How's the Recovery? Salvage and Subrogation in the Property Liability Insurance Industry

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IMPORTANCE U.S. property-liability insurers rely on salvage and subrogation recovery to reduce the overall size of claims. The decisions made by insurers with respect to these two processes could materially impact their operations as well as consumers.

OBJECTIVES In this study we conduct an empirical analysis to identify firm-specific characteristics associated with the speed of salvage and subrogation recovery. Among the unique contributions of this study, we focus on both property *and* liability lines of business which allows us to indirectly account for salvage and subrogation independently from one another. Additionally, we consider commercial as well as personal auto lines of business, which provides for settings where key differences exist.

EVIDENCE The financial impact associated with the ability to recover a portion of paid losses cannot be overstated. In 2021, insurers recovered nearly $51.6 billion for the auto physical damage, commercial auto liability, and personal auto liability lines of business combined.[1] It was also recently estimated that missed subrogation opportunities cost the insurance industry $15 billion annually (Harman, 2021).[2]

FINDINGS With respect to auto physical damage coverage, we observe that firm size, age, leverage, profitability, accrual decisions, and the importance of the auto physical damage line to the insurer are positively related to the speed of recovery. We also find that the recovery rate tends to be slower for members of an insurance group. The results for personal and commercial auto liability lines are mixed. In particular, we find that factors such as leverage, diversification, and the importance of the commercial auto liability line on an insurer's portfolio of business impact recovery speed for the commercial auto lability line, whereas profitability, leverage, firm size, and age each affect recovery speed for the personal auto liability line.

CONCLUSION AND RELEVANCE Insurers may look to salvage and subrogation recoveries as a way to keep claim costs down. Furthermore, an understanding of recovery efforts may impact the decision-making process for managers and allow them to more efficiently oversee the collection of salvage and subrogation. Policyholders are concerned with reimbursement of out-of-pocket expenses associated with losses as well as the premiums they are charged, both of which are impacted by salvage and subrogation recovery and the speed that recovery takes place. Finally, regulators, whose job it is to ensure the solvency of insurers and who also oversee the rates

1. Authors' calculations based on values reported in the 2021 NAIC annual statements.

2. Harman, P.L., 2021, Insurers are Overlooking Subrogation Options When Paying Claims, *Property & Casualty 360,* Sept. 17, 2021.

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ABSTRACT

Insurers have significant flexibility in the management of the claims process and the degree to which they prioritize the collection of salvage and subrogation. These decisions could materially impact the financial well-being of insurers as well as the prices paid by consumers. Given the potential implications that salvage and subrogation can have for insurers, consumers, and regulators, we investigate the relation between the speed at which U.S. property-liability insurers recover salvage and subrogation and insurer-specific financial and operational characteristics. The analysis is conducted for commercial and personal auto lines of business and studies both physical damage and liability coverages. The findings indicate that factors such as leverage, profitability, size, and accrual decisions are associated with the speed of recovery but that considerable differences exist across coverages.

Keywords: Salvage, subrogation, property-liability insurance, auto insurance, claims

Introduction

Insurers frequently attempt to recoup a portion of the amounts paid for property and liability claims either through the process of salvage or subrogation. With respect to first-party property losses, insurers will often settle the loss by agreeing with the insured as to the amount of payment for the property, and following the settlement, the insurer takes ownership of the damaged property and has the right to sell it. The payment received is referred to as salvage, and this amount can offset the total amount paid for the claim. Additionally, insurers can also use subrogation as a form of recovery. In this case, the insurer, upon paying a claim for a loss covered under the policy, acquires the right to recover from a tortfeasor the full or proportionate amount of the benefits paid to the insured (Trefz, 2013). The amount of subrogation is limited to the amount of the loss payment made to the insured (Skurnick, 1973), such that the insurer cannot profit through subrogation. The insurers' rights of both salvage and subrogation are established in the issued policies, and both are at the discretion of the insurer upon the payment of a claim.[1]

The financial impact associated with an insurer's ability to recover a portion of paid losses cannot be overstated. In 2021 alone, insurers were able to recover nearly $51.6 billion for the auto physical damage, commercial auto liability, and personal auto liability lines of business combined.[2] It was also recently estimated that missed subrogation opportunities cost the insurance industry $15 billion annually (Harman, 2021). Although the claims department is not intended to be a revenue-generating area (Colquitt & Dumm, 2000), it would seem prudent for insurers to pursue all reasonable avenues for recovery, including through salvage and/or subrogation. However, there are many companies that do not maximize their opportunities in the pursuit of salvage and subrogation (Colquitt & Dumm, 2000). The reasons why firms may not pursue recovery are varied. Some insurers may establish benchmarks for recovery (Carris & Bartlett, 1995) and, upon reaching those benchmarks, limit additional recovery efforts. Other companies may simply act irrationally by not pursuing the recovery available through salvage and subrogation (Carris & Bartlett, 1995). Wickert and Nelson (1995) argue that some firms may either take a "defensive mindset" rather than using subrogation more proactively while others "are shoddy in their investigation of a case's subrogation potential." Another reason for the variation may be the fact that insurance, especially personal auto insurance, has more recently been viewed by many consumers as a commodity (O'Brien, 2012; Burand, 2015).[3] This view has driven insurance companies to reduce premiums (O'Brien, 2012), which, in turn, leads insurers to further attempt to manage costs, including those associated with the collection of

1. It should be noted that endorsements exist, which can place restrictions on the ability to subrogate against a negligent third party. For example, the "Waiver of Our Rights to Recover from Others Endorsement" (Form WC 00 03 13) to the Workers' Compensation and Employers' Liability Insurance Policy allows the insured to eliminate the insurer's right of recovery against specifically listed individuals and organizations. With regards to auto insurance, a similar endorsement exists for commercial auto liability. More specifically, an (Insurance Services Office (ISO) endorsement (Form CA 04 44 10 13) entitled "Waiver of Transfer of Rights of Recovery Against Others to Us (Waiver of Subrogation)" may be used to modify the Business Auto Coverage Form, Motor Carrier Coverage Form, and Auto Dealers Coverage Form.

2. Authors' calculations based on values reported in the 2021 NAIC annual statements.

3. Although personal auto insurance is often considered a commodity by consumers, other lines of insurance are also affected by this mentality (O'Brien, 2012).

salvage and subrogation. Although both internal and external factors may impede insurer salvage and subrogation recovery efforts, the advancement of technology and proliferation of available data have almost certainly created opportunities for insurers to improve their level of recovery and to do so at a lower cost than what may have been possible in the past.

The issue of salvage and subrogation has largely been overlooked in the academic literature, even as the degree to which insurers rely on both continues to vary considerably across firms. This is of particular importance because salvage and subrogation can potentially impact both insurers as well as insureds, as salvage and subrogation may allow insurers to keep rates lower than they would otherwise be without these recovery options (Riggio, 2020).[4] Although prior literature has studied the degree to which salvage and subrogation take place (i.e., Colquitt & Dumm, 2000), to our knowledge, no such research has been conducted that studies the speed of recovery. We contend that the speed at which this process takes place is significant, as greater speed equates with a more efficient ability to match claims payments to the actual recovery and may lead to greater certainty and predictability regarding future recovery.[5] The primary objective of this study is to examine how firm-specific financial and operational characteristics impact the speed of salvage and subrogation recovery in both personal and commercial auto insurance for physical damage and liability coverages.[6] Our focus on physical damage and liability lines of business is particularly noteworthy as past research has primarily been concerned with physical damage coverage with little emphasis on liability.[7] This study is also timely, as claims payments are greatly influenced by inflation. The current economic environment results in a situation where, all else equal, the cost to repair or replace property will increase, and the impact those increases have on carriers and consumers may be controlled or limited through the effective use of salvage and subrogation.[8]

As a preview of our results, we find that firm characteristics such as firm size, profitability, organizational form, and line of business specialization are all related to recovery speed for the auto physical damage line of business. However, while numerous organizational and financial characteristics are associated with salvage and subrogation recovery for auto physical damage, which is more short-tailed in nature, our results are much more varied for the commercial auto liability and personal auto liability coverages. We argue that the limited and mixed results observed for the two

4. Given the intense competitive pressure which exists in the personal auto line of business, the ability to maintain lower rates and premiums is necessary to ensure sustained competitiveness in the market.

5. Matching claim payments (outflows) with recovery (inflows) permits insurers to use the newly recovered funds more quickly than would otherwise be possible with a prolonged recovery. Given the time value of money, a faster recovery is preferable.

6. The nature of a specific line of business would likely impact the speed of recovery for salvage and/or subrogation. For instance, the recovery period for auto liability may be impacted by the length of litigation associated with various claims, thereby delaying the opportunity to recover salvage and/or subrogation. Even with longer recovery periods for various lines, it seems reasonable that insurance companies would want to proceed with recovery in a timely and efficient manner.

7. The potential exists for a claim to occur where both physical damage and liability claims are made, and this could lead to a delay in the salvage and subrogation recovery process. The available data does not allow for the identification of such cases and, therefore, it is not possible to control for these specific instances. We acknowledge that this would have clear implications for the speed of recovery.

8. It was reported in May 2022 that the Consumer Price Index had increased by 8.6% over the previous 12 months, representing a 40-year high (Rockeman, 2022).

liability (long-tail) lines of business may be attributed to unobservable external factors which insurers may have little control over.

This research should be of interest to insurers, policyholders, and regulators. In an effort to stay competitive and/or to increase market share, insurers may look to salvage and subrogation recoveries as a way to keep claim costs down, allowing them to keep rates lower than they would otherwise be. Furthermore, an understanding of recovery efforts by insurers may impact the decision-making process for managers and allow them to more efficiently oversee the collection of salvage and subrogation. Policyholders, on the other hand, are concerned with reimbursement of out-of-pocket expenses associated with losses as well as the premiums they are charged, both of which are impacted by the insurer's ability to recover at least a portion of loss payments through salvage and subrogation and the speed at which recovery takes place. Finally, regulators, whose job it is to monitor the solvency of insurers and who also oversee the rates charged to consumers, would be interested in better understanding the factors that influence the recovery process.

The remainder of this study is organized as follows. In the next section, we provide a brief overview of relevant literature related to salvage and subrogation in the U.S. property-liability insurance industry as well as offer insights into recent salvage and subrogation trends in the auto physical damage, commercial auto liability, and personal auto liability lines of business. We then discuss the data, methodology, and variables that are employed in this study in order to investigate the influence of firm-specific factors on the speed of recovery. Finally, we present the results of our empirical analysis, followed by concluding remarks.

Relevant Literature and Market Trends

Insurers have many tools at their disposal which can be used to control costs. One frequently relied upon method is to exploit salvage and subrogation to reduce overall loss payments. In general, trade literature has primarily focused on the utilization of subrogation as a way to control claims costs and recover revenue (Hammon, 1979; Wolf, 1986; Credle, 1992; Carris & Bartlett, 1995; Smith & Geraghty, 2016; Harman, 2021). In the research most related to this study, Colquitt and Dumm (2000) investigate salvage and subrogation levels in auto physical damage for U.S. insurers for 1995. They find that larger insurers have economies of scale, leading to a greater recovery for salvage in physical damage claims. They also find that stock insurers have a greater level of recovery, suggesting that stock insurers act more aggressively in expense reduction (through a reduction in loss experience). Finally, the authors show that the average size of the claim handled by the insurer impacts the level of recovery, where firms with a larger average claim size are more aggressive in their recovery efforts. In two more recent studies, researchers empirically examined the firm-specific factors associated with subrogation estimation errors (Ames, Graden, & Sankara, 2017) as well as with the decision to accrue subrogation (Ames, Graden, & Sankara, 2019).

We expand on the work of Colquitt and Dumm (2000) by investigating the trend of salvage and subrogation for a period of over 20 years and by studying the speed of recovery. In addition, rather than focusing exclusively on physical damage claims,

which are most reflective of salvage recovery (Colquitt & Dumm, 2000),[9] we also look at recoveries associated with private passenger auto and commercial/truck auto liability and medical payments, which are more reflective of subrogation recovery. This distinction is important as, while they effectively achieve similar objectives of recovery following the payment of a claim, they are very different processes: One involves the sale of damaged tangible items, while the other frequently requires potentially prolonged negotiation and possible litigation.[10, 11]

Prior to providing a detailed discussion of the empirical approach used to examine salvage and subrogation recovery speed, we first present several trends relevant to this study. To illustrate the variation which exists in the industry, Table 1 presents a summary of firm-level salvage and subrogation recovery activity across all lines of business in the property-liability insurance industry for the period from 1996 to 2021. In Panel A, we report summary statistics for two primary measures of salvage and subrogation: 1) a binary variable equal to one for firms that recover any salvage/subrogation in a given year (*Any Salvage and Subrogation*); and 2) a continuous variable equal to the ratio of salvage and subrogation recovery to net claims payments in a given year (*Salvage and Subrogation to Net Claims Paid*).[12] With regards to the binary variable, we find that over threequarters -of the sample firms recover some amount of salvage and subrogation, suggesting that roughly one out of four property-liability insurers do not make recovery efforts. The continuous variable provides further insight into recovery efforts, and we present the summary statistics for the ratio both for the full sample (including those firms that did not recover salvage and subrogation) and for only the sample of firms with any recovery. Summary statistics indicate that, on average, salvage and subrogation represent 4.5% of net claims paid for the full sample and 6.2% of net claims paid when only considering firms with any positive recovery, with a maximum recovery of nearly 90% of net claims paid.

9. Although we contend that salvage is largely captured in the auto physical damage line of business, it is important to note that auto physical damage property recovery can consist of both salvage and subrogation and that any salvage received is typically a small portion of a totaled vehicle's total value. Additionally, insurers can receive salvage recovery for totaled vehicles that they take possession of, regardless of fault. On the other hand, subrogation value can either be the amount to repair a damaged vehicle or, for a total loss, the remaining loss after salvage recovery, if any. This issue was addressed in a Casualty Actuarial Society (CASACT) seminar (1988) in which the speaker noted, "Although subrogation is a liability concept, you may well find that subrogation actually outweighs salvage even in your company's auto physical damage experience. That's because to speed claim settlement, your company has paid for the physical damage of your not-at-fault insureds and then collected subrogation from the insurance companies of the at-fault drivers." Therefore, while for the purpose of this study, it is assumed that auto physical damage better captures salvage recovery relative to the liability lines of business, we do not argue that it comprises the greater portion of auto physical damage as this is dependent on the amount of subrogation received.

10. With respect to auto physical damage coverages, salvage primarily occurs with vehicles that have been totaled, and only in rare cases may an insurer have the ability to salvage parts from a vehicle that has been repaired.

11. The way in which these processes actually work is highly dependent on the carrier, the insurance product, and the type of claim being made. Furthermore, some firms conduct salvage and subrogation activities internally, while others contract with outside vendors to conduct these activities.

12. The values reported in Table 1 are at the firm level, and data necessary for the construction of the variables is obtained from Schedule P – Part 1 – Summary in the NAIC annual statements. Firms reporting negative salvage and subrogation recovery or negative net claims paid are omitted from the sample, and the continuous variables are winsorized at the 1st and 99th percentiles.

Table 1: Salvage and Subrogation in the U.S. Property-Liability Insurance Industry

Panel A. Variation in Salvage and Subrogation – Summary Statistics

Variables	Mean	Median	Std. Dev.	Min.	Max.
Any Salvage and Subrogation	0.7714	1.0000	0.4199	0.0000	1.0000
Salvage and Subrogation to Net Claims Paid - Full Sample	0.0451	0.0185	0.1119	0.0000	0.8897
Salvage and Subrogation to Net Claims Paid - Any Subrogation	0.0618	0.0315	0.1270	0.0003	0.8897

Any Salvage and Subrogation = binary variable equal to one for firms with any positive salvage and subrogation recovery across all lines of business, 0 otherwise; *Salvage and Subrogation to Net Claims Paid - Full Sample* = ratio of salvage and subrogation recovery to net claims paid for the full sample of firms; *Salvage and Subrogation to Net Claims Paid - Any Subrogation* = ratio of salvage and subrogation recovery to net claims paid for the sample of firms recovering any salvage and subrogation in a given year. Data used for the calculation of variables in Table 1 are obtained from Schedule P – Part 1 – Summary (Columns 10 and 11) reported in the NAIC annual statements. Firms reporting negative salvage and subrogation recovery or negative net claims paid are omitted from the sample and all continuous variables are winsorized at the 1st and 99th percentiles.

Panel B. Variation in Salvage and Subrogation – Univariate Comparisons

Panel B1. Salvage and Subrogation to Net Claims Paid - Full Sample - Quintiles

Q1	Q2	Q3	Q4	Q5
0.00%	0.47%	1.86%	3.82%	16.55%
Q1 - Q2	**Q2 - Q3**	**Q3 - Q4**	**Q4 - Q5**	
-0.47%***	-1.39%***	-1.96%***	-12.74%***	

Panel B2. Salvage and Subrogation to Net Claims Paid - Any Subrogation - Quintiles

Q1	Q2	Q3	Q4	Q5
0.54%	1.77%	3.14%	4.86%	20.61%
Q1 - Q2	**Q2 - Q3**	**Q3 - Q4**	**Q4 - Q5**	
-1.23%***	-1.37%***	-1.72%***	-15.75%***	

*, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively. Values in the columns titled *Q1, Q2, Q3, Q4,* and *Q5* represent mean values for a given variable that falls within quintiles 1, 2, 3, 4, or 5. Values in the columns titled *Q1 - Q2, Q2 - Q3, Q3 - Q4,* and *Q4- Q5* represent the differences in means between the respective quintiles.

In addition to summary statistics, Table 1 (Panel B) also presents univariate comparisons for the continuous measures across quintiles, where firms assigned to Quintile 1 have the lowest ratios of recovery to net claims paid, and those assigned to Quintile 5 have the largest values. Given that a large proportion of firms do not recover salvage and subrogation, we again present the results for the full sample as well as for only those firms with positive recovery. Across Panel B, we observe that there is a statistically significant increase in the ratio moving across each of the quintiles. For the sample of firms that collected any amount of salvage and subrogation in a given year (Panel B2), we find that firms in Quintile 1 had an average recovery that was roughly half a percent of net claims paid, while those in Quintile 5 had an average recovery in excess of 20%, indicating that firms assigned to Quintile 5 had a ratio of recovery to net claims paid that is 37 times greater than those firms assigned to Quintile 1. Furthermore, even across Quintiles 2 through 4, we observe statistically significant increases. In particular,

there is a 228% increase in the ratio of recovery to net claims paid from Quintile 1 to Quintile 2, a 77% increase in the ratio from Quintile 2 to 3, a 55% increase in the ratio from Quintile 3 to 4, and a 324% increase in the ratio from Quintile 4 to Quintile 5. Overall, the results in Panels A and B indicate that while the majority of insurers take advantage of salvage and subrogation efforts, almost a quarter of firms elect not to, and there is significant variation in terms of recovery efforts even amongst those firms that do recover salvage and subrogation relative to net claims paid.

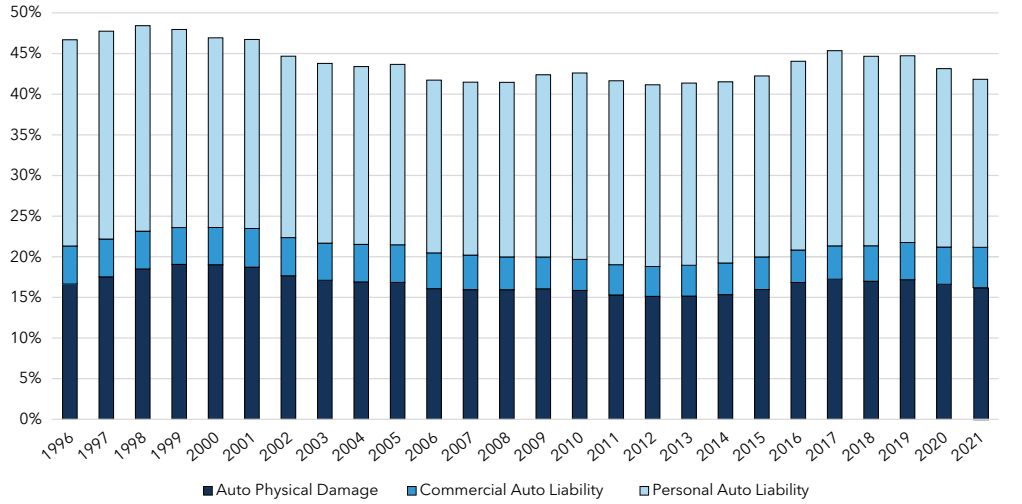
Although Table 1 establishes that there is variation in terms of salvage and subrogation efforts in the industry across all lines of business, it does not directly address the specific lines of business that are the focus of this study, and it is reasonable to believe that differences exist across the different lines. Given our focus on auto physical damage and auto liability lines of business, Figure 1 presents the share of auto insurance premiums relative to those collected for all other lines of property-liability insurance, and it is clear that while the share has fluctuated considerably over the past two and a half decades, it remains an incredibly significant part of the U.S. insurance industry.[13] As illustrated in Figure 1, net premiums written associated with auto physical damage and auto liability lines of business reached a high of nearly 50% of total net premiums written in the industry in 1998, but since that time, there has been a decline of approximately 13.6%, with auto physical damage and liability premiums accounting for 41.8% of total property-liability premiums in the U.S. marketplace in 2021. The steady decline, which has occurred since the late 1990s, may be attributable to the increased role of technology in the industry, the increasing age (and thus declining value) of automobiles on the road, as well as insurers attempting to offer more competitive prices.[14, 15] The trends observed in Figure 1 support our focus on the auto lines of business in this study.

13. The values reported in Figure 1 do not include premiums associated with no-fault coverages.

14. For example, a 2019 report by the U.S. Government Accountability Office (GAO) stated that technology has had the effect of reducing insurer costs associated with consumer communications, underwriting, claims handling, and fraud. Given that auto insurance lends itself to a greater degree of automation than other lines of business (for instance, with regards to underwriting, marketing, and pricing), these reduced costs could presumably result in a decline in the premiums charged to insureds, which could also be responsible for the decline observed in Figure 1.

15. The Bureau of Transportation Statistics reports that the average age of "light" vehicles in the U.S. increased by 44% from 1995 to 2021, with an average age of 8.4 years in 1995 to an average age of 12.1 years in 2021 (data available at *https://www.bts.gov/content/average-age-automobiles-and-trucks-operation-united-states*).

Figure 1: Percent of Auto Insurance Premiums to Total Net Premiums Written



Values represent the industry-wide proportion of net premiums written allocated to auto physical damage, commercial auto liability, and personal auto liability coverages.

Figures 2, 3, and 4 present inflation-adjusted trends in salvage and subrogation recovery across the three auto insurance lines of business that are the focus of this study. In terms of the auto physical damage line, we observe a substantial increase in the value of salvage and subrogation recovery efforts for the 26-year period, with total recovery equal to $12.79 billion in 1996 and increasing to a high of $31.2 billion in 2021, representing an increase of nearly 144%.[16] This increase may be due to several factors, including the increase in the number of registered motor vehicles in the U.S. and the increasing inclusion of technology in automobiles (such as sensors), which has significantly increased the cost of repair, replacement, and almost certainly salvage recovery.[17, 18] While there is an increase in recovery for auto physical damage, in Figure 3, we see that there is significant variation for the commercial auto liability line. Although salvage and subrogation recovery for this line has increased over the past two and a half decades (from just over $1.4 billion in 1996 to $1.6 billion in 2021), the increase is not nearly as substantial as that seen for auto physical damage (144% for auto physical damage versus only 13% for commercial auto liability). Finally, with respect to personal auto liability (Figure 4), we observe a very constant increase in recovery, with a minimum of less than $11 billion in 1996 to a maximum value of $19 billion in 2020, followed by a slight decline in 2021. The increases observed for both

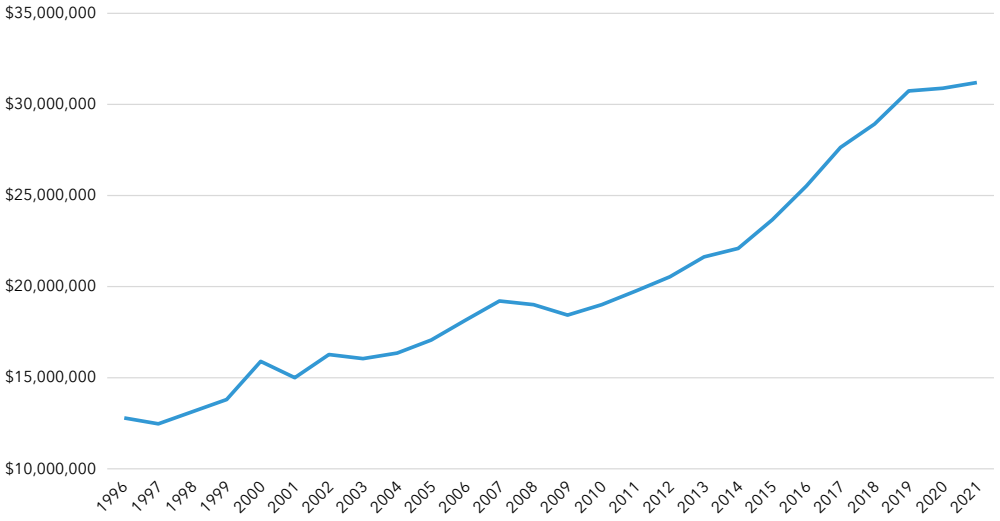
16. The NAIC annual statements aggregate salvage and subrogation values across both the personal and commercial lines for auto physical damage; as such, we are unable to study auto physical damage for the personal and commercial coverages separately.

17. The Federal Highway Administration (FHWA) reports that the total number of registered motor vehicles in the U.S. was 206.57 million in 1996 and 275.91 million in 2020, representing an increase of nearly 33.6%. Yearly motor vehicle registration statistics are available at https://www.fhwa.dot.gov/policyinformation/statistics.cfm (Table MV- 1).

18. The continuation of this increasing trend in auto physical damage recovery may be anticipated as persistent supply chain challenges in the U.S. and abroad have made the acquisition of parts and materials more difficult (Fish, 2021). It is likely that this trend will result in greater salvage values over time.

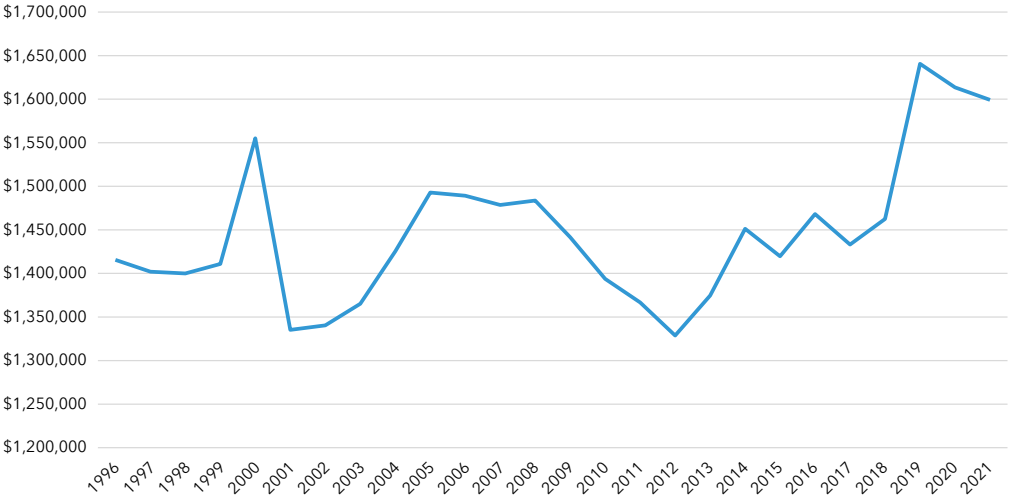
liability lines are attributable to a number of factors, including the problem of social inflation (Lynch & Moore, 2022).[19]

Figure 2: Total Auto Physical Damage Salvage and Subrogation Recovery ($000), 1996 to 2021



Authors' calculations based on values reported in NAIC annual statements. Values represent inflation-adjusted industry-level (aggregate) salvage and subrogation recovery in thousands for auto physical damage coverage.

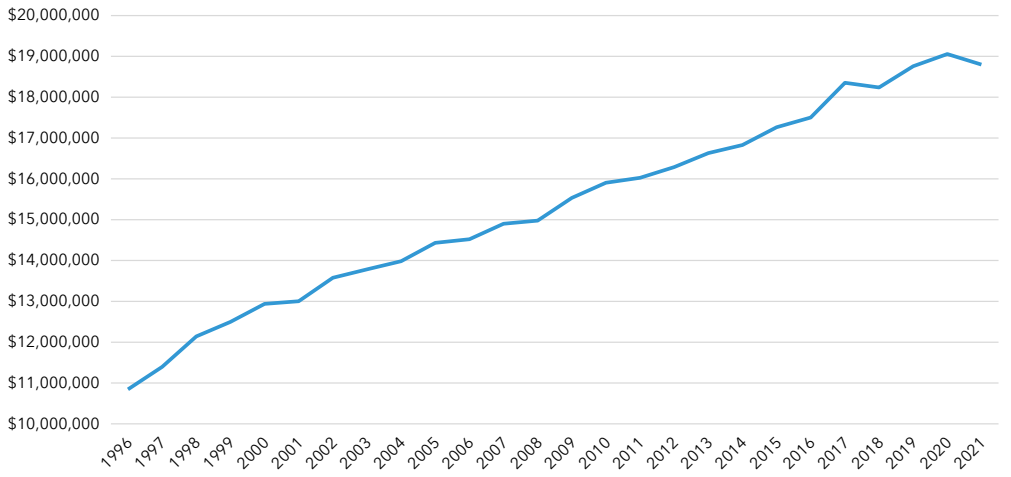
Figure 3: Total Commercial Auto Liability Salvage and Subrogation Recovery ($000), 1996 to 2021



Authors' calculations based on values reported in NAIC annual statements. Values represent inflation-adjusted industry-level (aggregate) salvage and subrogation recovery in thousands for commercial auto liability coverage.

19. Lynch and Moore (2022) "estimate that social inflation increased commercial auto liability claims by more than $20 billion between 2010 and 2019."

Figure 4: Total Personal Auto Liability Salvage and Subrogation Recovery ($000), 1996 to 2021

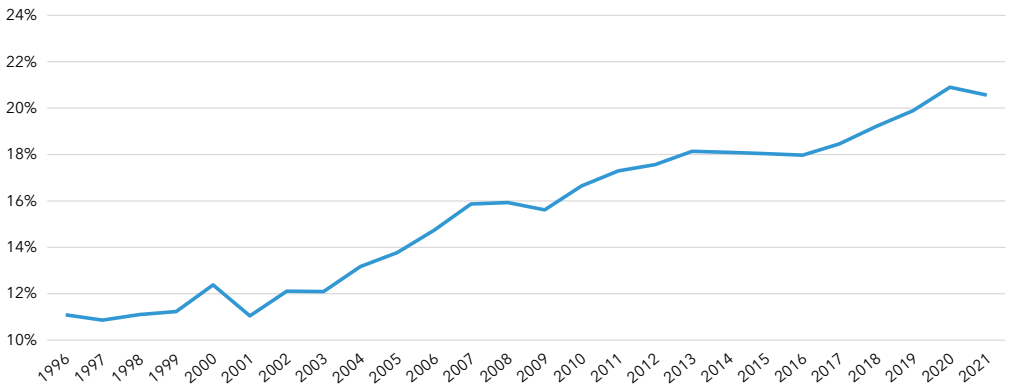


Authors' calculations based on values reported in NAIC annual statements. Values represent inflation-adjusted industry-level (aggregate) salvage and subrogation recovery in thousands for personal auto liability coverage.

Finally, in Figures 5 and 6, we illustrate the industry-wide impact that salvage and subrogation recovery can have on the insurer's balance sheet. In particular, we examine the ratio of salvage and subrogation recovery relative to total net claims paid, with Figure 5 presenting the trend for the auto physical damage line of business and Figure 6 presenting the trend for both the commercial auto and personal auto liability lines of business.[20] Figure 5 indicates that over the sample period, the industry has exhibited a substantial increase in the ratio of salvage and subrogation recovery to claims paid, with roughly 11% in 1996 to approximately 20% in 2021, representing an increase of over 85%. This implies that, in 2021, for every five dollars paid in claims, one dollar was recouped through the salvage and subrogation recovery process for auto physical damage coverage. Alternatively, an examination of Figure 6 provides clear evidence that, while there has been an increase in the ratio of recovery to claims payments over the sample period for the liability lines of business, the increase is much more muted, and the overall ratio is significantly smaller than that observed for the auto physical damage line. More specifically, we find that the average ratio of recovery to net claims paid over the sample period is 1.1% for commercial auto liability and 2% for the personal auto liability line of business.

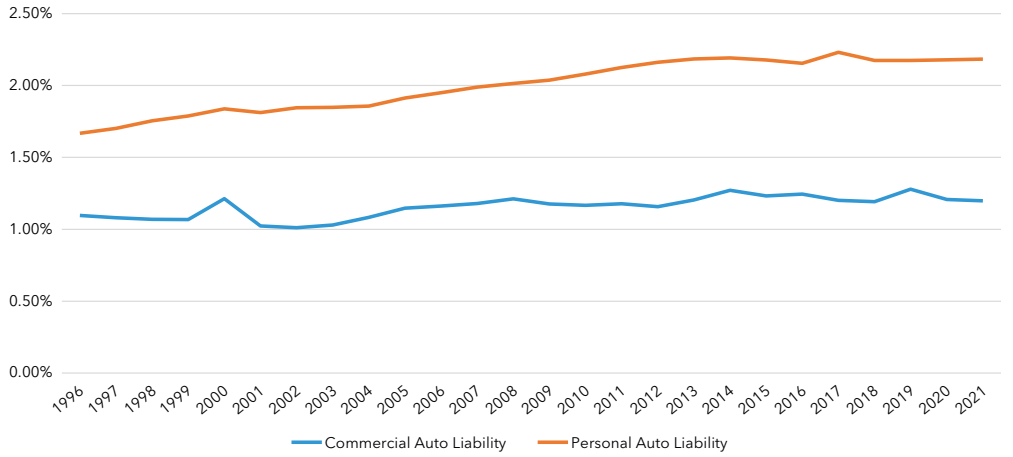
20. Data used for the construction of Figure 5 are obtained from Schedule P, Part 1J (Auto Physical Damage). Data used for the construction of Figure 6 are obtained from Schedule P, Parts 1B (Private Passenger Auto Liability / Medical) and 1C (Commercial Auto/Truck Liability/Medical).

Figure 5: Industry-Wide Ratio of Salvage and Subrogation Recovered to Total Net Claims Paid – Auto Physical Damage



Authors' calculations based on values reported in NAIC annual statements. Data obtained from Schedule P, Part 1J (Auto Physical Damage).

Figure 6: Industry-Wide Ratio of Salvage and Subrogation Recovered to Total Net Claims Paid – Commercial and Personal Auto Liability



Authors' calculations based on values reported in NAIC annual statements. Data obtained from Schedule P, Parts 1B (Private Passenger Auto Liability/Medical) and 1C (Commercial Auto/Truck Liability/Medical).

Taken together, the figures illustrate that: 1) significant sums are being recovered by U.S. property- liability insurance carriers for the auto lines of business, and recovery is increasing over time; 2) salvage and subrogation recovery has an important financial impact on property-liability insurers; and 3) while there is an increase across the different auto lines of business, there is considerable variation in the amounts recovered across commercial and personal auto lines of business, as well as across physical damage and liability lines.

Data, Methodology, and Variables

Data

The primary objective of this study is to empirically investigate the factors associated with salvage and subrogation speed of recovery for auto physical damage and liability lines of business. Our analysis is conducted using insurer-specific financial and operational data collected from the National Association of Insurance Commissioners (NAIC) for an initial sample period that spans from 1996 through 2021.[21] The initial sample includes all U.S. domiciled property-liability insurers. We apply several screens to the data, including removing firms with missing data, firms with variables with illogical values[22], and firms that do not have a sufficient number of observations to construct the variables. Firms that report policyholders' surplus, direct premiums written, and net premiums written equal to zero are also removed from the sample. Finally, we exclude all firms that are not of the stock or mutual organizational forms. Data necessary to calculate the amounts recovered for salvage and subrogation are obtained from Schedule P of the statutory annual statements for property-liability insurers. Salvage and subrogation data for auto physical damage is collected from Part 1J, while data for personal auto liability/medical payments and commercial auto/truck liability/medical payments are obtained from Part 1B and Part 1C, respectively.[23]

Methodology

The general form of the estimated model is given as:

$$\begin{aligned} &\%Recovered_{l,i,t} \\ &= \alpha + \beta Accrue_{l,i,t\text{-}1} + \beta \%DPW_{l,i,t\text{-}1} + \beta Size_{l,i,t\text{-}1} + \beta LnAge_{i,t\text{-}1} \\ &+ \beta Stock_{i,t\text{-}1} + \beta Group_{i,t\text{-}1} + \beta GEO\ Div_{i,t\text{-}1} + \beta LOB\ Div_{i,t\text{-}1} \\ &+ \beta Leverage_{i,t\text{-}1} + \beta ROA_{i,t\text{-}1} + \delta_i + \eta_t + \varepsilon_{i,t} \end{aligned} \quad (1)$$

for insurer i in year t.[24] $\%Recovered_{l,i,t}$ represents the proportion of the total recovery that is recovered within a given period for a given line of business, l, where total recovery for physical damage claims is assumed to occur after two years, while total recovery

21. While the initial sample is from 1996 through 2021, the final sample periods differ between the physical damage and liability lines because of the reported periods of recovery in the NAIC annual statements. In particular, because the auto physical damage line has a two-year recovery period that is reported in the statements, the final sample ends in 2020 for the physical damage models. Alternatively, because the commercial and personal auto liability lines have a nine-year recovery period, the final sample concludes in 2012, as nine years of forward-looking data are necessary to calculate the recovery rates.

22. Illogical values include negative values for salvage and subrogation recovered, total admitted assets, policyholders' surplus, direct premiums written, net premiums written, total liabilities, and firm age. Observations are also removed if the percent of recovery in a given year relative to total salvage and subrogation recovery is greater than 100%.

23. Part 1J of Schedule P provides combined data for physical damage claims for personal and commercial auto.

24. Variance inflation factors (VIFs) were checked for all models, and none exceeded a value of 2. Kennedy (2008) states that VIFs in excess of 10 indicate the presence of "harmful collinearity," suggesting that multicollinearity is not a problem within the context of our models.

for liability claims is assumed to occur after nine years.[25] For auto physical damage claims, we examine the percentage of total salvage and subrogation recovered in the year that the loss was incurred (year *t*), while for the commercial and personal auto liability lines of business, we investigate the percent of total salvage and subrogation recovered in the first year (the year the loss was incurred, *t*), the second year (year *t + 1*), and the third year (year *t +2*). All models include year control variables (η_t) and incorporate firm fixed effects or random effects (δ_i), as determined by the results of the Hausman test.[26] All independent variables are lagged one year in order to address the potential for endogeneity (e.g., Cole & McCullough, 2006; Elango, Ma, & Pope, 2008; Shiu, 2011), and all continuous variables are winsorized at the 1st and 99th percentiles to reduce the potential effect of outliers.

In addition to investigating the proportion of total salvage and subrogation recovered in a given year, we also examine the cumulative percentage of recovery for the liability lines of business to determine the cumulative speed at which collections take place.[27] For these additional models, we replace the *%Recoveredl,i,t* dependent variable with a variable that captures cumulative recovery while all control variables remain the same as those that appear in Equation (1). We describe the construction of each of the independent variables in detail in the next section.

Independent Variables

Accrued Salvage and Subrogation. Under Statutory Accounting Principles (SAP), property-liability insurers have the option to accrue for anticipated salvage and subrogation recoveries (Ames, Graden, & Sankara, 2019).[28] Using the accrual option allows insurers to report the claim liability at its net amount (after deducting for anticipated recovery). Foregoing the accrual option means that the insurer would report the claim liability at its gross amount without consideration for the potential recovery of salvage or subrogation (Ames, Graden, & Sankara, 2019).[29] We anticipate that insurers that report their claims liabilities with consideration for anticipated salvage and subrogation recovery do so because they expect to be more proactive in their recovery efforts.

25. The assumption that total salvage and subrogation recovery takes place within two (nine) years for physical damage (liability) claims is determined based on values reported in Schedule P of the annual statements. We acknowledge that the potential exists for recovery to take longer than these time periods, but our analysis is limited to those values reported in the NAIC annual statements.

26. In order to determine if fixed or random effects are most appropriate, we conduct a Hausman test for each of the models. The results of the Hausman test indicate that while fixed effects are appropriate for the majority of models, random effects are preferred for some. The use of fixed or random effects is dictated by the results of the Hausman test and is disclosed in each of the tables.

27. A similar analysis is not conducted for the auto physical damage line of business as it is assumed in the NAIC annual statements that total recovery takes place over a two-year period.

28. SAP gives the insurer the option to accrue for the estimated recoveries associated with salvage and subrogation. This differs from Generally Accepted Accounting Principles (GAAP), which requires firms to accrue for subrogation and to net the accrual against the claim's liability (Ames et al., 2019).

29. Ames et al. (2019) empirically examine the factors that are associated with the decision to accrue subrogation. Among their findings, the authors show that mutual insurers, firms with a weaker AM Best financial strength rating, and those with greater premium growth are less likely to accrue for anticipated salvage and subrogation, while publicly traded insurers are more likely to accrue. In a separate (unreported) analysis, we investigate the characteristics of firms that accrue for each of the lines of business that are the focus of this study. Among our findings, we observe that across the three lines of business, there is a consistent positive relation between group membership, size, and leverage, and the decision to accrue subrogation. Results from this supplemental analysis are available from the authors upon request. We thank an anonymous reviewer for recommending this additional analysis.

We follow Ames et al. (2019) and control for the decision of the insurer to accrue for anticipated salvage and subrogation using a binary variable equal to one for insurers reporting non-zero values for anticipated salvage and subrogation for a given year.

Percentage of Line-of-Business Premiums. Colquitt and Dumm (2000) hypothesize that insurers may focus more of their resources and attention on those lines of business that are more important to the firm's operations, such that they will more aggressively pursue and manage claims than they would for lines of business that are less central to the firm's operations. The proportion of business written in a given line of business (i.e., auto physical damage, commercial auto liability, and personal auto liability) is equal to direct premiums written in the line of business, divided by total direct premiums written.

Size and Age. Larger firms with greater resources may be able to more efficiently recover loss payments through salvage and subrogation due to scale efficiencies, while older firms may have greater experience in the salvage and subrogation process such that they are better positioned to recover at a quicker speed than newer, less experienced firms. To account for the impact that financial resources and experience may have on recovery speed, we include both insurer size and age variables. The size variable (*Size*) is calculated as the natural logarithm of net admitted assets. In addition to firm size, we also account for firm age (*Ln Age*) by including the natural logarithm of one plus the difference between year *t* and the insurer's date of incorporation.

Organizational Form. Prior literature suggests that there are significant differences that exist between stock insurers and mutual insurers.[30] It is argued that one of the primary differences that exists is that owners have a better ability to monitor the management of stock insurers than they are the management of mutual insurers. Because owners can more closely monitor the management of stock insurers, Colquitt and Dumm (2000) argue that stock insurers may have a greater average recovery relative to mutual insurers because they maintain lower expenses and "operate on a more favorable cost basis." Additionally, it is commonly recognized that the primary objective for stock insurers is to maximize profit for owners (e.g., Chaddad & Cook, 2004; Biener & Eling, 2011), which might further influence salvage and subrogation recovery decisions. In order to account for the impact that organizational form may have on insurers' salvage and subrogation recovery rates, we include a binary variable equal to one for stock insurers (*Stock*).

Group Affiliation. Colquitt and Dumm (2000) argue that affiliated insurers may be less aggressive in salvage and subrogation recovery as they have access to internal capital markets that are unavailable to unaffiliated firms and because it may be unprofitable to subrogate against another member of the firm's group. Consistent with this notion, Colquitt and Dumm (2000) report a negative and statistically significant relation between group affiliation and the average amount of salvage and subrogation recovered. Given these findings, we control for group membership through the inclusion of a binary variable equal to one for firms that are members of an insurance group (*Group*).

30. Some of these differences include the degree of discretion afforded management (Mayers & Smith, 1981), capitalization (Harrington and Niehaus, 2002), and risk-taking (Lamm-Tennant & Starks, 1993).

Diversification. Insurers with more diversified operations can rely less on the performance of any single line of business and can benefit from a coinsurance effect in which the losses of one line of business can be offset by stronger performance in other lines of business, thus reducing overall volatility (Liebenberg & Sommer, 2008). Additionally, greater diversification limits the importance of any single line on the firm's operations, which may reduce the speed of salvage and subrogation recoveries. We control for the potential effect that diversification may have on recovery rates by including measures of product and geographic diversification. We capture line of business diversification (*LOB Div*) by including a variable equal to one minus the line of business Herfindhal-Hisrchman Index (HHI), where the line of business HHI is based on direct premiums written in 23 distinct lines of business.[31] Similarly, we measure geographic diversification (*GEO Div*) as one minus the geographic HHI, which is based on direct premiums written in the 50 U.S. states and the District of Columbia.

Leverage. A primary goal of insurance regulation is to monitor the financial position of insurers and to ensure their continued solvency. One commonly relied upon measure of potential insolvency risk is leverage, where more highly levered firms face a greater risk of insolvency and are less financially stable (e.g., Carson & Hoyt, 1995; Shim, 2017). Following prior literature, we measure leverage (*Leverage*) as the ratio of net premiums written to total policyholders' surplus (e.g., Cummins & Doherty, 2002; Born, Cole, & Nyce, 2021). In general, insurers are expected to maintain a ratio of premiums-to-surplus that is less than 3:1 (Neale, Drake, & Konstantopoulos, 2020). In the event an insurer's ratio of premiums-to-surplus were to approach the 3:1 threshold, they may attempt to manage their balance sheet and reduce the ratio by increasing surplus through the salvage or subrogation recovery process.

Performance. One benefit of better performance is that firms can generate additional cash flow that can be used in ways that further the goals of the firm. Better-performing insurers may be able to use that additional cash flow to invest in their salvage and subrogation efforts and increase the speed of recovery.[32] We control for firm performance by including insurer return on assets (ROA) in each of the models, calculated as the ratio of net income to net admitted assets (*ROA*).

Specialty Auto Insurers. In addition to the variables discussed above, which are included in each of our empirical models, we also include a variable that accounts for whether an insurer only writes personal auto liability insurance coverage. We focus exclusively on this particular line of business in recognition of the fact that some specialty insurers only write personal auto liability coverage for high-risk drivers. These insurers frequently target higher-risk drivers, which could lead these carriers to only offer the minimum liability limits required by the state. Given the unique nature of these firms, we include a binary variable equal to one for insurers that only write personal

31. We follow Liebenberg and Sommer (2008) and combine similar lines of business into the following 23 total distinct lines: 1) accident and health; 2) aircraft; 3) boiler and machinery; 4) burglary and theft; 5) commercial auto; 6) commercial multi-peril; 7) credit; 8) earthquake; 9) farmowners; 10) financial guaranty; 11) fidelity; 12) fire and allied lines; 13) homeowners; 14) inland marine; 15) medical malpractice; 16) mortgage guaranty; 17) ocean marine; 18) other; 19) other liability; 20) personal auto; 21) product liability; 22) surety; and 23) workers' compensation.

32. A similar argument is offered by Chang and Chen (2018) in their examination of firms with captive insurance subsidiaries. The authors hypothesize that more profitable firms will be more likely to establish captives by using the additional cash flow that is generated by these firms; however, the authors do not find evidence of a relation between profitability and having a captive insurance subsidiary.

auto liability coverage (*Specialty*). This variable is only considered in the models examining salvage and subrogation for the personal auto liability line of business.[33]

Variable definitions are provided in Table 2 and summary statistics are presented in Table 3. Focusing first on the dependent variables, we observe that over 55% of recovery takes place in the first year for the auto physical damage line of business. The high percentage of recovery in this line is likely attributable to the fact that property damage is generally considered a short-tail line of business, which indicates that claims are often settled quickly. In addition, as recovery in this area is most likely associated with salvage, and insurers frequently have a standardized process associated with heavily damaged or totaled vehicles, the physical damage (salvage) recovery process is likely to be limited to a shorter timeframe than that associated with liability lines (subrogation). Alternatively, roughly 35 (28) percent of total recovery takes place in the first year for commercial (personal) auto liability coverages. The lower level of first-year recovery relative to the physical damage coverage is indicative of the fact that auto liability (both commercial and personal) is considered a long-tail line. The liability recovery is likely to be a function of subrogation rather than salvage. While the speed at which recovery takes place between the commercial and personal auto liability lines differs by over 20% in the first year, we find that the cumulative collection of salvage and subrogation is relatively close after three years, with nearly 76% of cumulative recoveries taking place by the end of the third year for both liability lines.

With respect to the independent variables, roughly 79% of the firms in our sample are stock insurers, over 83% are affiliated with a group, the average firm has an ROA of 2.34%, and the measure of leverage (the ratio of premiums-to-surplus) is well below the maximum acceptable ratio of 3:1. The summary statistics also indicate that the percentage of direct premiums written in the auto physical damage, commercial auto liability, and personal auto liability lines of business are 20.18%, 13.44%, and 30.42%, respectively. Finally, we find that the majority of firms accrue for anticipated salvage and subrogation, suggesting that these firms do expect to actively take steps to recover at least some portion of the claims paid.

Table 2: Variable Definitions

Variable	Definition
	Auto Physical Damage
Pct. Recovered Yr1	Percent of auto physical damage salvage / subrogation recovered in the year the loss was incurred
	Commercial Auto Liability
Pct. Recovered Yr1	Percent of commercial auto liability salvage / subrogation recovered in the year the loss was incurred
Pct. Recovered Yr2	Percent of commercial auto liability salvage / subrogation recovered one year after the loss was incurred
Pct. Recovered Yr3	Percent of commercial auto liability salvage / subrogation recovered two years after the loss was incurred
Cumulative Pct. Recovered Yr1	Cumulative percent of commercial auto liability salvage / subrogation recovered in the year the loss was incurred

33. We thank an anonymous reviewer for encouraging the inclusion of this additional variable in our analysis.

Cumulative Pct. Recovered Yr2	Cumulative percent of commercial auto liability salvage / subrogation recovered within the first two years of the incurred loss
Cumulative Pct. Recovered Yr3	Cumulative percent of commercial auto liability salvage / subrogation recovered within the first three years of the incurred loss
	Personal Auto Liability
Pct. Recovered Yr1	Percent of personal auto liability salvage / subrogation recovered in the year the loss was incurred
Pct. Recovered Yr2	Percent of personal auto liability salvage / subrogation recovered one year after the loss was incurred
Pct. Recovered Yr3	Percent of personal auto liability salvage / subrogation recovered two years after the loss was incurred
Cumulative Pct. Recovered Yr1	Cumulative percent of personal auto liability salvage / subrogation recovered in the year the loss was incurred
Cumulative Pct. Recovered Yr2	Cumulative percent of personal auto liability salvage / subrogation recovered within the first two years of the incurred loss
Cumulative Pct. Recovered Yr3	Cumulative percent of personal auto liability salvage / subrogation recovered within the first three years of the incurred loss
	Control Variables
Accrue Auto Physical Damage	Binary variable equal to 1 for insurers that accrue for anticipated auto physical damage salvage / subrogation, 0 otherwise
Accrue Commercial Auto Liab.	Binary variable equal to 1 for insurers that accrue for anticipated commercial auto liability salvage / subrogation, 0 otherwise
Accrue Personal Auto Liab.	Binary variable equal to 1 for insurers that accrue for anticipated personal auto liability salvage / subrogation, 0 otherwise
% DPW Auto Physical Damage	Percent of direct premiums written (DPW) in the auto physical damage line of business relative to total DPW
% DPW Commercial Auto Liab.	Percent of direct premiums written (DPW) in the commercial auto liability line of business relative to total DPW
% DPW Personal Auto Liab.	Percent of direct premiums written (DPW) in the personal auto liability line of business relative to total DPW
Size	Natural logarithm of net admitted assets
Ln Age	Natural logarithm of firm age
Stock	Binary variable equal to 1 for stock insurers, 0 otherwise
Group	Binary variable equal to 1 for insurers that are members of a group, 0 otherwise
GEO Div	Geographic diversification, equal to one minus the geographic HHI
LOB Div	Line of business diversification, equal to one minus the line of business HHI
Leverage	Ratio of net premiums written to policyholders' surplus
ROA	Return on assets, measured as the ratio of net income to net admitted assets
Specialty	Binary variable equal to 1 for insurers that only write personal auto liability insurance, 0 otherwise

Table 3: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Auto Physical Damage				
Pct. Recovered Yr1	0.5577	0.1473	0.0000	1.0000
		Commercial Auto Liability		
Pct. Recovered Yr1	0.3506	0.2391	0.0000	1.0000
Pct. Recovered Yr2	0.2958	0.2023	0.0000	1.0000
Pct. Recovered Yr3	0.1193	0.1472	0.0000	0.8824
Cumulative Pct. Recovered Yr1	0.3506	0.2391	0.0000	1.0000
Cumulative Pct. Recovered Yr2	0.6454	0.2742	0.0000	1.0000
Cumulative Pct. Recovered Yr3	0.7645	0.2546	0.0000	1.0000
		Personal Auto Liability		
Pct. Recovered Yr1	0.2826	0.1810	0.0000	1.0000
Pct. Recovered Yr2	0.3107	0.1321	0.0000	0.8333
Pct. Recovered Yr3	0.1654	0.1141	0.0000	0.6667
Cumulative Pct. Recovered Yr1	0.2826	0.1810	0.0000	1.0000
Cumulative Pct. Recovered Yr2	0.5938	0.2179	0.0000	1.0000
Cumulative Pct. Recovered Yr3	0.7598	0.2008	0.0000	1.0000
		Control Variables		
Accrue Auto Physical Damage	0.6811	0.4661	0.0000	1.0000
Accrue Commercial Auto Liab.	0.6417	0.4796	0.0000	1.0000
Accrue Personal Auto Liab.	0.6916	0.4619	0.0000	1.0000
% DPW Auto Physical Damage	0.2018	0.1578	0.0000	1.0000
% DPW Commercial Auto Liab.	0.1344	0.1702	0.0000	1.0000
% DPW Personal Auto Liab.	0.3042	0.2154	0.0000	1.0000
Size	12.2875	1.7904	6.7334	16.6051
Ln Age	3.6311	0.9104	0.0000	5.1648
Stock	0.7861	0.4101	0.0000	1.0000
Group	0.8329	0.3731	0.0000	1.0000
GEO Div	0.5118	0.3730	0.0000	0.9667
LOB Div	0.4544	0.2812	0.0000	0.8998
Leverage	1.2213	0.7451	0.0034	3.7770
ROA	0.0234	0.0390	-0.1629	0.1826
Specialty	0.0023	0.0476	0.0000	1.0000

All continuous variables are winsorized at the 1st and 99th percentiles. The final dataset consists of 11,559 observations for the auto physical damage models, 4,354 observations for the commercial auto liability models, and 5,286 observations for the personal auto liability models. Variable definitions are provided in Table 2.

Results

Auto Physical Damage Salvage and Subrogation Recovery

The results for the estimation of Equation (1) for auto physical damage recovery are presented in Table 4. Several variables included in the model have a statistically significant association with the proportion of physical damage recovery made in the first year. First, we find that insurers with a greater proportion of total direct premiums written in the auto physical damage line of business recover a larger percentage of their total recovery in the first year. If carriers have a greater specialization in a given line of business, as reflected by a higher proportion of total direct premiums written in the auto physical damage line, it is likely that the carrier is willing to make a greater investment in salvage and subrogation and has better processes (and an understanding of those processes) in place to make recoveries. Larger insurers (Size) have a greater proportion of their total recovery in the first year, suggesting that firms with greater resources and experience in the salvage and subrogation process are more efficient in recovery. The results also indicate that better-performing firms (i.e., those with a higher ROA) collect a greater proportion of total salvage and subrogation recovery in the first year, as do more highly leveraged firms. As hypothesized previously, all else equal, more profitable insurers can generate greater cash flow that could be used to invest in salvage and subrogation activities and may enhance processes that would then increase the speed of recovery. The finding of a positive relation between leverage and the proportion of salvage and subrogation recovered in the first year may be attributed to more highly-leveraged firms attempting to reduce leverage by increasing policyholders' surplus through increased recovery. Finally, we find evidence that stock insurers (*Stock*) collect a lower percentage of their total recovery in the first year relative to mutual insurers. One possible explanation for this finding is that mutual insurers may be more aggressive in their recovery of salvage and subrogation because they have fewer sources of capital relative to stock insurers, which could cause mutual insurers to rely more heavily on recovered funds than stock insurers.

Table 4: Auto Physical Damage Salvage and Subrogation Recovery

Variables	Coefficient	Standard Error
Accrue Physical Damage	0.0065	0.0058
% DPW Auto Physical Damage	0.1397***	0.0242
Size	0.0076***	0.0022
Ln Age	0.0022	0.0043
Stock	-0.0358***	0.0106
Group	-0.0061	0.0087
GEO Div	-0.0161*	0.0095
LOB Div	0.0192	0.0133
Leverage	0.0150***	0.0034
ROA	0.1666***	0.0529
Constant	0.4201***	0.0306

Observations	11,559

*, **, and *** denote statistical significance at the 10, 5, and 1% levels, respectively. The model includes random effects, unreported year fixed effects, and standard errors are clustered at the firm-level. The dependent variable is *Pct. Recovered Yr1* and it is equal to the percent of auto physical damage salvage/subrogation recovered in the year the loss was incurred. Variable definitions are provided in Table 2.

Commercial Auto Liability Salvage and Subrogation Recovery

In the preceding section, we investigated the firm-specific factors associated with salvage and subrogation recovery for the auto physical damage line of business. However, while the results indicate that there are a multitude of financial and operational characteristics associated with recovery for physical damage, it must be recognized that key differences exist between short-tail lines of business and the longer-tail auto liability lines. Furthermore, differences also exist across commercial and personal lines of business that cannot be disentangled using the auto physical damage coverage. We explore these potential differences both in the current section as well as the following section, where we investigate the factors related to recovery for commercial auto liability and personal auto liability, respectively. The results for the commercial auto liability line of business are presented in Table 5, while the results for personal auto liability are presented in Table 6. Because liability insurance is a long-tail line of business, we are able to calculate the proportion of the total recovery which takes place each year over a nine-year period of time. Given the evidence provided in Table 3, we focus on the first three years of recovery, as roughly 75% of total salvage and subrogation is recovered at that point. In the first three columns of Tables 5 and 6, we present the percent of the total amount that is recovered in year *t* (for years 1, 2, and 3), while in the last three columns in Tables 5 and 6, we present the cumulative proportion of the total recovery in the first, second, and third years.[34]

Table 5: Commercial Auto Liability Salvage and Subrogation Recovery

	Percent Recovered by Year			Cumulative Recovery		
Variables	**Year 1**	**Year 2†**	**Year 3†**	**Year 1**	**Year 2**	**Year 3**
Accrue Commercial Auto Liab.	0.0144	0.0173*	0.0194***	0.0144	0.0348	0.0553**
	(0.0193)	(0.0105)	(0.0072)	(0.0193)	(0.0228)	(0.0233)
% DPW Commercial Auto Liab.	0.1075**	0.0488*	0.0010	0.1075**	0.1730**	0.1211
	(0.0506)	(0.0272)	(0.0243)	(0.0506)	(0.0766)	(0.0750)
Size	0.0047	-0.0036	-0.0016	0.0047	0.0078	0.0171
	(0.0160)	(0.0036)	(0.0026)	(0.0160)	(0.0241)	(0.0258)
Ln Age	-0.0424	0.0028	-0.0002	-0.0424	-0.0725	-0.0071
	(0.0323)	(0.0074)	(0.0055)	(0.0323)	(0.0476)	(0.0482)

34. As an example of the calculations used for the liability lines, in 2012, Allstate Insurance Company (NAIC company code 19232) had recovered $618,000 for commercial auto liability losses incurred in 2012, while in 2013, they had recovered $1,028,000 for the 2012 losses (Schedule P – Part 1C). Given that after the nine-year period (2021), they reported recovering a total of $1,391,000 for 2012 incurred losses, the percent recovered in 2012 would be 44.43% in 2012 ($618 / $1,391) and 29.48% in 2013 (($1,028-$618)/$1,391) while the cumulative recovery in 2012 would be 44.43% and in 2013 it would be 73.91% (44.43% + 29.48%).

Stock	0.0525	-0.0150	-0.0187*	0.0525	0.0872	0.0458
	(0.0558)	(0.0141)	(0.0107)	(0.0558)	(0.0814)	(0.0996)
Group	0.0114	0.0150	-0.0022	0.0114	0.0458	0.0340
	(0.0287)	(0.0153)	(0.0131)	(0.0287)	(0.0385)	(0.0391)
GEO Div	-0.0729	-0.0050	0.0060	-0.0729	-0.0494	-0.0489
	(0.0498)	(0.0161)	(0.0122)	(0.0498)	(0.0554)	(0.0514)
LOB Div	-0.0722	-0.0162	-0.0174	-0.0722	-0.0740	-0.0612
	(0.0449)	(0.0225)	(0.0158)	(0.0449)	(0.0607)	(0.0553)
Leverage	0.0101	-0.0045	0.0016	0.0101	0.0000	0.0056
	(0.0114)	(0.0068)	(0.0050)	(0.0114)	(0.0162)	(0.0157)
ROA	-0.0307	0.2517**	-0.1780**	-0.0307	0.2087	0.0057
	(0.1390)	(0.1163)	(0.0724)	(0.1390)	(0.1462)	(0.1431)
Constant	0.4216*	0.3226***	0.1442***	0.4216*	0.7096**	0.4984
	(0.2343)	(0.0536)	(0.0358)	(0.2343)	(0.3482)	(0.3693)
Observations	4,354	4,354	4,354	4,354	4,354	4,354

*, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively. All models include unreported year fixed effects and standard errors (presented beneath coefficients in parentheses) are clustered at the firm-level. All models also include firm fixed effects except for those models which the Hausman test indicates random effects are most appropriate. Columns with a "†" denote the use of random effects rather than fixed effects. The dependent variables in the first three columns are *Pct. Recovered Yr1, Pct. Recovered Yr2,* and *Pct. Recovered Yr3* and are equal to the percent of commercial auto liability salvage / subrogation recovered in the year the loss was incurred, one year after the loss was incurred, and two years after the loss was incurred, respectively. The dependent variables in the last three columns are *Cumulative Pct. Recovered Yr1, Cumulative Pct. Recovered Yr2,* and *Cumulative Pct. Recovered Yr3* and are equal to the cumulative percent of commercial auto liability salvage/subrogation recovered in the year the loss was incurred, the first two years of the incurred loss, and the first three years of the incurred loss. Variable definitions are provided in Table 2.

In the first set of columns in Table 5, we observe very clear differences across the three years of recovery. For the first year, we find that firms with a greater proportion of direct premiums written in the commercial auto liability line of business recover a greater percentage of their total salvage and subrogation recovery. Similar to the results in Table 4, this finding is consistent with the expectation that firms with a specialization in a particular line of business may be more likely to make a greater investment in salvage and subrogation recovery and/or may be more knowledgeable or experienced with respect to recovery in that line.

With respect to the Year 2 results, we find that insurers that accrue for anticipated salvage and subrogation collect a higher percentage of recovery than do those insurers that do not elect to accrue. However, the relation is only marginally significant at the 10% level. As evidenced by the positive and (marginally) statistically significant result for the percentage of direct premiums written in commercial auto liability, expertise in commercial auto may play a role in the ability to recover a greater proportion of incurred losses in the second year. We also find that more profitable firms recover a greater proportion of salvage and subrogation in the second year.

The results for the percentage of salvage and subrogation recovered in Year 3 are provided in the third column and indicate that insurers that accrue anticipated salvage and subrogation collect a higher percentage of recovery in the third year than firms that do not accrue. As mentioned previously, this finding is consistent with the notion that firms electing to accrue anticipated salvage and subrogation may be more

proactive in the recovery process. In addition, profitability (*ROA*) is negatively related to recovery speed in the third year. The negative relation may be explained by the positive association found in Year 2, suggesting that more profitable firms are able to recover more quickly and that the less profitable firms take longer to recover salvage and subrogation. Finally, we find marginally significant evidence of a negative relation between the stock organizational form and the percentage of recovery in Year 3.

The final three columns in Table 5 present the results for models that use the cumulative proportion of salvage and subrogation recovered in a given year as the dependent variable. The results for the cumulative recovery in Year 1 are necessarily identical to those for the year-specific proportion recovered in Year 1. Following the first year of recovery, we find that firms writing a greater proportion of premiums in the commercial auto liability line have a greater cumulative recovery in the second year. This result is consistent with the Year 2 percentage recovered shown in the first set of columns. We also observe that firms that accrue subrogation for the commercial auto liability line of business recover a greater proportion of salvage and subrogation by Year 3. Interestingly, while the results previously presented in Table 4 indicate that several non-financial, firm-specific characteristics were associated with the rate of recovery for auto physical damage (i.e., size, organizational form, and diversification), we find little evidence of a relation between these factors and the rate of recovery for commercial auto liability. The relatively limited findings for the commercial auto liability line of business suggest that there are many unobservable factors (such as negotiating ability, differences in legal environment, internal policies, etc.) influencing commercial auto liability-specific recovery. Additionally, the increasing reliance on alternative dispute resolution (ADR) techniques as a substitute for potentially time-consuming litigation may influence the speed of recovery.

Personal Auto Liability Salvage and Subrogation Recovery

In Table 6, we present the results for salvage and subrogation recovery for the personal auto liability line of business. As with Table 5, we report results for the percentage recovered by year in the first three columns. First, we find that insurers that are more leveraged recover a higher percentage in the year the loss occurs (Year 1) than do other insurers. We also find that specialty insurers that may focus more of their business on higher-risk drivers recover a greater proportion in the first year. Finally, we observe a negative and marginally significant relation between firm age and Year 1 recovery. Unlike commercial auto liability, we do not observe a statistically significant relationship between the proportion of premiums written in the personal auto liability line of business and salvage and subrogation recovery in the first year. Considering the proportion of recovery in Year 2, we see that specialty insurers recover a lower proportion of salvage and subrogation in the second year. We also find marginal evidence that older firms recover a lower percentage in the second year relative to younger firms and that insurers with weaker performance (*ROA*) recover a greater percentage of recovery in Year 2. In Year 3, results indicate that specialty insurers recover a higher percentage of salvage and subrogation than non-specialty insurers that may not direct their business towards higher-risk drivers. There is also marginal evidence that stock insurers recover a higher percentage of salvage and subrogation

than mutual insurers in Year 3. This may indicate that stock insurers are persistent in their recovery later in the claim settlement process.

While we do find several similarities between the personal and commercial auto liability lines in the first three columns, as mentioned previously, it is noteworthy that the proportion of premiums written in the personal auto liability line of business is not significantly related to recovery. One plausible explanation for this difference is that subrogation may be more easily accomplished for personal lines relative to commercial lines, which likely involve larger dollar value claims, higher policy limits, and thus greater negotiation and possible litigation. The degree of complexity associated with subrogation for commercial auto liability may result in a situation where insurers with a specialization in that line can more effectively navigate the subrogation process, whereas such a degree of specialization is not as necessary for the less complex personal auto liability line of business.

In the remaining three columns of Table 6, we consider the cumulative recovery of salvage and subrogation for personal auto liability insurance. The most consistent finding suggests that more highly-leveraged firms collect a greater percentage of salvage and subrogation in the first three years following a loss. Once again, this is in line with the expectation that insurers that are more highly leveraged may attempt to reduce their leverage by increasing their surplus position through more aggressive recovery in the early years. In addition to the *Leverage* variable, the coefficient on the *Ln Age* variable is negative and significant across the three years, implying that older firms collect a lower cumulative percent in the first three years relative to younger firms. We also find that firm size is positively associated with cumulative recovery in Years 2 and 3 (albeit at the 10% level of significance), while insurers that may specialize in higher-risk drivers (*Specialty*) may recover a lower cumulative percent in the second year. Interestingly, while firm size appears to be related to cumulative recoveries for personal auto liability coverage, it is unrelated to recovery for commercial auto liability coverage. It is also noteworthy that while relatively few factors accounted for in our models were statistically associated with the cumulative speed of recovery for the commercial auto liability line of business, far more were related to cumulative recovery for the personal auto line. This may be attributed to personal auto liability claims being less complex and resulting in lower dollar value losses than what is frequently seen with commercial auto liability, such that fewer unobservable factors influence recovery rates for the personal liability line. Taken together, the results across Tables 4, 5, and 6 suggest that there are important firm financial and operational characteristics associated with salvage and subrogation recovery, but that substantial differences exist on the basis of tail length (long v. short) and consumer type (personal v. commercial).

Table 6: Personal Auto Liability Salvage and Subrogation Recovery

	Percent Recovered by Year			Cumulative Recovery		
Variables	**Year 1**	**Year 2**	**Year 3**	**Year 1**	**Year 2**	**Year 3**
Accrue Personal Auto Liab.	-0.0137	0.0039	0.0066	-0.0137	-0.0099	-0.0050
	(0.0126)	(0.0120)	(0.0075)	(0.0126)	(0.0166)	(0.0173)
% DPW Personal Auto Liab.	-0.0010	0.0097	0.0037	-0.0010	0.0072	0.0047

	(0.0409)	(0.0347)	(0.0225)	(0.0409)	(0.0428)	(0.0423)
Size	0.0149	0.0132	0.0024	0.0149	0.0276*	0.0318*
	(0.0131)	(0.0102)	(0.0077)	(0.0131)	(0.0165)	(0.0183)
Ln Age	-0.0329*	-0.0238*	0.0135	-0.0329*	-0.0570***	-0.0407**
	(0.0170)	(0.0129)	(0.0127)	(0.0170)	(0.0219)	(0.0206)
Stock	-0.0380	0.0385	0.0335*	-0.0380	0.0007	0.0337
	(0.0293)	(0.0271)	(0.0195)	(0.0293)	(0.0404)	(0.0370)
Group	0.0069	0.0052	0.0032	0.0069	0.0112	0.0148
	(0.0161)	(0.0182)	(0.0106)	(0.0161)	(0.0238)	(0.0231)
GEO Div	-0.0038	0.0007	0.0024	-0.0038	-0.0033	-0.0008
	(0.0345)	(0.0233)	(0.0187)	(0.0345)	(0.0462)	(0.0444)
LOB Div	0.0379	0.0271	-0.0108	0.0379	0.0612	0.0468
	(0.0439)	(0.0304)	(0.0230)	(0.0439)	(0.0485)	(0.0475)
Leverage	0.0166**	0.0016	0.0021	0.0166**	0.0183*	0.0204**
	(0.0071)	(0.0055)	(0.0047)	(0.0071)	(0.0096)	(0.0096)
ROA	0.1071	-0.1253*	-0.0489	0.1071	-0.0120	-0.0635
	(0.0878)	(0.0651)	(0.0509)	(0.0878)	(0.0912)	(0.0852)
Specialty	0.1351***	-0.2481***	0.1536***	0.1351***	-0.1127***	0.0506
	(0.0243)	(0.0273)	(0.0576)	(0.0243)	(0.0419)	(0.0321)
Constant	0.1856	0.1598	0.0629	0.1856	0.3553*	0.3939*
	(0.1609)	(0.1243)	(0.0868)	(0.1609)	(0.1942)	(0.2049)
Observations	5,286	5,286	5,286	5,286	5,286	5,286

*, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively. All models include unreported firm and year fixed effects and standard errors (presented beneath coefficients in parentheses) are clustered at the firm-level. The dependent variables in the first three columns are *Pct. Recovered Yr1, Pct. Recovered Yr2*, and *Pct. Recovered Yr3* and are equal to the percent of personal auto liability salvage / subrogation recovered in the year the loss was incurred, one year after the loss was incurred, and two years after the loss was incurred, respectively. The dependent variables in the last three columns are *Cumulative Pct. Recovered Yr1, Cumulative Pct. Recovered Yr2, Cumulative Pct. Recovered Yr3* and are equal to the cumulative percent of personal auto liability salvage/subrogation recovered in the year the loss was incurred, the first two years of the incurred loss, and the first three years of the incurred loss. Variable definitions are provided in Table 2.

Conclusion

An important, but at times overlooked, aspect of claims in the property-liability insurance industry is the role of salvage and subrogation. Following the payment of a covered claim, carriers are frequently afforded the ability to either (a) take possession of the damaged property and sell it (i.e., salvage) or (b) subrogate against a third party responsible for a given loss. While the concepts and processes are clearly different, the objective remains the same – recover some portion of the loss that was paid to the insured or some other injured party. However, although salvage and subrogation can ultimately have the effect of reducing the cost of claims for carriers, these two processes are not always used by insurers, and little research has been conducted to study the factors that influence attempted recovery. To our knowledge, the most comprehensive empirical research into salvage and subrogation is that of Colquitt and

Dumm (2000), which investigated the factors associated with the extent of salvage and subrogation for the auto physical damage line of business.

In this study, we extend the work of Colquitt and Dumm (2000) and examine how insurer-specific financial and operational characteristics impact the speed of salvage and subrogation recovery for U.S. property-liability insurers. Our study differs from that of Colquitt and Dumm (2000) in several important ways, which represent substantial contributions to the limited literature. First, we focus our research on both property and liability lines of business, while prior research focused exclusively on physical damage. Given the differences between short-tail and long-tail lines of business and that long-tail lines represent a significant portion of premiums written in the industry, developing an understanding of how factors related to recovery differ across the two is beneficial. Additionally, because salvage is most likely to be used for physical damage losses while subrogation will be used for liability claims, we can make inferences as to how factors differ with regard to the processes of salvage and subrogation. Second, we differentiate between personal and commercial auto lines of business in our study. In particular, we conduct our analysis across three distinct lines of business: 1) auto physical damage, 2) commercial auto liability, and 3) personal auto liability. Third, while Colquitt and Dumm (2000) study salvage and subrogation for a single year, we study the factors associated with recovery for a period that spans over 20 years. Finally, as noted previously, we study the speed of recovery as opposed to the average recovery size. The rate at which salvage and subrogation recovery takes place is important due to the potential financial implications, as funds collected in a timelier manner can be used more immediately to the benefit of the firm and the policy owners. More specifically, the speed of recovery can impact the profitability of insurers and can also lead to lower premiums due to the reduction in overall claim costs.

The results of this study demonstrate that there are significant differences between the factors that impact salvage and subrogation recovery rates, which are highly dependent on the type of coverage provided (physical damage v. liability) and the types of consumers purchasing the coverages (personal v. commercial lines). Among our findings, we show that many firm-specific characteristics are related to recovery speed for auto physical damage, including size, leverage, profitability, organizational form, and the proportion of business written in the auto physical damage line of business. However, while a number of the factors considered in this study are associated with salvage and subrogation recovery for this short-tail line of business, we find much more varied results for the two liability (long-tail) lines. Given that physical damage recovery is most likely influenced by salvage while auto liability recovery is more likely attributed to subrogation, the fact that we find less consistency across the liability lines could be due to external factors such as social inflation, the speed of litigation, and negotiations that insurers may exert less control over. Overall, the results of this study provide important insight into the complex relationships that can impact salvage and subrogation recovery rates, which can affect insurers, their policyholders, and the regulators that are responsible for overseeing the insurance market.

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