

## The Effect Of 2020s Inflationary Spikes on Actuarial Reserve Adequacy

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### Abstract

*The article examines the impact of inflationary spikes in the early 2020s on the adequacy of actuarial reserves in the property and casualty (P&C) segment, identifying the drivers of systematic delays in adjusting these reserves. The relevance of the study is determined by the fact that loss reserves constitute the core of an insurer's financial resilience. At the same time, the structural break in inflation trends from 2021 to 2024 disrupted the baseline stationarity premise upon which classical reserving methodologies implicitly rest. The objective is to provide an integrated assessment of how macro-inflationary shocks transmit into claim severity and generate the phenomenon of inflation recognition lag, as well as to compare the sensitivity of traditional approaches (Chain Ladder, Bornhuetter–Ferguson) to the new inflation regime. Scientific novelty lies in integrating a macro-level analysis of CPI and industry-specific inflation drivers with a micro-level examination of Allstate's public reporting (10-K) and a quantitative assessment of the temporal lag in reserve responses to inflation. It is shown that parameter inertia in Chain Ladder and the anchoring of Bornhuetter–Ferguson to a priori expectations create an under-reserving risk in accident years, followed by sharp reserve strengthening; in the Allstate case, the 2021 inflation impulse was fully reflected in reserves only in 2022 (strengthening on the order of \$1.7 bn). Additionally, it is substantiated that the decisive role is played not by the headline CPI, but by the insurer-specific inflation basket (including repairs, parts, and medical care) and the multiplicative overlay of social inflation, which amplifies pressure in long-tail liability lines. The article may be helpful for actuaries, risk managers, and financial executives of P&C insurers developing robust reserving procedures under non-stationary inflation.*

**Keywords:** reserve adequacy, actuarial models, inflation recognition lag, Chain Ladder method, social inflation, Allstate, consumer price index, stochastic reserving

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### 1. Introduction

In the early 2020s, the global insurance industry faced an unprecedented combination of risks. The global economy had not taken on this combination of risks in some time. The era of the Great Moderation, a period of low, stable, and predictable inflation, had ended. The world was then faced with increased turbulence, as the

COVID-19 pandemic, global supply chain disruptions, geopolitical conflicts, and record-high monetary stimuli came into play (Su et al., 2025). For the Property & Casualty (P&C) sector, these macroeconomic shifts constituted a severe stress test, exposing fundamental

vulnerabilities embedded in classical approaches to liability valuation.

The relevance of this study is driven by the critical role of actuarial reserve accuracy in ensuring insurers' financial stability and protecting policyholder interests. Loss reserves represent the largest liability item on a P&C insurer's balance sheet, and even minor deviations in assumptions may yield material distortions in reported earnings and capital (Cai et al., 2024). Traditional actuarial methods, such as the Chain Ladder approach, implicitly assume that historical loss development patterns, including their inflation component, will remain unchanged in the future (De Felice & Moriconi, 2023). However, the structural break in inflation dynamics that emerged in 2021 violated this stationarity condition.

Inflation affects the insurance business through the mechanism of increasing claim severity. The abrupt escalation in the costs of spare parts, construction materials, medical services, and labor resulted in claim settlement costs that substantially exceeded forecasts embedded in pricing and reserves. The situation was further compounded by the phenomenon of social inflation, the growth in litigation costs and compensation awards that often outpaces general economic inflation (Bostjancic, 2025). Under these conditions, the question of how timely and adequately actuarial models respond to external regime changes becomes central to assessing sector resilience.

A key problem addressed in this paper is the inability of traditional, retrospectively oriented reserving methods to adapt instantaneously to abrupt changes in the inflation regime, thereby producing an inflation recognition lag. In stable economic environments, actuarial models efficiently smooth random fluctuations (noise), delivering robust estimates. Yet under a powerful external shock, such as the 2021–2024 inflation surge, smoothing mechanisms may operate adversely for insurers by interpreting early signals of increasing loss costs as anomalies rather than as a regime shift (De Felice & Moriconi, 2023).

This dynamic leads to systematic under-reserving at the time losses arise (in the accident year) and to subsequent catch-up reserving or reserve strengthening in future calendar periods. Such delayed recognition of liabilities distorts financial statements, creates an illusory sense of short-term profitability, and may ultimately lead to capital strain over longer horizons. Particular complexity arises from the overlay of economic inflation with social

inflation, generating a multiplicative effect on loss costs in liability lines with long-tailed development.

The objective of this study is to identify and substantiate the mechanisms through which inflationary shocks of the early 2020s affect the adequacy of actuarial reserves in property and casualty insurance, with particular emphasis on the emergence of delayed loss recognition and systematic reserve understatement under traditional reserving methodologies.

To achieve this objective, the following tasks are addressed:

1. To conduct an in-depth analysis of the mathematical nature of traditional reserving methods (Chain Ladder, Bornhuetter-Ferguson) to identify their sensitivity to inflation shocks and the mechanisms underlying systematic bias.
2. To test, using Allstate Corporation financial reporting data and U.S. macroeconomic statistics (CPI), the hypothesis of a temporal lag between an inflation spike and reserve adjustments.
3. To assess the contribution of different inflation components, economic (parts, labor, medical costs) and social (litigation expenses), to claim severity dynamics.
4. To compare the response of different portfolio segments (auto insurance, property insurance) to inflationary pressure.
5. To develop proposals for improving actuarial methodology, including the adoption of models with explicit inflation components and reserve stress testing.

The scientific contribution of the study consists in empirically demonstrating the existence and magnitude of an inflation recognition lag in actuarial reserving under post-pandemic inflation conditions. Using post-2020 data, the study quantitatively links macro-inflationary shocks to delayed reserve adjustments at the insurer level and shows that traditional reserving methods exhibit systematic inertia under structural breaks in inflation. In addition, the study extends the conventional inflation framework by incorporating social inflation as a multiplicative factor affecting long-tail liability reserves.

Scientific novelty is also expressed in the quantitative assessment of the temporal lag of reserve responses to inflation. For the first time, using post-pandemic data, an econometric evaluation is conducted of the delay with which reserves respond to changes in inflation. Results are consistent with the hypothesis of lagged actuarial

adjustments, and will provide a greater understanding of how reserves have responded to inflation pressure in the current environment.

A further synthesis is developed to extend the customary concept of economic inflation to include social inflation in the insurance context of this study. This allows their cumulative effect to be evaluated and their overall effects on the adequacy of reserves to be assessed under the uncertain macroeconomic conditions present in the current environment.

## 2. Materials and Methodology

The study combines elements of actuarial mathematics and econometrics with a financial analysis and qualitative description of trends and potential development in the industry.

This analysis was based on academic literature and professional literature including refereed actuarial journals and professional associations' literature. The analysis was particularly focused on the progression of reserving models from classical deterministic algorithms to more dynamic models that explicitly take inflation into account. In the literature review, the theoretical limitations of existing models for an external non-stationarity scenario were outlined.

Allstate Corporation was selected as the primary object of empirical analysis. This selection is motivated by the fact that Allstate is among the largest U.S. personal lines insurers, including auto insurance and homeowner's insurance; accordingly, its metrics may be treated as representative for analyzing key industry trends.

An additional rationale is the high availability and granularity of the company's public disclosures. In Allstate's 10-K filings, expanded data are provided, including loss development triangles and information on prior-year reserve re-estimates, forming a reliable empirical foundation for quantitative analysis of liability dynamics and actuarial adjustments.

Finally, the Allstate choice is justified by the high sensitivity of its portfolio to inflation factors. The portfolio is concentrated in lines such as auto physical damage and auto liability, which are most exposed to parts inflation, repair cost escalation, and medical cost growth, rendering the company an appropriate case for examining the relationship between inflation and reserving behavior.

To quantitatively test the hypothesis of an inflation recognition lag, regression analysis was applied. The

relationship between the magnitude of reserve adjustments (dependent variable) and CPI inflation in prior periods (independent variable) was modeled. This enabled a statistical assessment of the presence and direction of linkage between past economic shocks and current actuarial decisions.

The empirical base is formed from several source groups. First, macroeconomic statistics were utilized, including data from the U.S. Bureau of Labor Statistics (BLS) on the Consumer Price Index for All Urban Consumers (CPI-U). Both the headline index and subindices, which reflect price dynamics in transportation, medical services, and motor vehicle repair, were utilized. Indicators were analyzed in both monthly and annual dynamics from 2015 to 2024.

Second, corporate financial reporting was employed. Allstate Corporation's Annual Reports on Form 10-K filed with the U.S. Securities and Exchange Commission for 2020, 2021, 2022, 2023, and 2024 were examined for loss reserve development, prior year reserve re-estimates, and management's description of loss experience in the MD&A (Management Discussion and Analysis).

Third, industry analytics and academic publications were incorporated, including reports from the CAS and the Insurance Information Institute (III) on social inflation and its impact on commercial auto insurance. Studies by reinsurance companies Swiss Re (Sigma Series), addressing global inflation risks and their effects on the insurance sector, were also utilized, along with analytical materials from the Big Four consultancies on insurance market outlooks.

## 3. Results and Discussion

### 3.1. Macroeconomic context: Anatomy of the 2020s inflation shock

To understand the dynamics of insurance reserves, the nature of the inflation surge confronting the U.S. economy in the analyzed period must be examined in detail. Unlike the monetary inflation episodes of prior decades, inflation in 2021–2024 exhibited a complex, multifactor structure, complicating its forecasting (Blanchard & Bernanke, 2024).

After deflationary shocks from 2020's COVID-19 pandemic lockdowns deflated demand and people moved less, inflation rapidly rose in 2021. A CPI-U inflation rate from 1.5 to 2.5% occurs in a normal year. In June 2022

inflation rose to 9.1%. This rate reached the highest point of 40 years (BLS, 2022).

Inflation dynamics in 2020 may be characterized as a pandemic pause of sorts. Lockdowns reduced the frequency of traffic accidents, and temporary deflation was observed in specific sectors. As a result, actuaries recorded artificially depressed loss experience attributable not to structural risk improvement but to short-term shifts in behavior and mobility.

The main factor at work in 2021 was a supply shock: shortages in the supply of semiconductors that sent used car prices up 40% year on year, adding fuel to the inflation of spare part prices. Against this other backdrop, the prices of repairing property damage began to increase, and became the first major transmission channel for inflationary pressure in claims costs.

In 2022, inflation became broad-based. Energy, food, and service prices increased, accompanied by accelerating medical inflation and rising labor costs. This period corresponds to the peak of inflationary pressure on the economy, when multiple sources of price growth intensified simultaneously, creating maximal strain on the structure of insurance costs.

In 2023–2024, the inflation regime is described as sticky inflation. Although the headline CPI began to decline, components most critical to the insurance sector, service costs, medical care, and repairs, exhibited resistance (stickiness) to deceleration. As a result, growth rates in these categories remained elevated, sustaining prolonged inflationary pressure, particularly in the segments that directly determine claim settlement costs (Blanchard & Bernanke, 2024).

The analysis indicates that the inflation basket of a P&C insurer differs materially from the consumer basket (Léonard & Conlon, 2023). This implies that headline CPI does not fully reflect the cost structure faced by insurers in claim settlement, because the principal drivers of claim payments are formed in other segments of the economy and follow distinct price dynamics.

In particular, auto parts and repair costs play a substantial role. Component shortages, combined with wage growth in repair services, resulted in repair-cost inflation (severity) exceeding the headline CPI. Consequently, motor vehicle restoration cost escalation became one of the most pronounced channels through which inflation translated into higher insurance payments.

Medical services represent another significant factor. Medical inflation (Medical CPI) has historically

outpaced headline inflation; in the analyzed period, its dynamics were additionally reinforced by pent-up post-pandemic demand for care and rising provider costs. This creates upward pressure on claim payments in lines where medical costs constitute a substantial portion of losses.

Finally, labor costs form an essential component of the insurer's inflation basket. Wage growth in construction and services has a direct influence on claim settlement costs in homeowners' and commercial property insurance, as a significant share of expenses in these lines is associated with labor, restoration work, and service operations.

### ***3.2. Theoretical analysis: Crisis of traditional reserving methods***

The inflation shock of the 2020s served as a stress test for classical actuarial models. An analysis of the theoretical foundations of Chain Ladder (CL) and Bornhuetter-Ferguson (BF) helps explain their vulnerability to abrupt macroeconomic changes.

The CL method is considered the gold standard for reserving due to its simplicity and intuitive interpretability. It is based on the fundamental assumption that past loss development patterns will repeat in the future (Vanegas et al., 2024). Mathematically, this implies that development factors (link ratios) computed from historical triangles implicitly embed information about past inflation.

If inflation is stable, the method performs adequately, as the historical average inflation is projected into future payments. However, under a sharp acceleration in inflation, i.e., a structural shift in price dynamics, systematic bias emerges. This bias arises because development parameters, by construction, rely on inertial regularities of the prior period and thus cannot instantaneously incorporate a new inflation regime that qualitatively differs from the previous one.

The key mechanism is inertia. Development factors (LDF), averaged over 3–5 years, inevitably dilute the influence of the most recent high-inflation year with observations from earlier years when inflationary pressure was materially lower. As a result, the estimated development dynamics become smoothed and lagging, and the contribution of the current price jump is statistically understated.

A related manifestation is the projection of the past. The method transfers low historical inflation into future periods, where realized inflation is high. Such

extrapolation generates a forecast that effectively continues the prior price trajectory even though the economic environment has shifted into a different regime, thereby reducing the realism of expected future payments.

The diagonal effect provides an additional explanation. Inflation acts along the diagonals of the triangle, i.e., by calendar year, simultaneously increasing payments for all accident years. The Classical Chain Ladder, which analyzes development by rows, responds with delay because it interprets observed increases as random deviations until the diagonal trend becomes sufficiently pronounced and persistent.

As a result, under sharp inflation growth, Chain Ladder systematically understates reserves. The reason is that its forecasting logic is more oriented backward, toward reproducing historical regularities, than forward, where rapid reflection of the new inflation regime in expected claim settlement costs is required.

The Bornhuetter-Ferguson (BF) method is often used to estimate reserves for immature accident years when payment data remain sparse. It represents a weighted combination of expected losses (a priori) and observed experience (Maulidiah et al., 2025).

During inflation shocks, BF is exposed to anchoring bias. This is because the method relies on an a priori expectation of future loss experience, which sets the initial frame for calculations and may retain excessive influence even when the external environment changes rapidly, and prior benchmarks lose relevance.

The a priori expected loss ratio (ELR) is often taken from pricing or business planning processes. If rates are not adjusted for inflation promptly, for example, due to regulatory lags or competitive pressure, then the ELR becomes understated relative to actual cost dynamics. In that case, the foundational premise of the method systematically diverges from real claim settlement conditions.

BF binds the reserve to this understated expectation because, at early development stages, observed data receive limited weight in the calculation. Consequently, early signals of rising actual payments may be partially ignored, and the estimate is adjusted only with delay, once accumulated data become sufficiently large to pull the calculation toward observed reality.

Thus, BF, used under normal conditions to stabilize Chain Ladder estimate volatility, may, under inflation shocks, instead preserve an underestimation error. The stabilizing effect in this regime transforms into a mechanism that holds the calculation near an incorrect anchor, increasing the risk of systematic reserve understatement.

**3.3. Empirical analysis: The Allstate Corporation case**

A detailed analysis of Allstate’s disclosures enables the tracing of the practical realization of theoretical risks.

Data from Allstate’s 10-K filings for 2020–2024 demonstrate a clear correlation between inflation trends and reserve behavior (SEC, 2021; SEC, 2022; SEC, 2023; SEC, 2024). Table 1 presents a comparison of CPI inflation and Allstate reserve revaluation (2020–2024).

**Table 1.** Comparison of CPI Inflation and Allstate Reserve Revaluation (2020–2024)

Reserving year (t)	CPI inflation (t-1), %	Prior-year reserve revaluation (\$m)	Revaluation direction	Period characteristics
2020	1.8	-436	Release	Low-inflation period, favorable development
2021	1.2	+122	Slight strengthening	Start of inflation increase, lagged effect
2022	4.7	+1,741	Significant strengthening	Inflation peak, recognition of a structural shift
2023	8.0	+549	Strengthening	High-inflation inertia, tail of adjustments
2024	4.1	-308	Release	Inflation stabilization, model adaptation

The dynamics of Allstate's reserve adjustments in the analyzed period reflect the inflation regime shift and the manner in which this shift gradually permeates actuarial estimates. In 2020, against the backdrop of low inflation (2019 inflation at 1.8%) and a simultaneous decline in claim frequency due to the pandemic, the company released reserves of \$436 million. This outcome may be interpreted as confidence in the persistence of observed trends and in the statistical support for the reduction in loss experience.

In 2021, inflation began to accelerate; however, the reserve response remained minimal, with a strengthening of only \$122 million. This situation corresponds to the classical inflation recognition lag, where neither model parameters nor expert judgment had yet fully incorporated the new trend, likely perceiving it as temporary. The transitory inflation model in use at that time by the United States Federal Reserve could be seen as consistent with an inertial view of expectations.

By 2022, the signals became so obvious as to become impossible to deny. Though inflation was 4.7% in 2021 and continued to have an impact in 2022, Allstate's \$1.74 billion charge to strengthen reserves and recognize an underwriting shortfall from earlier years indicates their true state of affairs. The lines of business most affected in the program were the auto lines, Physical Damage and Bodily Injury, which tend to be most sensitive to repair cost inflation, parts inflation and medical cost inflation.

Given 8.0% inflation in 2022, the equivalent amount in 2023 dollars is \$549 million. This pattern suggests that the most substantial adaptation had already occurred in 2022, while in 2023, actuarial models and management assumptions operated with more adequate baseline

settings, i.e., they aligned more closely with the updated economic reality.

In 2024, a return to reserve release of \$308 million is observed, which may be interpreted as evidence of the absorption of the inflation shock. At the same time, this interpretation allows for the possibility that, during 2022–2023, the company may have formed an excessive reserve level, acting more conservatively amid elevated uncertainty and seeking to mitigate the risk of further deterioration in inflation dynamics.

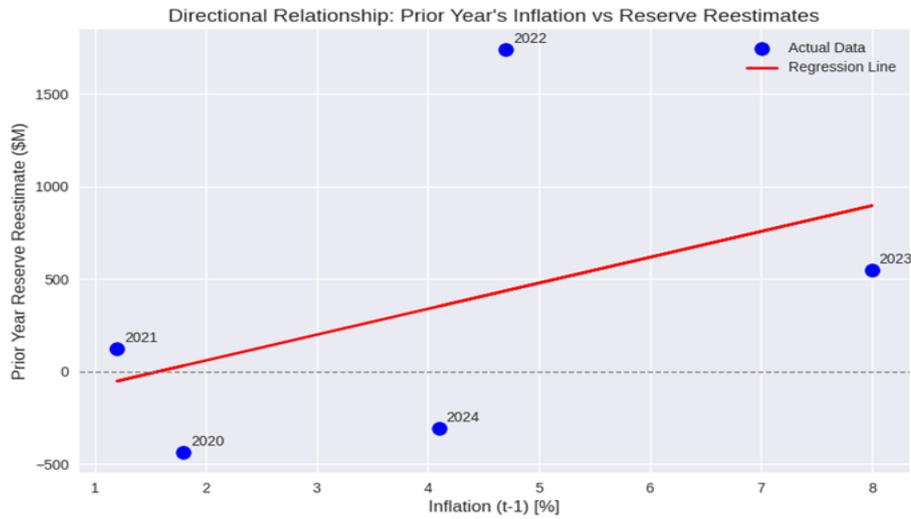
To formally test the hypothesis that prior-year inflation influences current-year reserve strengthening, a linear regression model was estimated. Model specification:

$$\text{Reserve Reestimate } (t) = \alpha + \beta * \text{Inflation } (t - 1) + \varepsilon (t)$$

where *Reserve Reestimate* (*t*) is the amount of reserve revaluation in year *t* (\$m), *Inflation* (*t* - 1) is the annual CPI inflation rate in year *t*-1 (in unit fractions).

Based on the estimation results, the coefficient  $\beta$  equals 13,946.86. In applied terms, this implies that a 1 percentage point increase in prior-year inflation (i.e., 0.01) is associated with a reserve strengthening increase of approximately \$139 million in the current year. Because the coefficient of determination  $R^2$  equals 0.183, inflation explains 18.3% of the variation as the reserve revaluation. The P-value is 0.472.

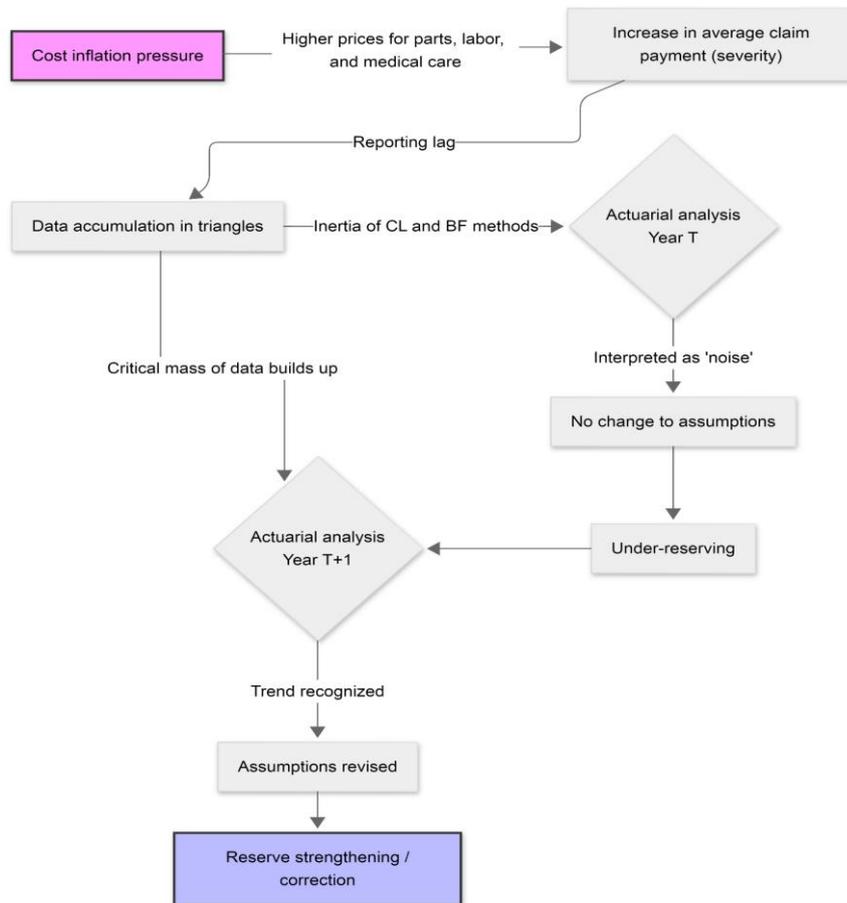
The P-value does not meet the usual 0.05 importance level since  $n=5$  but the coefficient sign ( $\beta > 0$ ) and magnitude support the hypothesis since they matter economically. The positive association suggests that higher inflation in the past may lead to a future need to increase reserves. The low  $R^2$  suggests that inflation is not the sole factor. Relationship Between Prior-Year Inflation (*t*-1) and Reserve Reestimates illustrated in Figure 1.



**Fig. 1.** Relationship Between Prior-Year Inflation (t-1) and Reserve Reestimates

A substantial role is also played by social inflation, legislative changes, internal claim-handling processes, and management strategy.

**Figure 2** demonstrates the mechanism of inflation lag in reserving.



**Figure 2.** The mechanism of inflation lag in the reservation

### 3.4. The Social Inflation phenomenon

The analysis would be incomplete without addressing social inflation, a factor that operates in parallel with economic inflation and amplifies pressure on reserves, especially in liability segments.

Social inflation is understood as growth in the cost of insurance claims beyond the level of general economic inflation, driven by changes in the legal environment and public attitudes.

Key drivers include so-called Nuclear Verdicts, i.e., a sharp increase in the frequency and magnitude of jury awards exceeding \$10m. This phenomenon is linked to shifts in public sentiment, including anti-corporate sentiment, as well as to plaintiff strategies, such as the approach described as the Reptile Theory.

Another factor is Litigation Funding. The development of third-party investment in lawsuits allows plaintiffs to pursue their claims more vigorously and at higher costs, raising DCC (Defense and Cost Containment) costs borne by insurers.

A further contributing factor is the expansion of liability boundaries; statutory and judicial expansion of the coverages increases the potential volume of insurance payouts. Reviver statutes have been mentioned in this context, as they provide new and retrospective opportunities for claimants to bring liability claims and create increased liability coverage for insurers.

According to a 2024 report by Swiss Re and CAS, U.S. social inflation grew 5.4% annually from 2017 to 2022, versus economic inflation at 3.7% during the same period (Swiss Re, 2024). For Allstate, this manifested in substantial reserve strengthening in Bodily Injury and Commercial Auto in 2022 (\$676 million and \$295 million, respectively), which the company directly linked to increased claim severity, litigation costs, and a higher share of attorney-involved claims (SA Transcripts, 2023). Unlike parts prices, social inflation exhibits a longer recognition lag, as litigation can persist for years and the effect materializes in the long tail of loss development.

### 3.5. Comparative analysis: Industry context

Allstate's experience is not unique, and analysis of competitors, including Progressive, Travelers, and GEICO, confirms the systemic character of the problem. This implies that the inflation shock manifested not as a localized feature of a single company but as a market-wide stress factor that was sequentially reflected in reserve estimates and financial outcomes across insurers.

In 2023, Progressive also had \$1.1 billion of adverse reserve development and positive reserve development in 2022, reflecting a lag period. Yet, even with a highly advanced property-casualty insurer, Jacobs & Leone (2023) reported a 6- to 10-month lag in the reduction of reserves due to inflation, followed by a much faster rate change.

For GEICO, 2022 was a year of sharp deterioration, with a \$1.9bn underwriting loss, mostly driven by claim severity. In 2023, GEICO's improvement was driven by expense reductions, rate increases, and releases of prior year reserves, which may imply that the company follows a more aggressive (or volatile) reserving policy (Sclafane, 2024).

A comparison of these cases indicates that the inflation shock indeed had a market wide effect. However, the timing and the magnitude of re-assessments was sensitive to the portfolio composition and conservatism of the underlying actuarial models that determine how soon a new pricing regime gets translated into reserve movements.

## 4. Conclusions

Inflationary pressures during the 2020s re-evaluated actuarial reserving. This research shows that reserving practices that assume experience is stable over time are subject to recognition lag in the event of an anomaly. Under a sharp macroeconomic inflection, this lag leads to a predictable underestimation of liabilities, as estimation procedures are stuck reproducing inertia from the previous regime.

Further, Allstate data suggests that the 2021 inflation shock was not fully reflected in reserves until 2022, as the company increased all reserves in 2022 by around US\$1.7 billion. Regression analysis, in turn, identified a positive and economically meaningful relationship between past inflation and current reserve strengthening, thereby documenting statistical alignment between the inflation impulse and subsequent actuarial adjustment.

At the same time, the critical factor proved not to be headline inflation, but rather the specific growth in loss components, including spare parts and medical services, as well as the overlay of social inflation, which acts as a multiplier for liability lines. In such a structure, inflationary pressure manifests unevenly, concentrating in the very cost elements that determine claim severity and therefore translates more rapidly and more strongly into the need for additional reserves.

The results also indicate a methodological impasse: Chain Ladder and Bornhuetter-Ferguson, in their classical forms, exhibit pronounced inertia and do not enable a prompt reaction to structural shifts. Under inflation shocks, the problem is reinforced by anchoring to outdated a priori coefficients, whereby the computational logic may entrench underestimation instead of neutralizing it at an early stage.

The practical significance of the study lies in emphasizing the need to implement more dynamic models with explicit inflation parameters in actuarial practice. In particular, insurers are advised to utilize diagonal methods, such as the Separation Method, to identify calendar-year inflation effects, introduce scenario-based stress testing of reserves for hyperinflation, and strengthen feedback loops between claims departments and actuarial functions to detect social inflation trends earlier.

While the empirical evidence is based on a single-insurer case study, the results are consistent with broader industry observations and support the conclusion that inflation shocks are not immediately incorporated into actuarial reserves. This suggests that the identified mechanisms are structural rather than idiosyncratic, although further multi-insurer research is required to generalize the findings.

In the long run, the transition to more sensitive and adaptive reserving models becomes not merely a desirable enhancement, but a condition for survival and for maintaining the financial stability of insurance companies in a world of elevated macroeconomic uncertainty.

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