOPMENT

By Jim Lynch, FCAS, MAAA, and Dave Moore, FCAS, CERA

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Abstract

The phenomenon of social inflation has garnered a great deal of attention in the property and casualty (P&C) insurance industry. The term defies strict definition, though it is widely acknowledged to involve excessive growth in insurance settlements. We examine evidence for its existence in standard industrywide claims triangles through 2019. The focus is on commercial automobile liability insurance, though other annual statement lines of business are examined as well. We find development patterns in commercial auto liability are consistent with most descriptions of social inflation. We estimate that social inflation increased commercial auto liability claims by more than $20 billion between 2010 and 2019. Evidence of a similar trend is also present in two other lines of business: other liability—occurrence and medical malpractice—claims made. We also use standard actuarial metrics and visualizations to demonstrate how actuarial insights can be presented to an interested lay audience, such as lawmakers, regulators, the news media, and the public.

Introduction

The term *social inflation* isn't new—Warren Buffett used it in the 1970s to describe "a broadening definition by society and juries of what is covered by insurance policies."[1] The term has become increasingly common as insurance companies try to describe the contemporary societal forces that they believe are accelerating loss costs. Actuaries in some quarters, particularly outside the United States, have referred to similar phenomena as *superimposed inflation*.

"The concept of social inflation is hard to define," writes Christopher Mackeprang, "which makes it hard to find empirical evidence that supports or disproves it."[2]

Here are several definitions:

Social inflation . . .

- refers to the trend of rising insurance costs due to increased litigation, plaintiff-friendly judgments, and higher jury awards.[3]

[1] Warren Buffett, "Chairman's Letter—1977," March 14, 1978, accessed June 15, 2021, https://www.berkshirehathaway.com/letters/1977.html.

[2] Christopher Mackeprang, "Quantifying Social Inflation—Jury Awards, Income Inequality, and the Bronx Jury Hypothesis," Gen Re Perspective, September 24, 2020, http://www.genre.com/knowledge/blog/quantifying-social-inflation-jury-awards-income-inequality-and-the-bronx-jury-hypothesis-en.html.

[3] Alexander Djazayeri, "Social Inflation: An Emerging Risk for Corporations," HDI Global, 2020, https://www.hdi.global/infocenter/insights/2020/social-inflation/.

- refers to all ways in which insurers' claims costs rise over and above general economic inflation, including shifts in societal preferences over who is best placed to absorb risk. More narrowly defined, social inflation refers to legislative and litigation developments that impact insurers' legal liabilities and claims costs.[4]
- describes the convergence of societal and legal trends to the tune of increased litigation, broader definition of duty to care, legal decisions tipping in the plaintiff's favor, and larger jury awards.[5]
- basically, means juries are handing down much larger awards to plaintiffs, which causes insurance companies to pay significantly more money for claims.[6]
- refers to steeply rising insurance rates due to social factors, such as large jury awards and broader definitions of liability.[7]
- refers to recent growth in liability risk and costs due to several trends and developments, including the following:
    - Changes in underlying beliefs about the appropriateness of filing lawsuits and expectations of higher compensation
    - Rollbacks of previously enacted tort reforms intended to control costs
    - Legislative actions to retroactively extend or repeal statutes of limitations
    - Increased attorney advertising and increased attorney involvement in liability claims
    - The emergence and growth of third-party litigation financing
    - Increasing numbers of very large jury verdicts, reflecting an increase in juries' sympathy toward plaintiffs and in their willingness to punish those who cause injury to others
    - Proliferation of class-action lawsuits[8]
- is the phenomenon of unexpected rising insurance claim costs because of societal trends and views toward litigation?[9]
- is used by insurers to describe the rising costs of insurance claims resulting from things like increasing litigation, broader definitions of liability, more plaintiff-friendly legal decisions, and larger compensatory jury awards. [10]

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[4] Geneva Association, "Social Inflation: Navigating the Evolving Claims Environment," December 2020, https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/social_inflation_web_171220.pdf.

[5] Andrea Dickinson and Meg Sutton, "The Ripple Effect of Social Inflation and Nuclear Verdicts on the Insurance Industry," Amwins, December 8, 2020, https://www.amwins.com/resources-insights/article/the-ripple-effect-of-social-inflation-and-nuclear-verdicts-on-the-insurance-industry.

[6] Tod Bergen, "Social Inflation: What Is It? What Causes It? Why Should You Care?" McConkey Insurance & Benefits (blog), November 9, 2020, https://www.ekmcconkey.com/blog/social-inflation-what-is-it-what-causes-it-why-should-you-care/.

[7] Sangmin Oh, "Social Inflation," SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, September 2, 2020), https://doi.org/10.2139/ssrn.3685667.

[8] Insurance Research Council, "Social Inflation: Evidence and Impact on Property-Casualty Insurance," June 2020, https://www.insurance-research.org/sites/default/files/news_releases/IRCsocinfFINAL.pdf.

[9] Larry Schiffer, "Social Inflation: What Is It and Why Should Reinsurers Care?," IRMI, February 2020, https://www.irmi.com/articles/expert-commentary/social-inflation-what-is-it-and-why-should-reinsurers-care.

[10] Bethan Moorcraft, "What Is Social Inflation, and Why Is It Hurting Insurance?," Insurance Business America, January 3, 2020, https://www.insurancebusinessmag.com/us/news/breaking-news/what-is-social-inflation-and-why-is-it-hurting-insurance-195626.aspx.

- is the increase in insurance losses caused by such factors as higher jury awards, more liberal treatment of claims by workers compensation boards, legislated rises in compensation benefit levels, and new concepts of tort and negligence?[11]
- refers to an upward creep in perceptions by an injured party of what they are owed, their willingness to pursue that via the legal system, and what that means for insurance policies covering companies' liabilities.[12]
- refers to the rising costs of insurance claims that are a result of societal trends and views toward increased litigation, broader contract interpretations, plaintiff-friendly legal decisions, and larger jury awards.[13]
- is a fancy term to describe rising litigation costs and their impact on insurers' claim payouts, loss ratios, and ultimately, how much policyholders pay for coverage?[14]

While there's no universally agreed-upon definition of social inflation, frequently mentioned aspects include

- growing awards from sympathetic juries ("nuclear verdicts") driven, in part, by plaintiff attorneys' adoption of strategies that attempt to enrage jurors into awarding large verdicts and increased advertising by law firms.
- a proliferation of class-action lawsuits and "litigation funding"—in which investors finance lawsuits against large companies in return for a share in the settlement.
- rollbacks of tort reform measures intended to control costs and legislative actions to retroactively extend or repeal statutes of limitations.

Forums of discussion have ranged from blog posts to industry panels to company earnings calls.

A post on the website of the brokerage Amwin discusses "an increase in both frequency and severity of liability claims . . . driving up the cost of claims, but also contributing to rate increases across the board."[15] In a typical discussion, panelists agreed that social inflation vied with technological innovation as being "one of the biggest disruptors facing the insurance industry."[16] One journalist noted the ubiquitous presence of the term on

[11] "Social Inflation in the U.S.: What Is It and Why Is It a Concern?," PartnerRe (blog), November 26, 2010, https://partnerre.com/opinions_research/social-inflation-in-the-u-s-what-is-it-and-why-is-it-a-concern/.

[12] Telis Demos, "The Specter of Social Inflation Haunts Insurers," *Wall Street Journal*, December 27, 2019, sec. Markets, https://www.wsj.com/articles/the-specter-of-social-inflation-haunts-insurers-11577442780.

[13] Steve Rich, "Social Inflation: A Concerning—and Costly—Trend," Acadia Insurance, October 31, 2019, https://www.acadiainsurance.com/social-inflation-a-concerning-and-costly-trend/.

[14] Jeff Dunsavage, "Florida's AOB Crisis: A Social-Inflation Microcosm," The Triple-I Blog, November 8, 2019, https://www.iii.org/insuranceindustryblog/floridas-aob-crisis-a-social-inflation-microcosm/.

[15] Dickinson and Sutton, "The Ripple Effect of Social Inflation and Nuclear Verdicts on the Insurance Industry,"

[16] Claire Wilkinson, "Social Inflation Keeps Rising for Insurers: Panelists," *Business Insurance,* January 17, 2020, https://www.businessinsurance.com/article/00010101/NEWS06/912332630/Social-inflation-keeps-rising-for-insurers-Panelists. Accessed June 15, 2021

insurance company earnings calls, with one CEO decrying "the broken system [that] imposes a tort tax across society."[17]

Notably, whereas much of the discussion focuses on the causes of social inflation, considerably less time is spent examining data for the presence of social inflation. The Geneva Association and the Insurance Research Council take nearly identical, and typical, approaches.

The Geneva Association compares annualized growth in claims across two time periods—2007 to 2013 versus 2014 to 2019. In each of the seven lines of business examined, the growth in claims in the former period lags growth in consumer prices, while in the latter period claims growth exceeds the increase in the Consumer Price Index (CPI).[18] The Insurance Research Council takes a similar approach and reaches a similar conclusion, focusing on six lines instead of seven and using 2018 as its endpoint instead of 2019.[19]

Other researchers are skeptical that such analysis is revealing. They note that losses booked to the calendar year are management estimates and subject to, in their words, "manipulation." Hunter, Doroshow, and Heller write that the industry "inflates losses by manipulating its own claim reserves," "signaling to each other to raise prices." They conclude that " 'social inflation does not exist" but is instead an "industry-created marketing term."[20]

In addition, the CPI is not a perfect benchmark against which trends in claim costs can be measured. Ahlgrim and D'Arcy note that though the CPI is one indicator of price increases, "the effects on insurers may be dramatically different. . . . [T]he reported CPI strips out the extra costs embedded in new products that reflect product upgrades." The upgrades are typically technological advances that increase the price of the product while improving its quality.[21] Weisbart and Lynch point out that the increase in new car prices regularly outstrips CPI inflation in automobiles, and that insurance that covers auto repairs pays the entire increase in the cost of parts, which is much higher than the inflation rate. They note that between 1963 and 2013, the CPI for urban consumers rose

[17] Tom Jacobs, "Travelers Sounds Alarm as P&C Insurers Seek to Constrain Social Inflation," S&P Global Market Intelligence, March 4, 2020, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/travelers-sounds-alarm-as-p-c-insurers-seek-to-constrain-social-inflation-57274949.

[18] Darren Pain, "Social Inflation: Navigating the Evolving Claims Environment," The Geneva Association Research Brief, December 17, 2020, https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/social_inflation_brief_web.pdf.

[19] Insurance Research Council, "Social Inflation: Evidence and Impact on Property-Casualty Insurance."

[20] J. Robert Hunter, Joanne Doroshow and Douglas Heller, "How the Cash-Rich Insurance Industry Fakes Crises and Invents Social Inflation," Consumer Federation of America and the Center for Justice and Democracy at New York Law School, March 2020, p. 2, https://consumerfed.org/wp-content/uploads/2021/04/How-the-Cash-Rich-Insurance-Industry-Fakes-Crises-and-Invents-Social-Inflation.pdf.

[21] Kevin Ahlgrim and Stephen P. D'Arcy, "The Effect of Deflation or High Inflation on the Insurance Industry," 2012, p. 5, https://www.soa.org/globalassets/assets/files/research/projects/research-2012-02-effect-deflation-report.pdf.

650 percent, while property damage severity rose 1,666 percent—more than twice as fast.[22]

For this paper, we define social inflation as excessive inflation in claims. The paper attempts to find evidence consistent with social inflation via standard actuarial analyses of aggregate industry data. Specifically, we examine the loss development factors from standard accident year loss triangles. As such, we focus on evidence that the size of claims has increased. Although many discussions of social inflation suggest the phenomenon increases claims frequency, such an exploration is beyond the scope of this study.

Basic actuarial techniques such as the chain-ladder method assume that losses move from unreported to reported in a consistent, predictable manner.[23] Many factors drive that movement, one of which is inflation.[24]

Embedded in the typical process of selecting a loss development factor—taking the average of several link ratios—is the assumption that development factors are values taken by a random process with a stable mean. That implies that inflation over the period has been constant.[25]

In her basic actuarial reserving text, Friedland notes that the chain-ladder method assumes no changes within the insurance organization, such as the introduction of new claims processing systems, claims management philosophy, policyholder deductibles, or reinsurance limits. The method also assumes no environmental changes, such as tort reform.[26]

Mack proves that the chain-ladder method assumes that losses across accident years are independent, though he notes that as a practical matter "the independence of the accident years can be distorted by certain calendar year effects like major changes in claims handling or in case reserving."[27]

From these analyses, one can infer that steadily increasing link ratios imply that the process no longer has a stable mean. The instability could, in theory, have many causes, but for the data we examine, we assert that the most likely reason is an increase in claims inflation, or, in modern parlance, social inflation.

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[22] Steven Weisbart and James Lynch, "Inflation from All Angles," PowerPoint presentation presented at the Casualty Actuarial Society Spring Meeting, Colorado Springs, Colo., May 18, 2015, https://www.iii.org/presentation/inflation-from-all-sides-051915.

[23] Geoff Werner and Claudine Modlin, *Basic Ratemaking*, 5th ed. (Casualty Actuarial Society, 2016), 105, https://www.casact.org/sites/default/files/old/studynotes_werner_modlin_ratemaking.pdf.

[24] Jacqueline Friedland, *Estimating Unpaid Claims Using Basic Techniques* (Casualty Actuarial Society, 2010), 84, https://www.casact.org/sites/default/files/2021-03/5_Friedland.pdf.

[25] Or, less likely, that movements in the many factors that cause losses to develop are offsetting one another.

[26] Friedland, *Estimating Unpaid Claims Using Basic Techniques*, 95.

[27] Thomas Mack, "Distribution-Free Calculation of the Standard Error of Chain Ladder Reserve Estimates," *ASTIN Bulletin* 23, no. 2 (1993): 213–25, https://doi.org/10.2143/AST.23.2.2005092.

In this paper we suggest that the presence of rising link ratios in lines of business where those ratios are normally stable is evidence of social inflation.

Discussion of Data

The limitations of the chain-ladder method affect the robustness of this conclusion. The method is intended to detect the presence of loss development and its size, not its source. However, the data set we use limits alternative explanations for rising link ratios.

We use annual statement data as of December 31, 2019, from Schedule P as submitted to the National Association of Insurance Commissioners. We also use older Schedule P evaluations to broaden the triangle history from 10 to 20 years. We access the data via S&P Global Market Intelligence, which accumulates the submissions of individual companies and adjusts the data for intragroup cessions. The data set is widely used in the industry.

Schedule P data provide several loss triangles net of reinsurance at a line-of-business level. We focused primarily on paid loss triangles (Schedule P, part 3) and reported loss triangles, which can be inferred by subtracting Schedule P, part 4 (incurred but not reported losses and defense and cost containment expenses - DCC) from Schedule P, part 2 (incurred losses and direct cost containment expenses).

We also collected gross data from Schedule P, part 1, which can be converted into loss triangles by accumulating information from several years of annual statements. At an industry level, this results in double-counting of claims ceded through proportional reinsurance. The ceding company counts them as part of its direct losses, while the proportional reinsurer counts them as assumed losses. We found results similar to what the analysis of net triangles showed.

Annual statement data have advantages and disadvantages for this kind of analysis. Feldblum, writing about annual statements of individual companies, discusses assumptions that "are not perfectly fulfilled" by Schedule P data. He notes that the data are affected by legal changes, changes in types of claims, changes in laws and regulations, and changes in policy limits and attachment points. He writes, "The Schedule P exhibits are a compromise between a simple, unrefined view of the company's total reserves and a refined analysis by homogeneous loss groupings."[28]

Many of the considerations that can significantly affect company-level reserving analysis via Schedule P have a muted impact when examining countrywide data. What follows is a discussion of key considerations of the data set and the difference between company-level analysis and industry-level analysis.[29]

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[28] Sholom Feldblum, "Completing and Using Schedule P," *CAS Forum,* fall 2002, p. 414, https://www.casact.org/sites/default/files/database/forum_02fforum_02ff353.pdf.

[29] Casualty Actuarial Society, "Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves," Casualty Actuarial Society, May 1988, p. 6. The CAS replaced the principles in 2014, but the considerations section remains a handy guide to assessing actuarial datasets.

- *Homogeneity.* Schedule P data are classified by annual statement line of business. Most actuaries work with company data at a finer level of detail. For example, commercial auto liability is a single line in Schedule P, but actuaries will look at a finer cut, separating bodily injury claims from property damage claims, separating data by state or groups of states, and separating claims by attachment point. Annual statement data cannot be split out this way. Some annual statement lines consist of several different products. The line *other liability—claims made,* for example, includes directors and officers, employment practices liability, fiduciary liability, and various errors and omissions lines, and each has its unique development patterns. Our analysis assumes the business mix does not change appreciably across the years we examine.
- *Credibility.* In company-level analysis, actuaries must reach conclusions about the credibility of data. This study is a compilation of industrywide data for a given year. In addition, this study does not depend on estimates of future values. It observes the actual values and draws inferences from them. For those purposes, the data set can be considered as close to 100 percent credible as possible.
- *Emergence, settlement, and development patterns.* At a company level, it is important to know whether changes in management or procedures could be affecting development patterns. This study assumes that most companies keep managers and procedures in place from one year to the next and that there are not enough companies changing significantly enough to affect loss development patterns.
- *Frequency and severity.* Emergence in loss development triangles comes from two sources: incurred but not reported claims and development on known claims. This study assumes that there is no material change in the reporting pattern of incurred but not reported claim counts. For commercial auto liability, our primary focus, the lag between accident and first report to the insurer tends to be short, so this assumption seems reasonable.
- *Reinsurance.* Schedule P triangles are net of reinsurance, so the individual company's reinsurance arrangements would be an important consideration. At an industry level, much of this is mitigated. Quota share reinsurance should not greatly affect Schedule P triangles. If the primary company changes its retained quota share, its reinsurers will have an equal offsetting change. As both are reported in the industry triangles, the change due to change in quota share reinsurance can be assumed to be zero. Excess reinsurance is reported in Schedule P's nonproportional reinsurance lines. In effect, net triangles are gross of proportional reinsurance and net of nonproportional reinsurance.
  This study assumes that in most years, most companies keep the same or similar retentions and that there are not enough companies changing in any one year to significantly affect loss-reporting patterns.
  Using data net of nonproportional reinsurance would tend to shorten development patterns and blunt evidence of any trends present, particularly as a cohort of claims ages.

- *Discounting.* Most Schedule P lines are reported on an undiscounted basis. The exception is workers compensation, whose triangles regularly include tabular discounts. We excluded this line from our analysis.
- *Operational changes, changes in contracts.* The discussion here follows the logic already given. At a company level, it is important to understand the changes in deductibles, policy limits, and terms and conditions of the underlying policy. At an industry level, these changes occur slowly. Further, insurers do not move in lockstep. This study assumes that not enough companies change their operations or contracts the same way in any one year to significantly affect loss-reporting patterns.

Schedule P triangles contain losses from catastrophes, which can significantly affect development patterns. We excluded from our analysis lines so affected.

Analysis

We reviewed the following annual statement lines of business:

- Commercial auto liability
- Medical professional liability—claims made
- Other liability—claims made
- Other liability—occurrence
- Personal auto liability
- Product liability—occurrence

We chose not to analyze homeowners and commercial multiple peril lines because of their catastrophe exposure, and we did not analyze workers compensation due to the potential impact of tabular discounts. We did not examine nonproportional lines aside from a cursory look that led us to conclude that factors in those lines would not be stable enough to draw any robust conclusions. We draw no conclusion as to whether social inflation is or is not present in those lines.

To better understand and illustrate what we found, we applied traditional actuarial tools in nontraditional ways. Our tools would not be particularly effective to achieve typical actuarial goals—projecting loss costs or estimating loss reserves—but they do help identify the trends we are studying.

This paper focuses on commercial auto liability data. Most observers consider it to be the line where social inflation appeared first and where the impact has been greatest.[30] The techniques used on this line were also applied to the other lines. We will provide some limited commentary on results as respecting those lines, as well. More information can be found in the appendices.

[30] Annmarie Geddes Baribeau, "Tipping the Scales: Measuring the Impact of Social Inflation," *Actuarial Review,* July 23, 2020, https://ar.casact.org/tipping-the-scales-measuring-the-impact-of-social-inflation/.

Like earlier researchers, we begin by showing changes in premium and losses standardized by the size of the economy. Chart 1 shows three insurance metrics per million dollars of nominal gross domestic product (GDP) by accident year: net earned premium; ultimate loss and DCC at first evaluation (12 months); and ultimate loss and DCC as of December 31, 2019. Nominal GDP is used to normalize premium and losses in the line, as insurance exposures tend to grow over the long term at approximately the same rate as the economy.[31] If the ratio of net earned premium to nominal GDP grows, it is a sign of increasing rates. If the ratio of accident year loss to nominal GDP grows, it is a sign of rising losses in excess of general economic trends and a potential indicator that social inflation is present.

Commercial auto ultimate losses were falling relative to GDP from 2000 to 2009 and have been growing faster than GDP since.

The net ultimate loss and DCC at 12 months per million of GDP and the net earned premium per million of GDP both decreased until 2012 and first increased in 2013, while the net ultimate loss and DCC per million of GDP as of December 31, 2019, decreased until 2009 and first increased in 2010. The fact that losses began growing in 2010 and earned premium began growing in 2013 suggests a two- or three-year delay recognizing that losses were increasing. That the December 31, 2019, ultimate losses for each accident year were lower than the original estimates from 2003 through 2009 shows that initial estimates for each of those years were too high. All subsequent initial estimates have been too low.

This suggests a cyclical process. As losses fell across the years, the reserving process was slow to recognize the true scope of the phenomenon. The pricing process lagged as well. When the phenomenon reversed, both pricing and reserving were slow to recognize the change.

[31] Weisbart and Lynch, "Inflation from All Angles."

Chart 1. Net earned premium (EP) and ultimate loss and DCC to GDP in $ millions by accident year—P&C industry—commercial auto liability

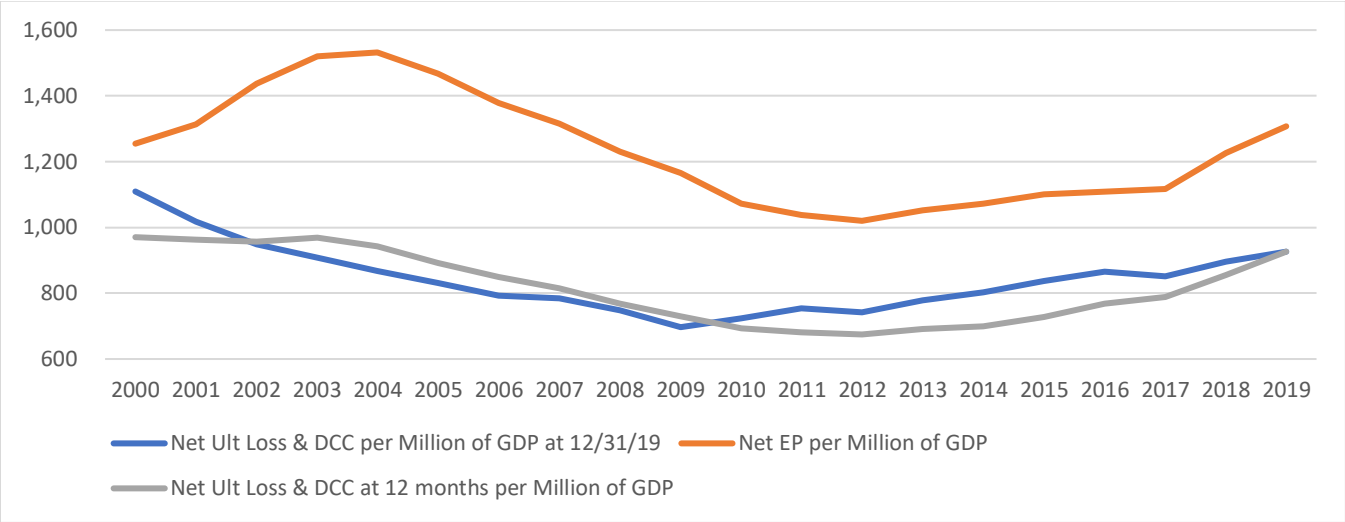
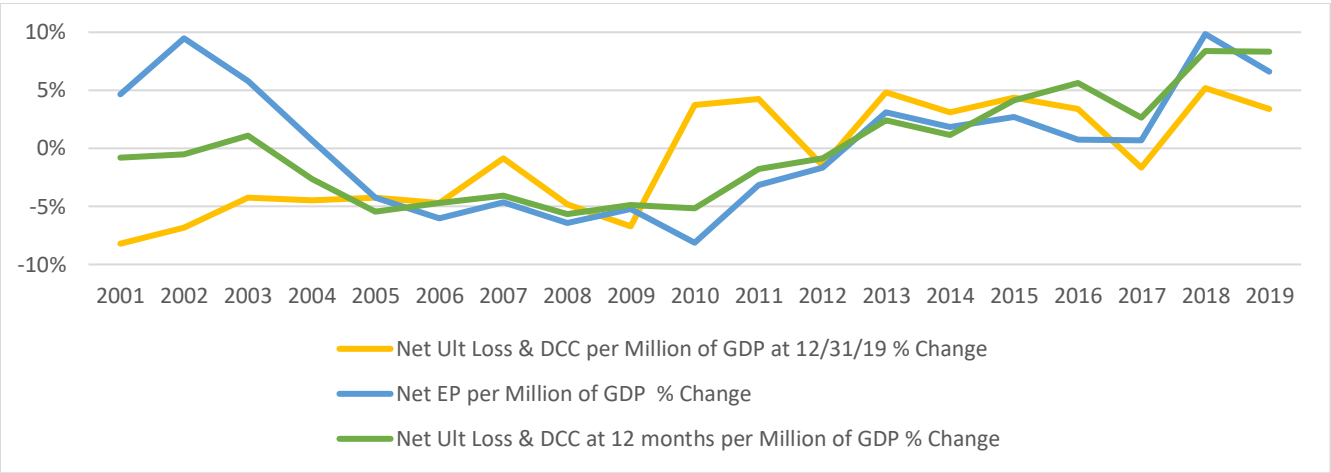


Chart 2 shows the percentage change in the same three metrics over time. Note the sharp increase in ultimate losses from 2009 to 2010 (evaluated at 2019) and the relatively minor change in both premium and ultimate loss at first evaluation—again showing the lag in responding to the issue as it emerges.

Chart 2.Change in net earned premium and ultimate loss and DCC to GDP in $ millions by accident year—P&C industry—commercial auto liability



Growth in ultimate losses could be a sign of social inflation. However, fast-rising costs by themselves could be caused by increases in exposures or claim frequency, instead of or in addition to rising claim severity. In the next section, we focus on analysis of accident year paid triangles—the actual amounts paid out by insurers, without any loss estimates, either by claims professionals or corporate executives. The actual payments would be subject to standard claim settlement patterns.

Table 1 shows the net paid loss and DCC link ratio triangle for commercial auto liability from 2000 to 2019. Red highlighting in a cell indicates that the link ratio increased relative to its counterpart in the prior year. As can be seen, there is a lot of red for commercial auto liability.

Table 1. Net paid loss and DCC link ratio—P&C industry—commercial auto liability

Acc Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	CYR 12-60
2000	2.097	1.420	1.198	1.097	1.050	1.019	1.011	1.007	1.004	
2001	2.058	1.422	1.201	1.095	1.045	1.021	1.011	1.005	1.003	
2002	2.080	1.481	1.225	1.110	1.051	1.023	1.010	1.005	1.003	
2003	2.117	1.454	1.232	1.116	1.050	1.020	1.010	1.005	1.005	
2004	2.041	1.442	1.236	1.115	1.049	1.021	1.010	1.006	1.002	4.128
2005	2.140	1.439	1.226	1.105	1.046	1.019	1.010	1.003	1.004	3.984
2006	2.064	1.444	1.213	1.107	1.043	1.023	1.011	1.005	1.004	4.220
2007	2.099	1.424	1.222	1.106	1.049	1.022	1.007	1.006	1.003	4.097
2008	2.048	1.433	1.228	1.111	1.049	1.022	1.010	1.006	1.002	4.142
2009	2.081	1.440	1.238	1.117	1.053	1.022	1.012	1.006	1.005	3.910
2010	2.125	1.450	1.232	1.120	1.051	1.025	1.011	1.005	1.004	4.033
2011	2.129	1.440	1.242	1.127	1.057	1.023	1.012	1.007		4.157
2012	2.155	1.454	1.249	1.127	1.050	1.025	1.012			4.246
2013	2.169	1.465	1.273	1.130	1.056	1.029				4.273
2014	2.174	1.515	1.262	1.145	1.057					4.386
2015	2.273	1.489	1.288	1.135						4.486
2016	2.287	1.518	1.284							4.941
2017	2.293	1.511								4.854
2018	2.358									5.137
2019										5.191

Each link ratio along the diagonal has embedded in it a sample of the underlying change in inflation. If most or all of the individual factors—12–24, 24–36, 36–48, and 48–60—were higher than their predecessors, that could be considered evidence of accelerating inflation. Our analysis focuses on changes in link ratios from calendar year to calendar year (along the diagonal). We calculate the product of the 12-to-24-, 24-to-36-, 36-to-48-, and 48-to-60-month link ratios along a given diagonal of the development triangle. We call this the calendar year 12–60 development factor (CYR 12–60).

To illustrate the calculation of the CYR 12–60 development factor, the 2019 CYR 12–60 development factor shown in Table 1 is 5.191. This equals the product of the 12-to-24-, 24-to-36-, 36-to-48-, and 48-to-60-month link ratios along the latest diagonal (= 2.358 * 1.511 * 1.284 * 1.135). The 2018 CYR 12–60 development factor is 5.137, being 2.293 * 1.518 * 1.288 * 1.145.

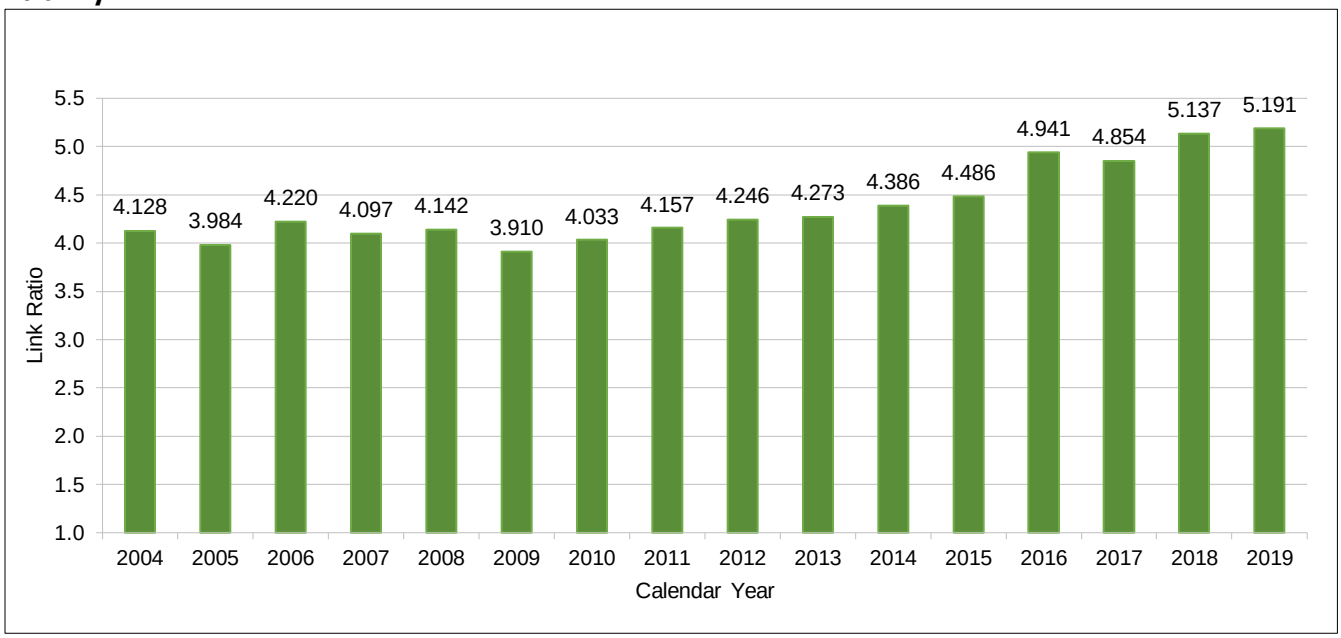
If the CYR 12–60 factor is higher than its predecessor, that is evidence of growing inflation.[32]

In the exhibit, the column at the far right is the CYR 12–60 development factor for the years in which it can be calculated. Note the steady increase in the factor since 2010.

Calendar Year 12-to-60-Month (CYR 12–60) Development Factor

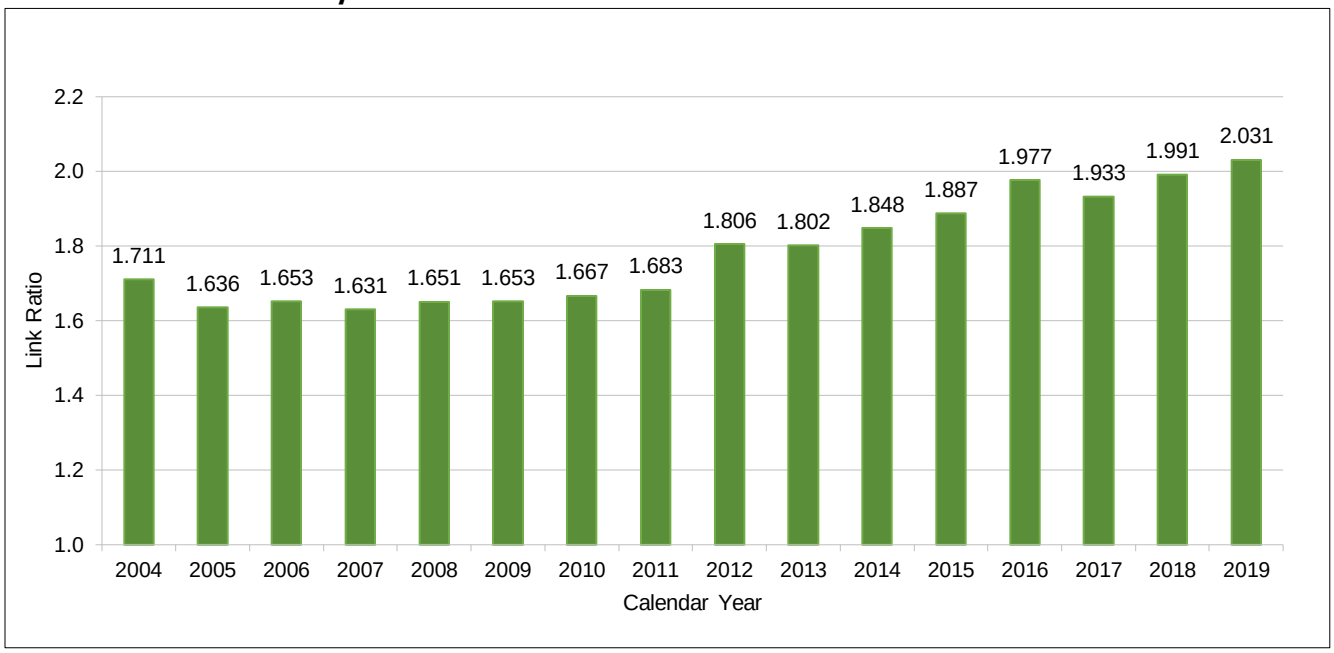
Charts 3 and 4 show the CYR 12–60 loss development factors (LDFs) by calendar year for commercial auto liability, first for paid losses, then for case incurred losses.

Chart 3. Net paid loss and DCC CYR 12–60 loss development factors—commercial auto liability



[32] We also studied the accident year 12–60 development factor: the product of the 12-to-24-, 24-to-36-, 36-to-48-, and 48-to-60-month link ratios along a given row (i.e., accident year). Also, we reviewed multiple age intervals: 12 to 36 months; 12 to 48 months, and so on. They generally provided similar indications. For simplicity of presentation, we focus on the 12-to-60-month age interval.

Chart 4. Net case incurred loss and DCC CYR 12–60 loss development factors—commercial auto liability



We observe a low point in the paid CYR 12–60 LDFs at calendar year 2009. Since 2009, this metric has increased every year with the exception of 2017. The calendar year 2018 LDF increased above both the 2016 and 2017 LDFs. These patterns would not likely be subject to manipulation by corporate executives.

We see a similar pattern in the case incurred CYR 12–60 LDFs. The low point occurs at calendar year 2007. Again, the LDFs show a clear, increasing pattern with the LDF increasing almost every year. Small decreases are observed in 2013 and 2017, but those were followed by increases to levels higher than the two preceding years in each case. The case incurred CYR 12–60 LDFs showed signs of increase two years sooner than the paid CYR 12–60 LDFs.

We performed similar calculations for the other lines of business. We determined that CYR 12–60 LDFs were generally lowest around 2008.

These metrics show the presence of increasing LDFs for commercial auto, other liability—occurrence, and medical malpractice—claims made, particularly from the late 2000s and onward. It should be noted that whereas these metrics do not show social inflation for some lines of business, that does not necessarily mean there is none. Other liability—claims made is an example. We believe social inflation is having a significant impact on other liability—claims made; however, we do not see evidence of that in these link ratios. It may be that the risks in these are so heterogeneous that the noise of random variation across many different products overwhelms any signal of inflation that could show itself in development factors. We include only the commercial auto exhibits in the body of the paper. Please see the appendices for an abbreviated set of charts for other lines studied.

The preceding discussion, we believe, demonstrates both the utility of actuarial triangles in finding signs of social inflation and the likely presence of social inflation in at least three lines of business.

Rolling 12-Month Actual versus Expected Emergence

Next, we compare actual versus expected emergence from 12 to 120 months for calendar years 2009 through 2019 (which spans accident years 2000 through 2019).

To project emergence in each year, we use a three-year weighted average of three previous development factors. The calculation is as follows:

- Let $E(L_{i,j})$ = expected cumulative paid loss and DCC for accident year i at age j in months
- Let $A_{i,j}$ = actual cumulative paid loss and DCC for accident year i at age j in months
- $E(L_{i,j}) = (A_{i,j\text{-}12}) * (A_{i\text{-}3,j} + A_{i\text{-}2,j} + A_{i\text{-}1,j}) / (A_{i\text{-}3,j\text{-}12} + A_{i\text{-}2,j\text{-}12} + A_{i\text{-}1,j\text{-}12})$

The expected projection is only one diagonal forward; for example, the 2019 diagonal starts with the 2018 actual diagonal and applies three-year average link ratios to project the 2019 diagonal.

Table 2 shows the results for commercial auto liability insurance. Actual emergence exceeded expected emergence consistently for the past decade. Paid development factors underestimated emergence by 4.2 percent from 2010 to 2019. Case incurred factors underestimated emergence by 7.6 percent.

Table 2. Actual versus expected net loss and DCC link ratio—P&C industry—commercial auto liability (in $ millions)

Calendar Year	**Paid** Emergence on Prior Accident Years through 120 Months				**Case Incurred** Emergence on Prior Accident Years through 120 Months			
	Expected	Actual	Variance	% Variance	Expected	Actual	Variance	% Variance
2010	8,227	8,115	(112)	-1.4%	4,150	4,283	133	3.2%
2011	8,002	8,082	79	1.0%	4,146	4,239	93	2.2%
2012	8,058	8,485	427	5.3%	4,257	5,085	827	19.4%
2013	8,421	8,637	216	2.6%	4,695	5,065	370	7.9%
2014	8,816	9,121	306	3.5%	5,109	5,645	536	10.5%
2015	9,335	9,718	383	4.1%	5,718	6,137	419	7.3%
2016	9,935	11,032	1,096	11.0%	6,268	7,106	839	13.4%
2017	11,108	11,483	375	3.4%	7,219	7,414	194	2.7%
2018	12,086	12,942	855	7.1%	7,848	8,312	463	5.9%
2019	13,565	14,058	493	3.6%	8,818	9,380	563	6.4%
2010 - 2013	32,709	33,318	609	1.9%	17,248	18,672	1,424	8.3%
2014 - 2016	28,087	29,871	1,785	6.4%	17,095	18,889	1,794	10.5%
2017 - 2019	36,759	38,483	1,724	4.7%	23,885	25,105	1,220	5.1%
2010 - 2019	97,555	101,672	4,117	4.2%	58,228	62,666	4,438	7.6%

This suggests traditional actuarial methods such as the loss development method, without adjustment, would consistently underpredict ultimate losses. This, in turn, could have affected both reserving and pricing decisions. This is consistent with the observation of increases in net earned premium per million dollars of GDP lagging increases in net ultimate losses per GDP by roughly three years (i.e., a lag in incorporating increasing trends into pricing). It is also consistent with unfavorable development in ultimate loss and DCC estimates, which has happened every year since 2012, as shown in Table 3. The average development as a percentage of net earned premium was 4.6 percent over the entire period. Hence, on average, prior-year development added 4.6 percentage points to the net combined ratio over this time period. Furthermore, the development as a percentage of net earned premium appears to be increasing. From 2017 to 2019, the prior-year development added 8.1 percentage points to the net combined ratio over this time period.

We also note that on a percentage basis, the excess emergence on case incurred claims is greater than the excess emergence on paid claims. This may reflect the challenge insurance personnel face in recognizing and adjusting their efforts in an inflationary environment. It suggests that actuaries consider placing greater emphasis on paid methods when they are working in such an environment, though more research may be needed to establish that.

Table 3. Calendar year prior-year development—P&C industry—commercial auto liability (in $ millions)

Calendar Year	Net Earned Premium	Net Ultimate Loss & DCC Prior Year Development	Net Ultimate Loss & DCC Prior Year Development to NEP
2009	16,850	-385	-2.3%
2010	16,062	-827	-5.1%
2011	16,125	-318	-2.0%
2012	16,523	541	3.3%
2013	17,657	703	4.0%
2014	18,779	785	4.2%
2015	20,074	1,656	8.2%
2016	20,782	1,852	8.9%
2017	21,811	1,634	7.5%
2018	25,268	1,843	7.3%
2019	28,013	2,570	9.2%
2009 - 2010	32,912	-1,212	-3.7%
2011 - 2013	50,304	926	1.8%
2014 - 2016	59,634	4,292	7.2%
2017 - 2019	75,092	6,047	8.1%
Total	217,942	10,052	4.6%

Most quantitative professionals, including actuaries, can examine Table 2 as well as Chart 5 and quickly grasp the main points:

- A force—perhaps social inflation—is causing traditional loss development methods to be inaccurate.
- The shortfall is significant and consistently biased in one direction.

Chart 5. Unexpected paid losses by year—P&C industry—commercial auto liability

We call the amount that actual losses exceed expectations "unexpected" because they were not anticipated by standard loss development techniques. This is evidence that social inflation in the 2010s caused paid losses to be more than $4 billion higher than might have been predicted with standard loss development techniques. This underestimation occurs because the inflation component of loss development has been accelerating. Retrospective factors don't reflect the additional inflation the next year will bring.

The loss development method underestimates the total financial impact of social inflation. Each year that the average LDF rises, it captures some of the new inflation. The next section creates an estimate of how much ultimate losses have risen because of social inflation.

Implied Ultimate Variance

To attempt to quantify the impact of social inflation, we calculate the implied net ultimate loss and DCC for commercial auto liability based on the paid and case incurred loss development methods using alternative LDF assumptions for accident years 2010 to 2019. These alternative LDF assumptions are based on using three-year weighted average link ratios from the latest three calendar years as of December 31, 2008. We reason that in the absence of social inflation, loss development factors would not be creeping higher.[33]

[33] We used the implied tail factor from 120-ultimate based on the actual booked ultimate for accident year 2010. The implied tail factor equals the booked ultimate divided by the paid (or case incurred) to date as of December 31, 2019.

Table 4 shows a comparison of the implied LDFs. We note that the three-year weighted average age-to-ultimate LDFs as of December 31, 2019, are significantly higher than those as of December 31, 2008. They are also higher than the implied LDFs based on the booked ultimates as of December 31, 2019, at every evaluation age from 12 to 72 months.

Table 4. Comparison of implied, weighted average LDFs—P&C industry—commercial auto liability

	A	B	C	D	E	F
	Net Paid Loss & DCC Age-to-Ult LDFs			Net Case Incurred Loss & DCC Age-to-Ult LDFs		
Age in Months	Booked Ultimate Implied LDFs	3yr Weighted Average as of 12/31/2019	3yr Weighted Average as of 12/31/2008	Booked Ultimate Implied LDFs	3yr Weighted Average as of 12/31/2019	3yr Weighted Average as of 12/31/2008
120	1.007	1.007	1.007	1.005	1.005	1.005
108	1.011	1.010	1.010	1.006	1.006	1.006
96	1.020	1.017	1.016	1.010	1.008	1.006
84	1.030	1.029	1.027	1.012	1.012	1.008
72	1.053	1.055	1.048	1.018	1.021	1.012
60	1.107	1.112	1.099	1.027	1.037	1.022
48	1.249	1.264	1.224	1.067	1.085	1.049
36	1.561	1.616	1.507	1.145	1.196	1.119
24	2.318	2.434	2.173	1.336	1.425	1.265
12	5.587	5.628	4.565	1.914	2.059	1.681

We calculated the implied ultimates using the historical paid and case incurred loss and DCC at 12 months and applied the 12-to-ultimate implied LDFs as of December 31, 2008. This allows inclusion of all loss development caused by increased LDFs after 12 months.

The results are displayed in Table 5. Columns F and G show the difference between the booked ultimate and what would have been booked in a world without social inflation. This method indicates that the potential impact of social inflation is approximately $20 billion, or roughly 14 percent of all booked commercial auto liability losses over the 10 years we examined.

Table 5. Implied net ultimate loss and DCC using 12/31/2008 alternative LDFs—P&C industry—commercial auto liability

Amounts in Millions	A	B	C	D = A*(Alternative LDF)	E = B*(Alternative LDF)	F = D - C	G = E - C
	Per 12/31/YYYY Schedule P		Per 12/31/2019 Schedule P	Implied Net Ultimate Loss & DCC using Alternative LDFs		Variance to Booked	
Year	Net Paid Loss & DCC @ 12 months	Net Case Incurred Loss & DCC @ 12 months	Net Ultimate Loss & DCC	3yr Weighted Average as of 12/31/2008 (Paid)	3yr Weighted Average as of 12/31/2008 (Case Incurred)	3yr Weighted Average as of 12/31/2008 (Paid)	3yr Weighted Average as of 12/31/2008 (Case Incurred)
2010	2,305	5,959	10,836	10,522	10,015	-314	-821
2011	2,447	6,193	11,714	11,168	10,407	-546	-1,307
2012	2,453	6,299	12,028	11,196	10,587	-832	-1,441
2013	2,554	6,603	13,065	11,657	11,097	-1,407	-1,968
2014	2,655	6,946	14,065	12,119	11,673	-1,946	-2,392
2015	2,791	7,504	15,275	12,739	12,611	-2,536	-2,664
2016	2,917	8,081	16,236	13,318	13,581	-2,918	-2,655
2017	3,078	8,465	16,647	14,051	14,226	-2,595	-2,421
2018	3,379	9,404	18,468	15,426	15,803	-3,042	-2,664
2019	3,554	10,375	19,856	16,222	17,436	-3,633	-2,420
Total	28,131	75,829	148,189	128,419	127,436	-19,771	-20,753
					% Variance	-13.3%	-14.0%

This method likely understates the impact of social inflation for at least two reasons:

1. It does not consider any inflation in losses reported or paid within the first 12 months of an accident year, so in that sense it could be considered an underestimation.
2. It does not consider any potential deficiency in the booked amounts as of December 31, 2019.

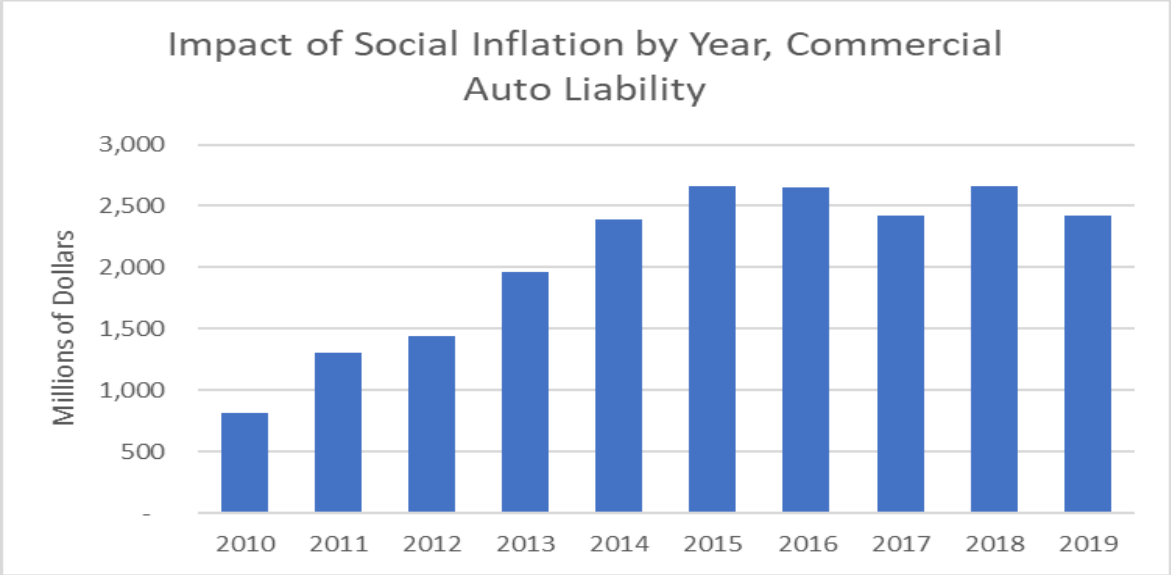
In Table 6, we apply the three-year weighted average LDFs as of December 31, 2019, to the paid and case incurred net loss and DCC as of December 31, 2019. This approach implies that the booked net ultimates as of December 31, 2019, were understated by $1.9–$3.9 billion dollars. In reviewing the 2020 P&C industry Schedule P, we see that the industry increased estimates on accident years 2019 and prior by $2.1 billion, which is within the indicated range shown.

Table 6. Implied net ultimate loss and DCC using 12/31/2019 alternative LDFs—P&C industry—commercial auto liability

Amounts in Millions	A	B	C	D	E	F = D - C	G = E - C
	Per 12/31/2019 Schedule P			Implied Net Ultimate Loss & DCC using Alternative LDFs		Variance to Booked	
Year	Net Paid Loss & DCC	Net Case Incurred Loss & DCC	Net Ultimate Loss & DCC	3yr Weighted Average as of 12/31/2019 (Paid)	3yr Weighted Average as of 12/31/2019 (Case Incurred)	3yr Weighted Average as of 12/31/2019 (Paid)	3yr Weighted Average as of 12/31/2019 (Case Incurred)
2010	10,763	10,784	10,836	10,836	10,836	0	0
2011	11,584	11,643	11,714	11,705	11,711	-10	-4
2012	11,795	11,905	12,028	11,994	12,004	-34	-24
2013	12,679	12,905	13,065	13,043	13,065	-22	1
2014	13,361	13,823	14,065	14,100	14,112	34	47
2015	13,803	14,870	15,275	15,355	15,426	80	151
2016	13,004	15,212	16,236	16,443	16,507	207	271
2017	10,665	14,540	16,647	17,237	17,395	590	748
2018	7,968	13,820	18,468	19,393	19,698	925	1,230
2019	3,554	10,375	19,856	20,001	21,361	145	1,505
Total	109,176	129,877	148,189	150,106	152,114	1,917	3,925
					% Variance	1.3%	2.6%

The growing impact of social inflation over time can also be illustrated by Chart 6, which estimates the impact of social inflation by accident year as estimated by the case incurred method (from column G in Table 5).

Chart 6. Impact of social inflation by year—P&C industry—commercial auto liability



Conclusion

Because social inflation is ill defined, there is an element of subjectivity in quantifying its presence. Nevertheless, we found substantial evidence in industrywide loss triangles that three lines of business (commercial auto liability, other liability—occurrence, and medical malpractice—claims made) display characteristics consistent with what one would expect from most common discussions of social inflation—namely, that the inflation component of loss development factors has been rising. LDFs in other lines reviewed are not definitively rising, although shortcomings in our data and methods preclude us from saying whether social inflation is affecting those lines. We estimate that rising LDFs have increased losses in commercial auto liability by more than $20 billion, or approximately 14 percent of all losses in that line from 2010 to 2019.

Based upon this analysis, actuaries who believe they are encountering social inflation should take care when selecting link ratios and/or methods on which to rely. If using the loss development method, actuaries should consider selecting link ratios from the most recent development year instead of any multiyear average or consider extrapolating link ratios. As noted previously, they should consider giving greater weight to the methods that are performing better in an actual versus expected analysis.

Actuaries should also be sure to communicate with other stakeholders—claims and management—the nature of what they are seeing and how they are addressing it. Actuaries at larger companies should look for similar phenomena in their books of business. Those at smaller companies, where lower volume results in greater variability in LDFs, should consider analyzing countrywide data to track the phenomenon.

While our analysis appears to shed light on the phenomenon of social inflation, we recommend further research to better isolate the phenomenon. Other industry data sources—for example, statistical agents such as ISO or insurance companies with large market shares—have more robust loss triangles, containing direct losses and focusing on subsegments within a line of business with adjustments for limits and deductibles and other items. Those would also have more precise data on claim counts, which would allow analysis into issues regarding claim frequency. Repeating our analysis on those would provide more specific insights. Standard actuarial trend analysis could also provide insights into how claim size has been changing over time.

Appendices

- Appendix A: Medical Professional Liability—Claims Made Charts
- Appendix B: Other Liability—Claims Made Charts
- Appendix C: Other Liability—Occurrence Charts
- Appendix D: Personal Auto Liability Charts
- Appendix E: Product Liability—Occurrence Charts

Appendix A. Medical Professional Liability—Claims Made Charts

Chart A1. Net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

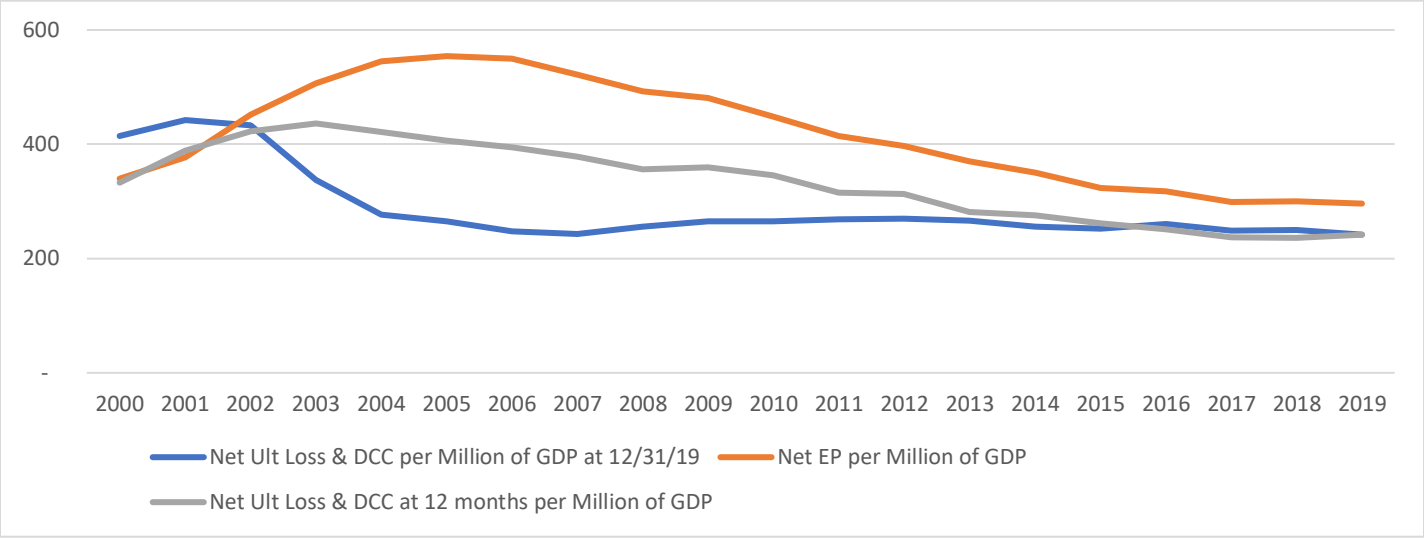


Chart A2. Change in net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

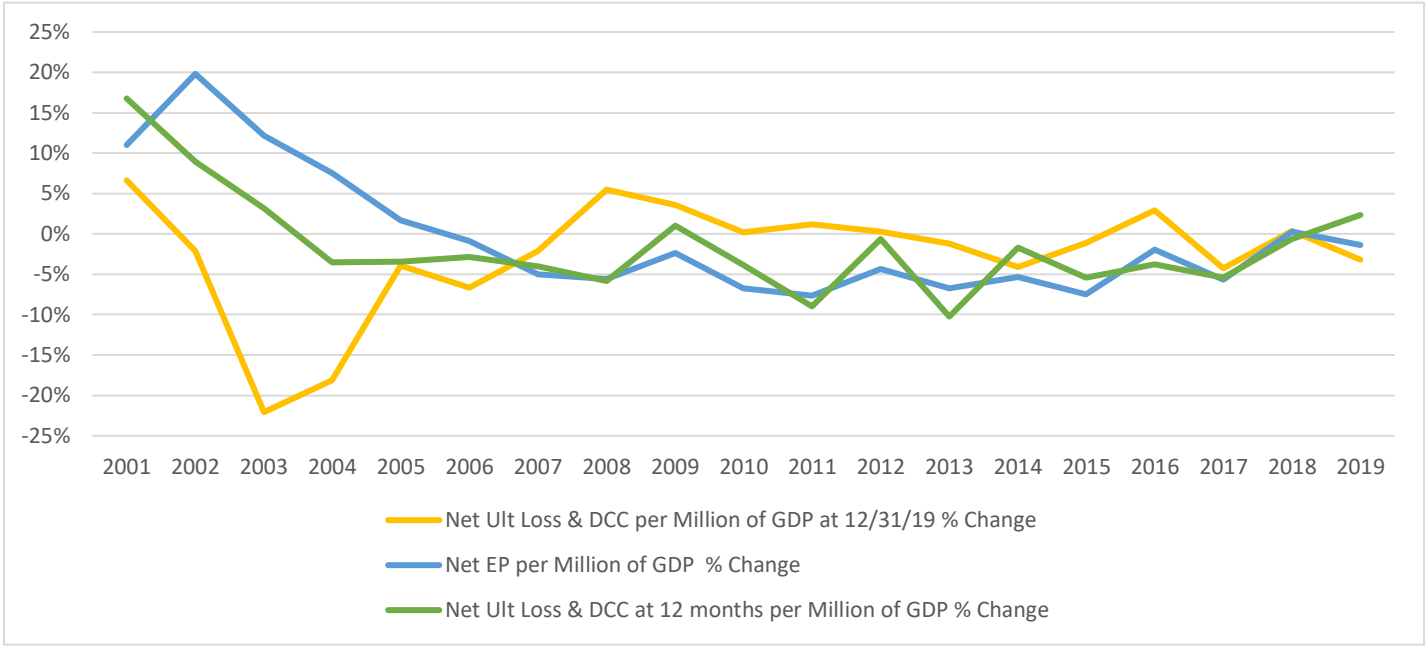


Table A1. Net paid loss and DCC link ratio—P&C industry

Net Paid Loss & DCC Link Ratio - P&C Industry

Acc Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	CYR 12-60
2000	5.305	2.131	1.388	1.099	1.073	1.052	1.027	1.011	1.018	
2001	5.749	1.952	1.353	1.152	1.078	1.038	1.026	1.015	1.008	
2002	5.514	2.020	1.377	1.173	1.090	1.052	1.035	1.019	1.016	
2003	6.105	1.943	1.325	1.155	1.098	1.057	1.028	1.014	1.018	
2004	5.031	1.917	1.380	1.157	1.096	1.041	1.031	1.024	1.015	18.339
2005	5.470	1.983	1.392	1.188	1.074	1.052	1.032	1.016	1.014	15.503
2006	4.786	1.963	1.366	1.176	1.098	1.045	1.021	1.018	1.014	16.295
2007	4.899	1.938	1.312	1.184	1.090	1.046	1.035	1.023	1.018	15.132
2008	4.810	1.930	1.377	1.175	1.083	1.048	1.040	1.028	1.018	15.487
2009	5.026	1.888	1.367	1.160	1.096	1.050	1.041	1.018	1.011	15.132
2010	4.810	1.886	1.344	1.207	1.095	1.050	1.040	1.020	1.013	14.963
2011	4.939	2.023	1.383	1.216	1.099	1.048	1.039	1.019		14.806
2012	5.449	1.976	1.408	1.181	1.089	1.061	1.029			14.967
2013	5.145	1.989	1.349	1.182	1.092	1.069				17.190
2014	4.907	1.988	1.373	1.193	1.109					16.978
2015	5.143	2.090	1.398	1.178						16.718
2016	5.074	2.098	1.409							16.284
2017	5.410	2.009								17.220
2018	5.365									18.927
2019										17.887

Chart A3. Net paid loss and DCC CYR 12–60 loss development factors—P&C industry

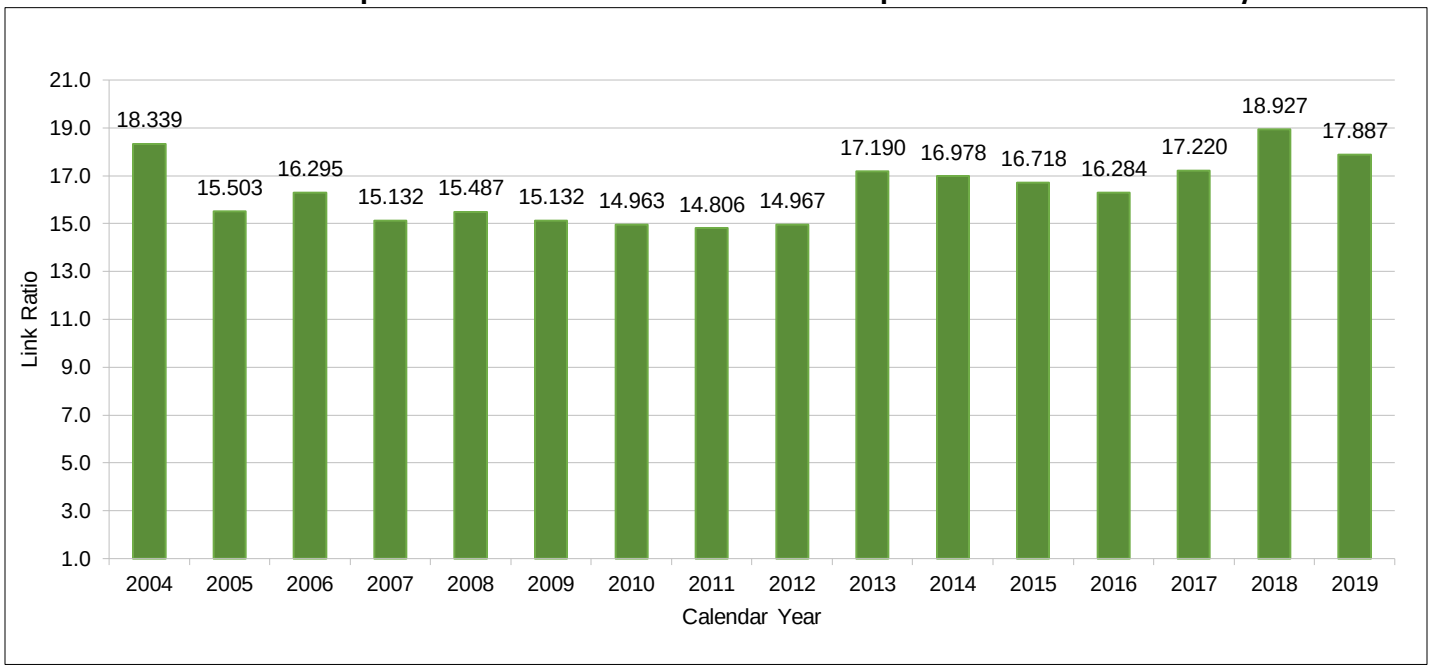
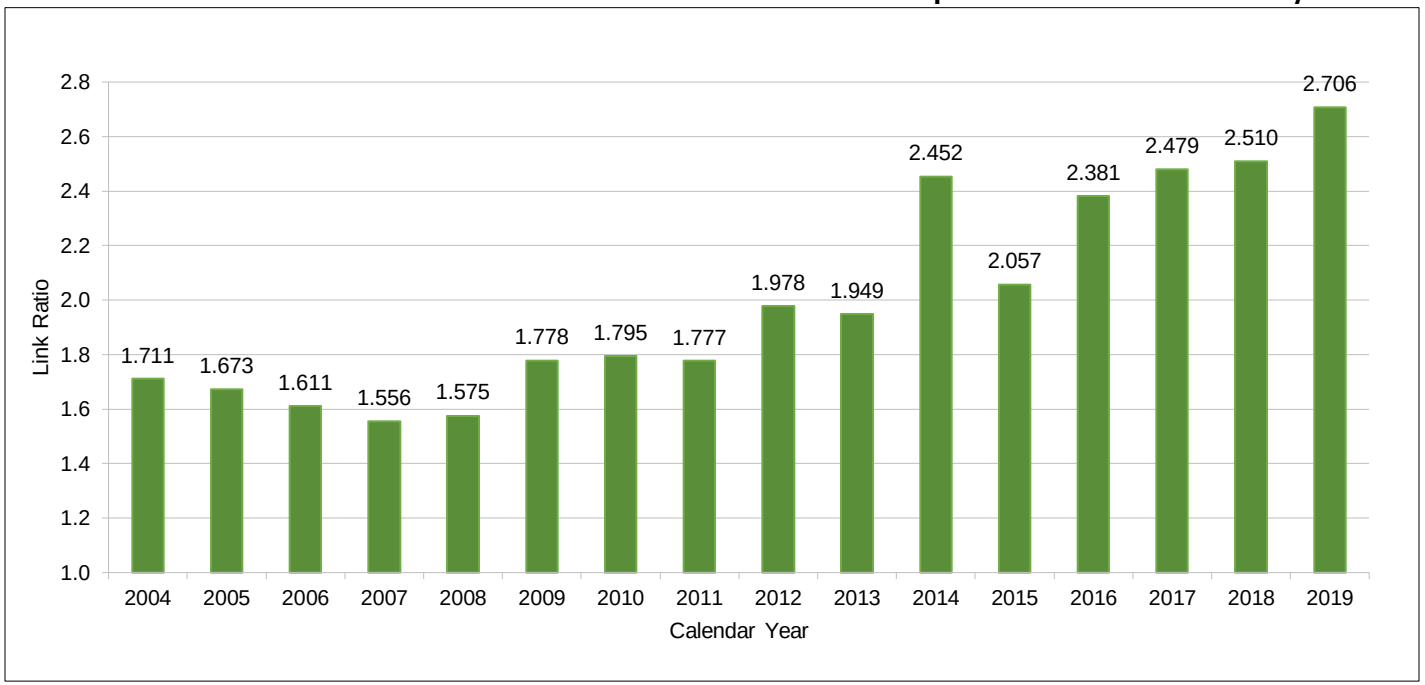


Chart A4. Net case incurred loss and DCC CYR 12–60 loss development factors—P&C industry



Appendix B. Other Liability—Claims Made Charts

Chart B1. Net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

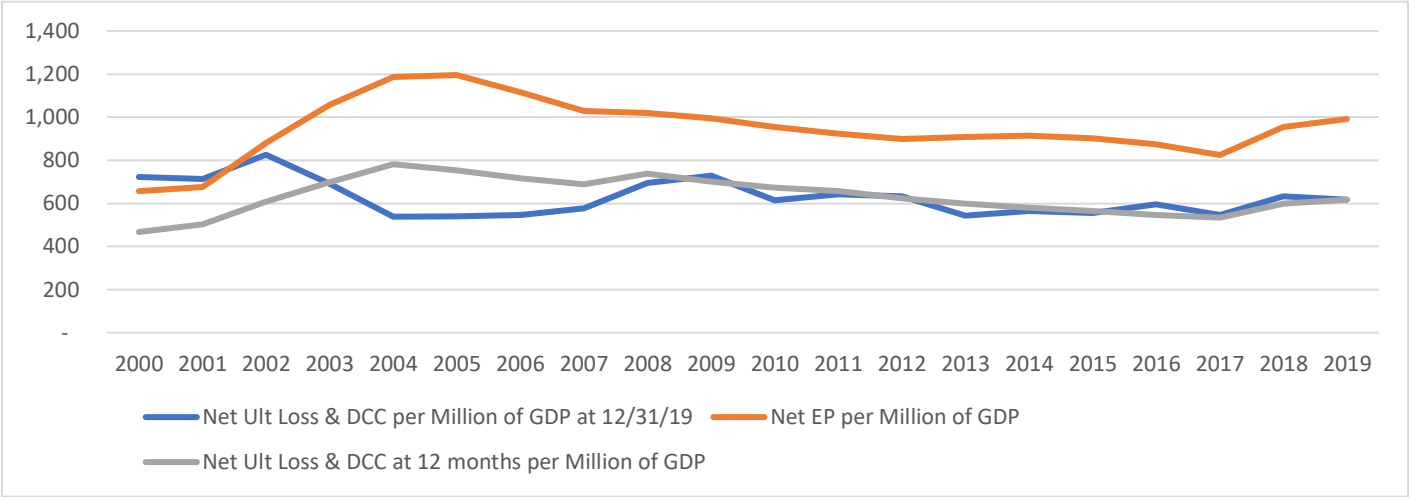


Chart B2. Change in net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

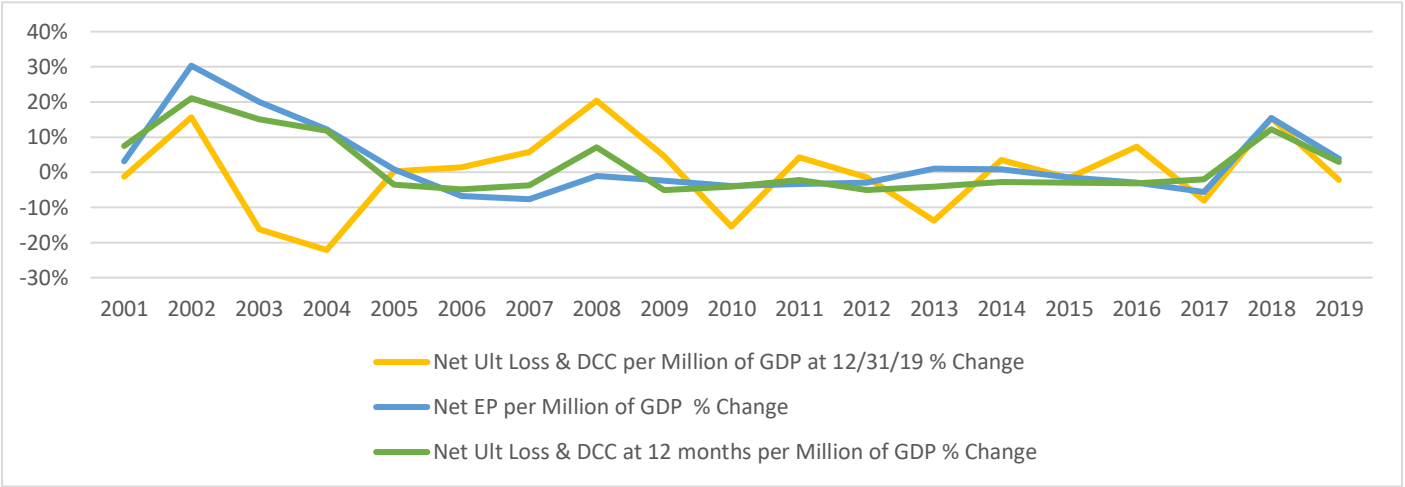


Table B1. Net paid loss and DCC link ratio—P&C industry

Net Paid Loss & DCC Link Ratio - P&C Industry

Acc Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	CYR 12-60
2000	2.759	1.829	1.315	1.194	1.135	1.111	1.041	1.047	1.017	
2001	4.071	1.724	1.432	1.196	1.087	1.068	1.063	1.036	1.024	
2002	3.146	1.880	1.448	1.226	1.105	1.089	1.042	1.038	1.015	
2003	3.703	1.838	1.387	1.185	1.150	1.091	1.058	1.048	1.022	
2004	3.508	1.814	1.446	1.173	1.097	1.096	1.058	1.021	1.016	11.903
2005	3.780	1.884	1.431	1.193	1.127	1.073	1.034	1.037	1.012	11.163
2006	3.466	1.986	1.330	1.186	1.078	1.051	1.045	1.028	1.031	11.659
2007	3.928	1.774	1.390	1.178	1.122	1.071	1.032	1.026	1.016	11.184
2008	3.455	1.732	1.331	1.174	1.100	1.065	1.069	1.034	1.018	13.100
2009	3.861	1.793	1.405	1.188	1.114	1.086	1.051	1.027	1.027	9.729
2010	3.968	1.762	1.326	1.169	1.147	1.060	1.052	1.036	1.017	11.029
2011	3.751	1.752	1.304	1.247	1.128	1.074	1.037	1.016		11.163
2012	3.599	1.718	1.479	1.183	1.123	1.074	1.050			10.904
2013	4.099	1.900	1.385	1.180	1.111	1.042				9.933
2014	4.072	1.860	1.355	1.195	1.102					10.736
2015	3.713	1.895	1.349	1.178						14.269
2016	3.692	1.776	1.331							11.306
2017	3.644	1.787								11.183
2018	4.232									10.432
2019										11.863

Chart B3. Net paid loss and DCC CYR 12–60 loss development factors—P&C industry

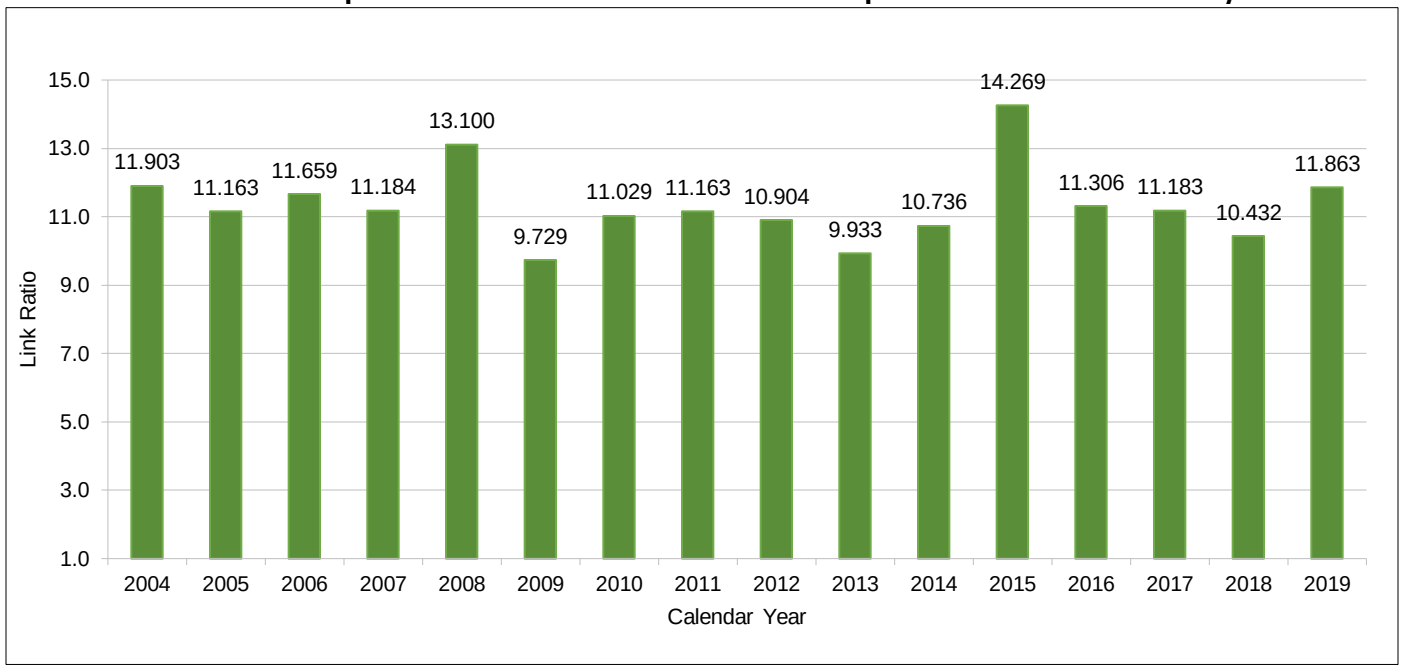
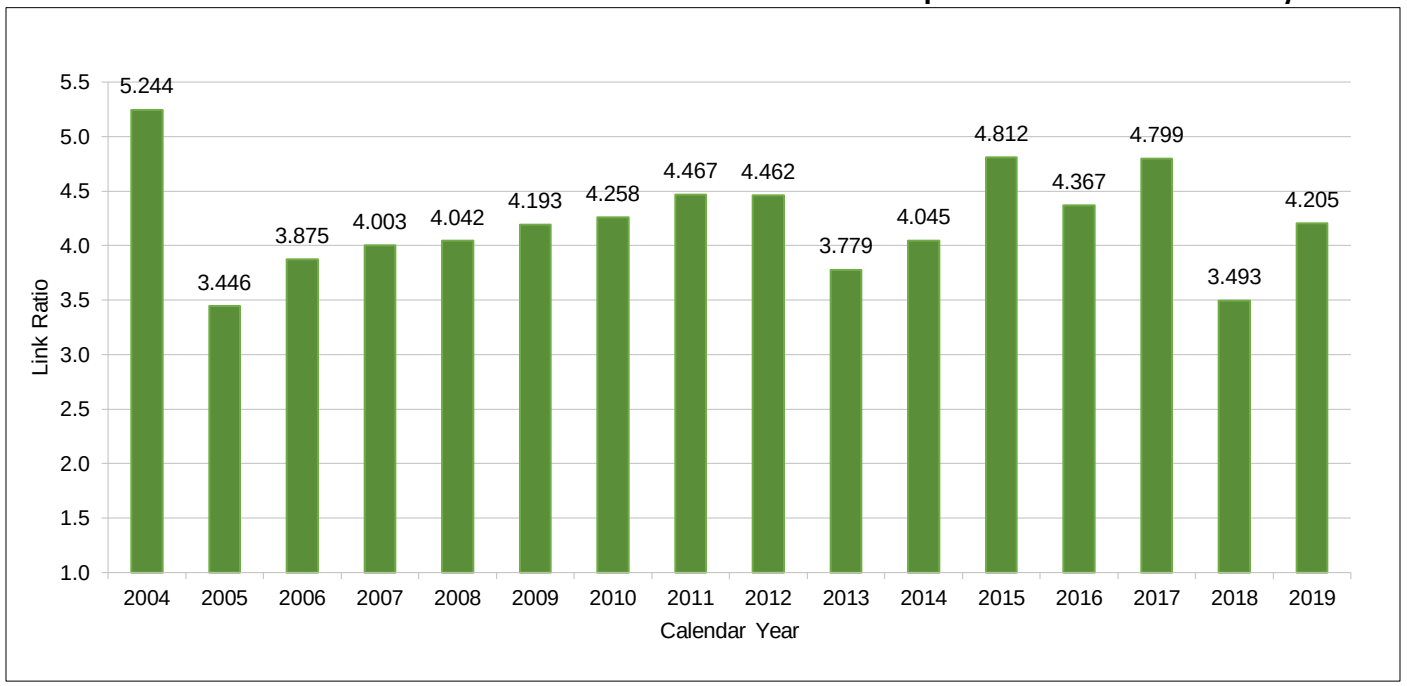


Chart B4. Net case incurred loss and DCC CYR 12–60 loss development factors—P&C industry



Appendix C. Other Liability—Occurrence Charts

Chart C1. Net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

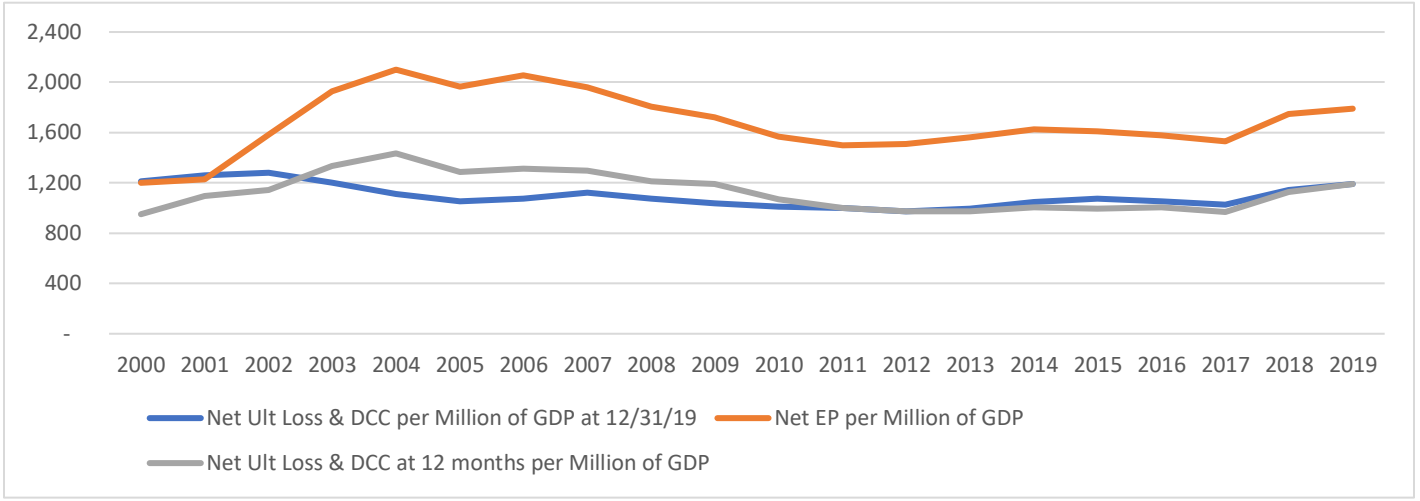


Chart C2. Change in net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

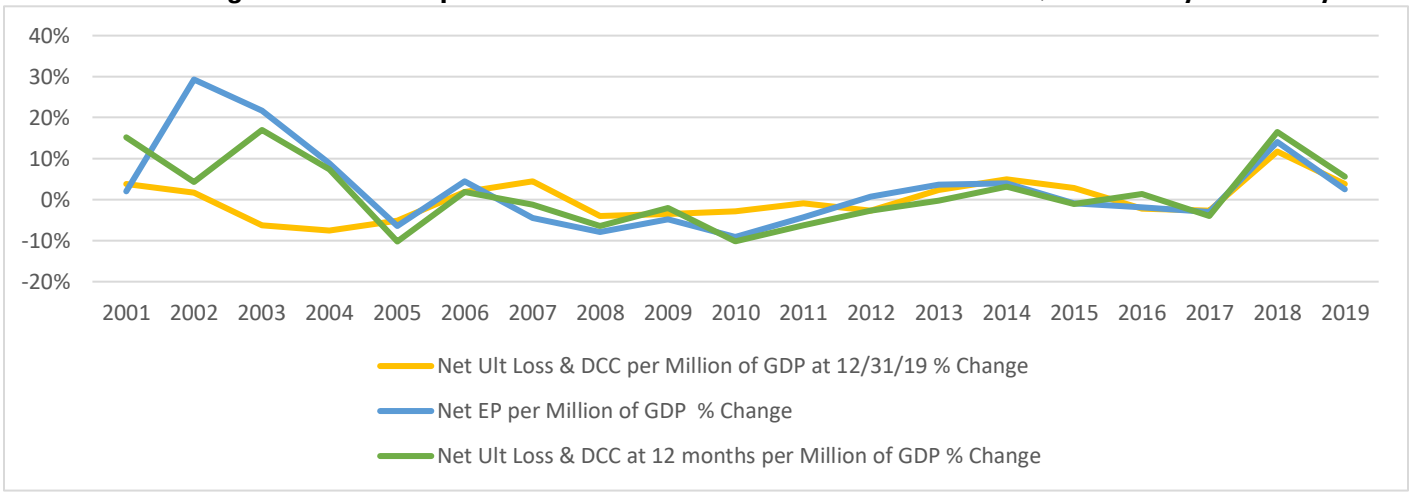


Table C1. Net paid loss and DCC link ratio—P&C industry

Net Paid Loss & DCC Link Ratio - P&C Industry

Acc Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	CYR 12-60
2000	2.180	1.551	1.294	1.153	1.071	1.068	1.056	1.032	1.021	
2001	2.090	1.549	1.257	1.147	1.117	1.085	1.044	1.035	1.012	
2002	1.846	1.570	1.323	1.211	1.102	1.093	1.044	1.019	1.021	
2003	1.923	1.522	1.304	1.183	1.150	1.051	1.039	1.025	1.020	
2004	1.749	1.500	1.335	1.218	1.114	1.045	1.047	1.025	1.020	4.381
2005	1.721	1.456	1.353	1.193	1.081	1.061	1.046	1.038	1.030	4.037
2006	1.868	1.599	1.315	1.163	1.105	1.070	1.040	1.023	1.026	4.078
2007	1.974	1.499	1.306	1.205	1.121	1.071	1.041	1.034	1.025	4.295
2008	2.145	1.612	1.367	1.213	1.119	1.070	1.046	1.037	1.039	5.201
2009	2.043	1.558	1.351	1.207	1.117	1.070	1.060	1.039	1.028	5.043
2010	2.377	1.726	1.366	1.229	1.112	1.086	1.069	1.034	1.019	4.999
2011	2.512	1.693	1.403	1.251	1.147	1.087	1.057	1.032		6.099
2012	2.543	1.712	1.425	1.248	1.167	1.078	1.051			7.108
2013	2.953	1.827	1.446	1.264	1.131	1.078				7.100
2014	2.464	1.775	1.444	1.231	1.136					8.720
2015	2.851	1.696	1.450	1.245						8.024
2016	2.701	1.760	1.449							9.137
2017	2.827	1.718								8.358
2018	2.836									8.882
2019										8.791

Chart C3. Net paid loss and DCC CYR 12–60 loss development factors—P&C industry

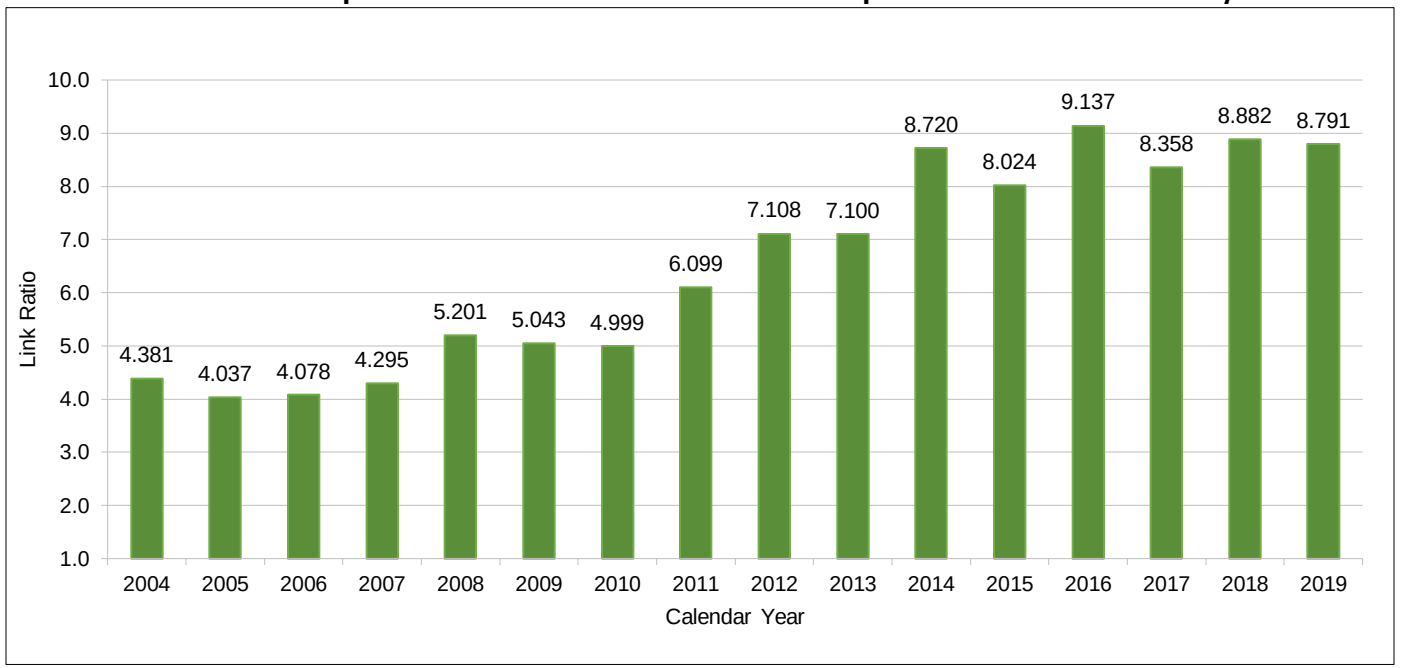
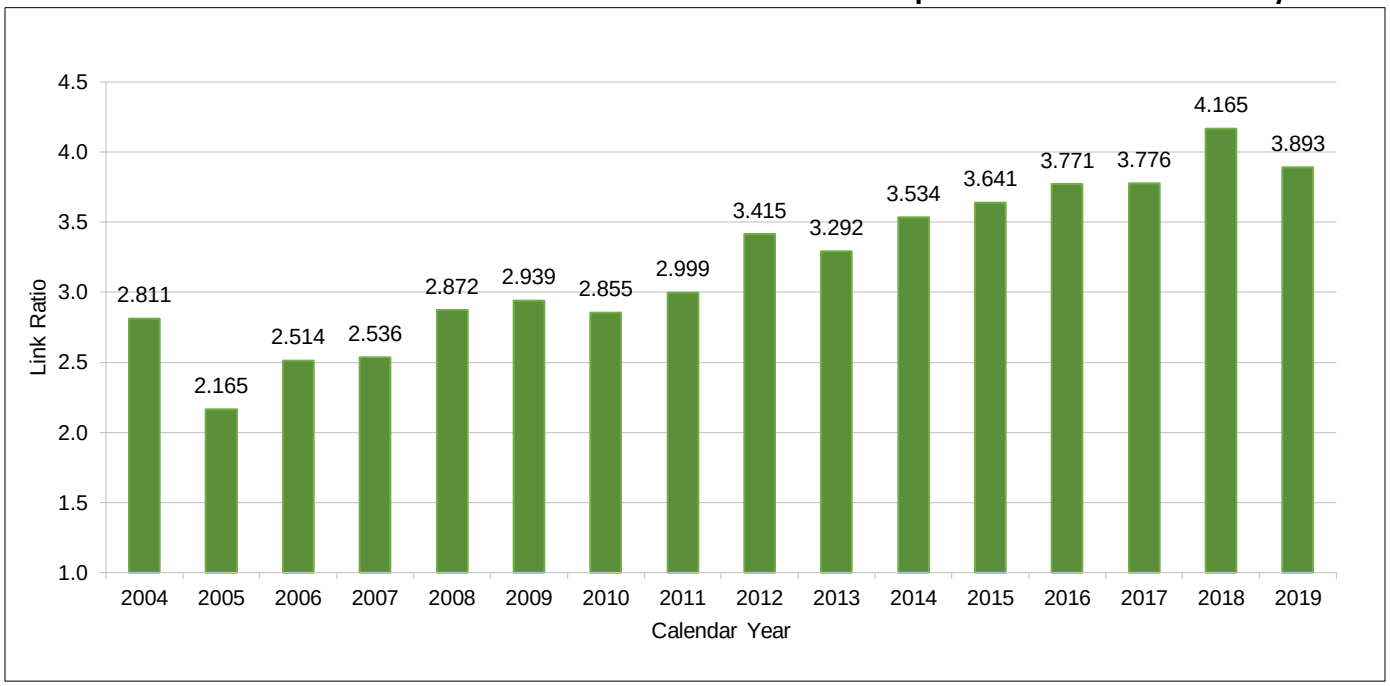


Chart C4. Net case incurred loss and DCC CYR 12–60 loss development factors—P&C industry



Appendix D. Personal Auto Liability Charts

Chart D1. Net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

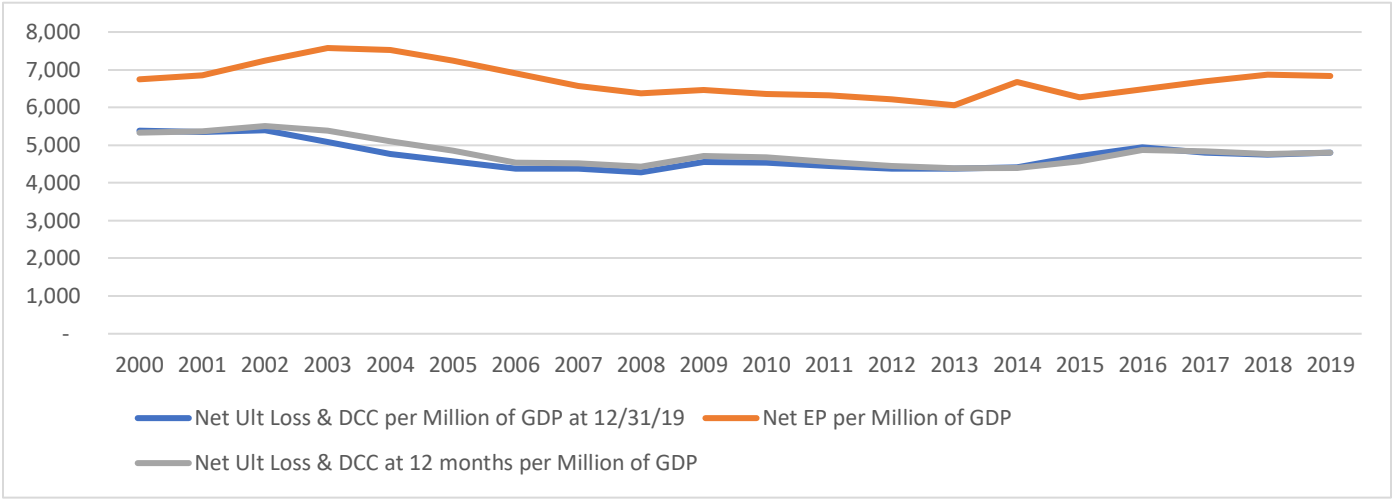


Chart D2. Change in net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

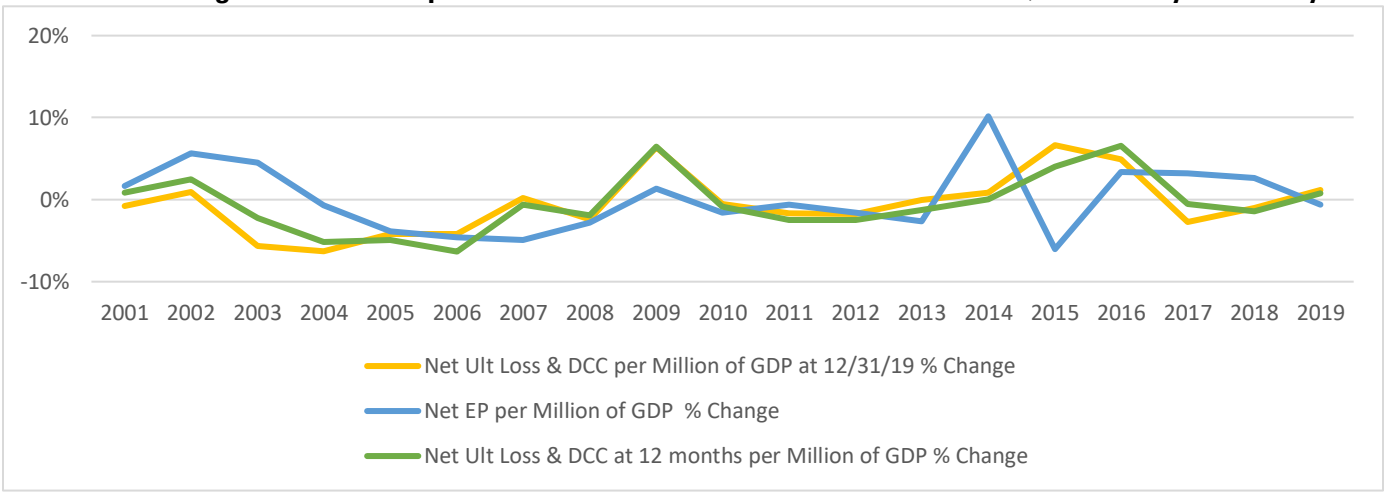


Table D1. Net paid loss and DCC link ratio—P&C industry

Acc Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	CYR 12-60
2000	1.762	1.190	1.090	1.043	1.019	1.010	1.005	1.003	1.002	
2001	1.744	1.191	1.090	1.044	1.033	0.995	1.005	1.003	1.001	
2002	1.735	1.194	1.091	1.043	1.019	1.009	1.004	1.002	1.001	
2003	1.719	1.185	1.092	1.044	1.020	1.008	1.004	1.002	1.002	
2004	1.703	1.187	1.092	1.043	1.017	1.008	1.004	1.002	1.001	2.334
2005	1.701	1.186	1.090	1.041	1.017	1.007	1.004	1.002	1.001	2.298
2006	1.701	1.185	1.085	1.039	1.016	1.007	1.004	1.002	1.001	2.299
2007	1.700	1.175	1.085	1.040	1.016	1.008	1.004	1.002	1.002	2.299
2008	1.694	1.177	1.084	1.042	1.018	1.008	1.005	1.003	1.001	2.291
2009	1.689	1.180	1.088	1.043	1.019	1.009	1.005	1.003	1.002	2.248
2010	1.693	1.183	1.089	1.044	1.020	1.009	1.005	1.002	1.002	2.241
2011	1.690	1.185	1.089	1.045	1.019	1.009	1.004	1.003		2.252
2012	1.691	1.184	1.091	1.043	1.017	1.008	1.005			2.265
2013	1.705	1.187	1.089	1.042	1.017	1.010				2.276
2014	1.716	1.186	1.088	1.043	1.018					2.297
2015	1.734	1.187	1.090	1.045						2.321
2016	1.742	1.190	1.094							2.336
2017	1.750	1.199								2.345
2018	1.772									2.368
2019										2.430

Chart D3. Net paid loss and DCC CYR 12–60 loss development factors—P&C industry

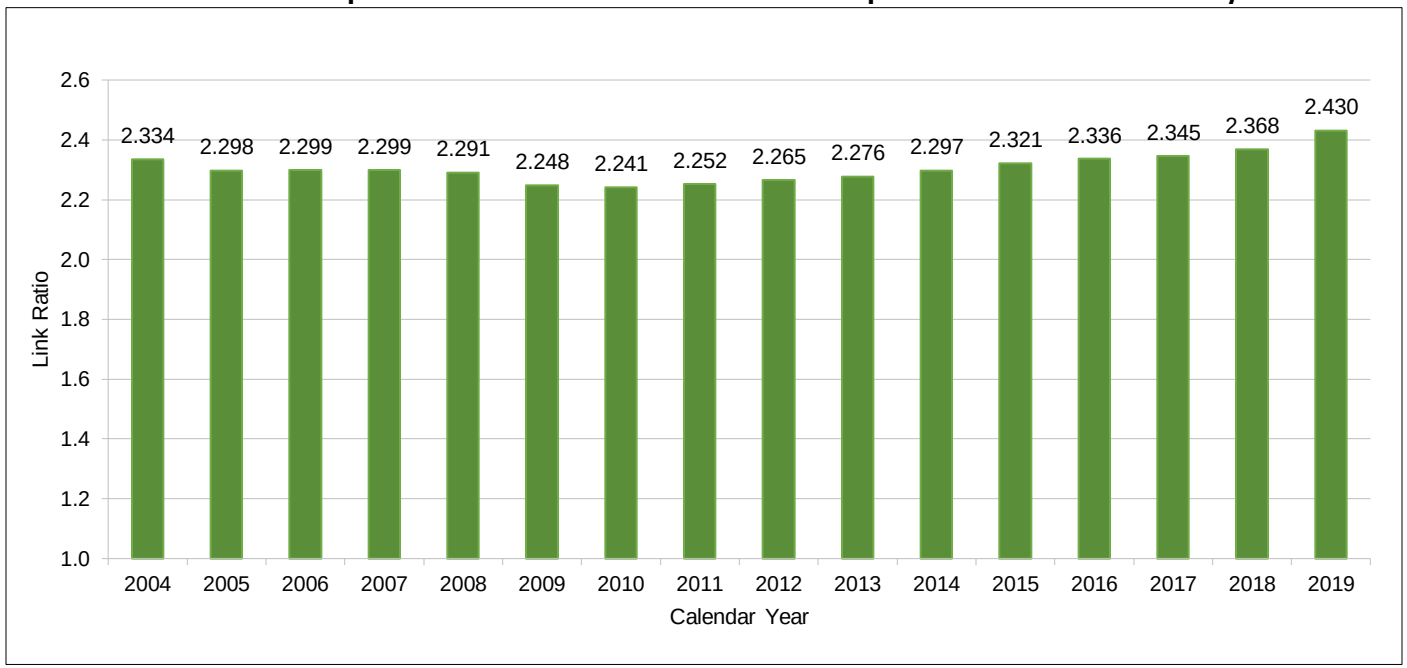
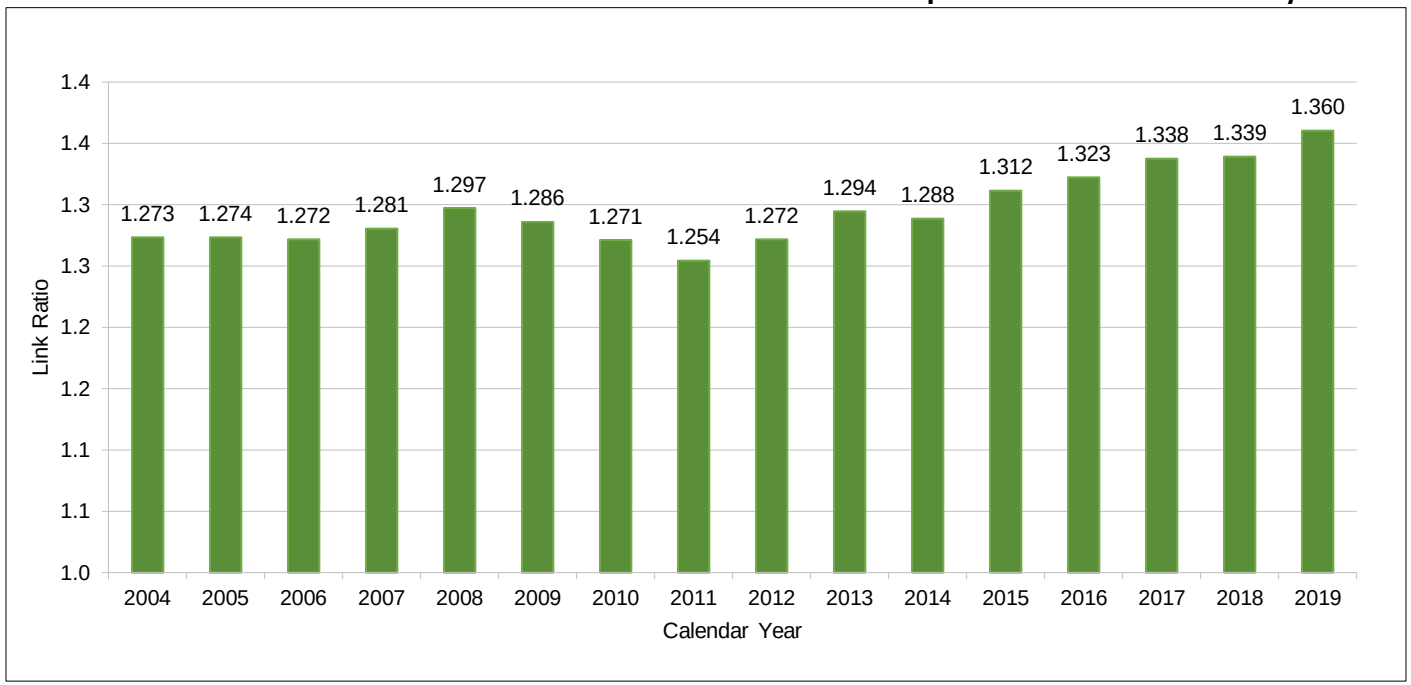


Chart D4. Net case incurred loss and DCC CYR 12–60 loss development factors—P&C industry



Appendix E. Product Liability—Occurrence Charts

Chart E1. Net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

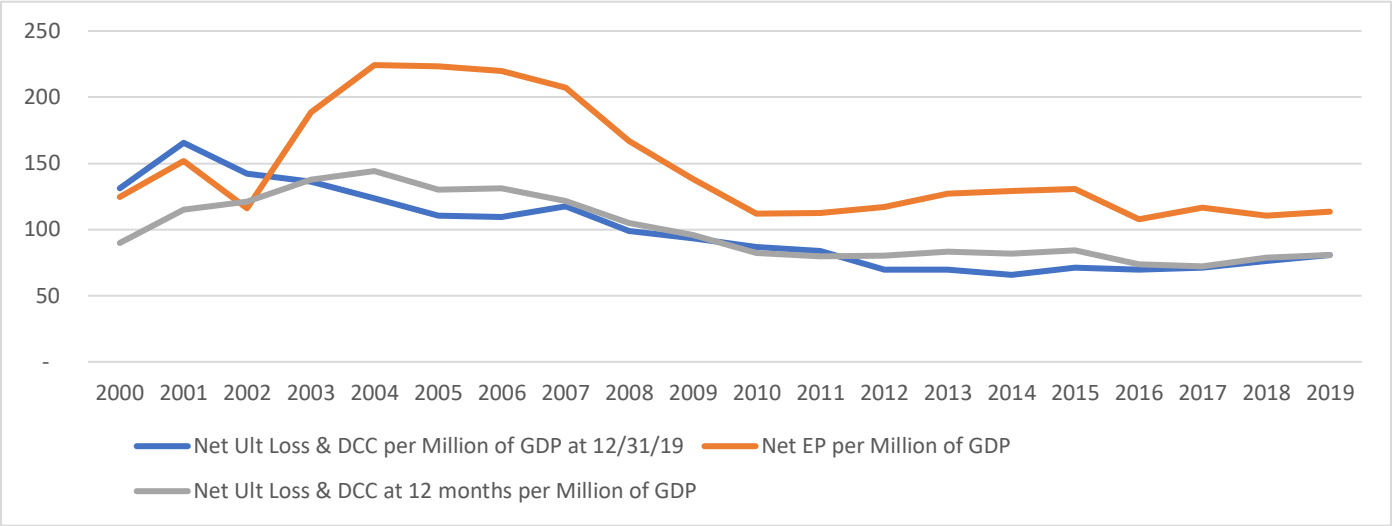


Chart E2. Change in net earned premium and ultimate loss and DCC to GDP in $ millions by accident year

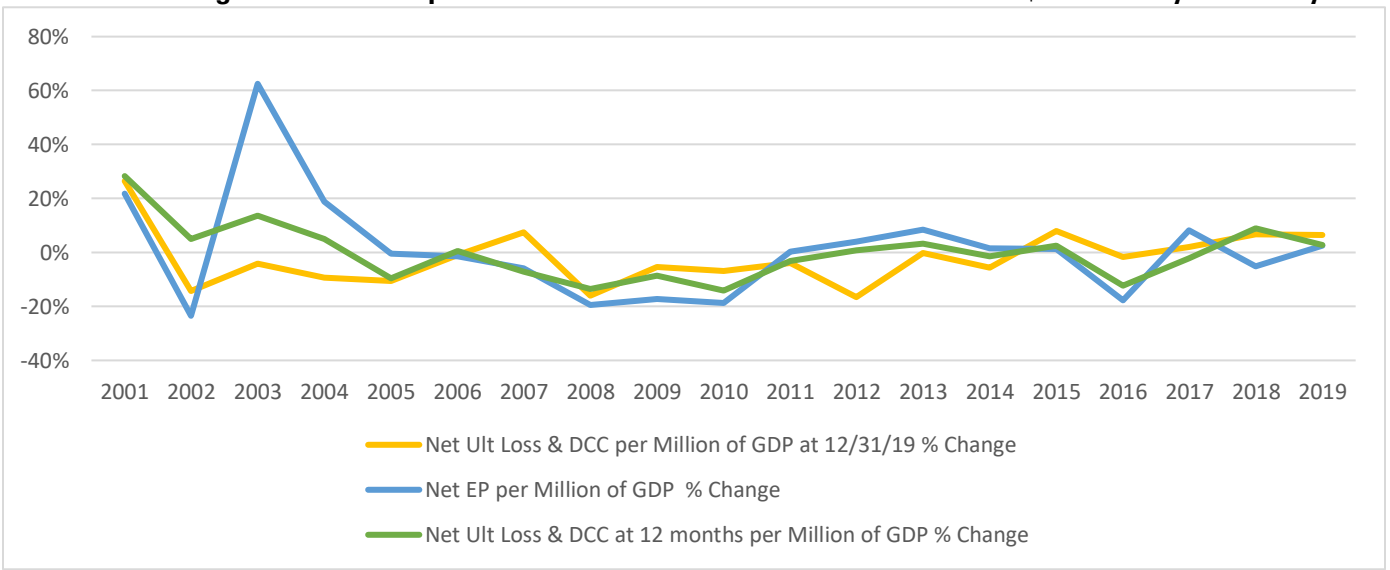


Table E1. Net paid loss and DCC link ratio—P&C industry

Acc Year	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	CYR 12-60
2000	2.955	1.983	1.580	1.227	1.163	1.118	1.130	1.039	1.044	
2001	2.847	2.001	1.574	1.380	1.232	1.135	1.109	1.094	1.067	
2002	2.565	2.097	1.540	1.456	1.228	1.126	1.101	1.078	1.056	
2003	2.793	1.990	1.519	1.360	1.190	1.138	1.121	1.072	1.059	
2004	2.394	1.633	1.780	1.376	1.229	1.133	1.114	1.076	1.058	11.306
2005	1.854	2.858	1.844	1.467	1.268	1.140	1.119	1.090	1.067	10.129
2006	3.592	2.130	1.670	1.358	1.176	1.133	1.105	1.073	1.064	6.697
2007	2.784	1.985	1.584	1.472	1.218	1.090	1.067	1.052	1.070	24.859
2008	2.665	1.906	1.552	1.337	1.203	1.089	1.086	1.065	1.052	15.049
2009	2.542	1.948	1.481	1.332	1.155	1.141	1.101	1.075	1.063	12.963
2010	3.137	1.906	1.524	1.337	1.152	1.106	1.071	1.043	1.036	10.425
2011	3.225	1.798	1.543	1.418	1.173	1.095	1.091	1.048		13.955
2012	3.084	1.936	1.517	1.305	1.163	1.117	1.079			12.165
2013	2.685	1.932	1.525	1.276	1.174	1.101				11.252
2014	3.107	1.751	1.549	1.289	1.168					10.727
2015	2.942	1.776	1.541	1.322						12.913
2016	2.987	1.954	1.623							10.250
2017	3.291	1.796								10.481
2018	3.939									12.771
2019										15.183

Chart E3. Net paid loss and DCC CYR 12–60 loss development factors—P&C industry

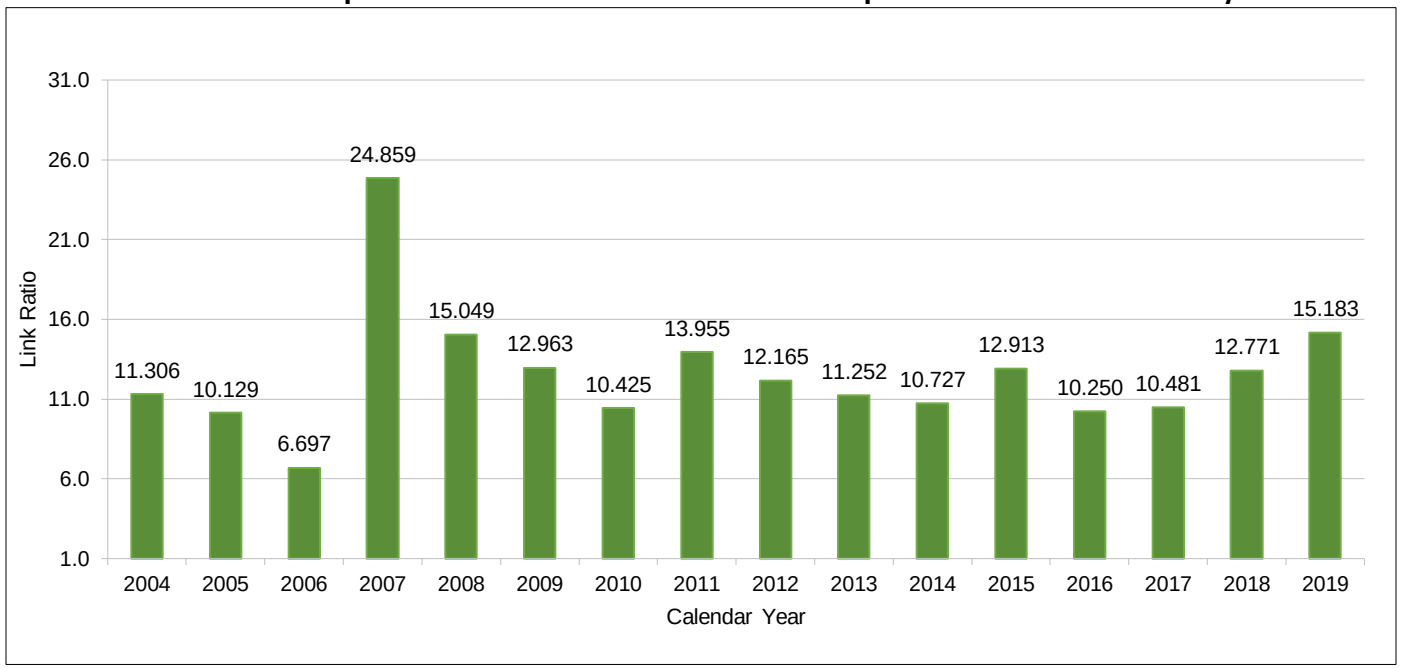


Chart E4. Net case incurred loss and DCC CYR 12–60 loss development factors—P&C industry