The Impact of Climate Change on Home Insurance Costs in Canada*

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Abstract

We estimate the impact of climate change on home insurance premiums in Canada using historical annual report data from Canada's largest home insurer. We estimate that catastrophic losses have increased by 8.8% per year from 2008–2024, with an estimated 6.7pp or 66% of this increase attributable to climate change; that each dollar of increased catastrophic losses leads to $1.61 of increased premiums; and that climate change has raised premiums by $182 per policy from 2008–2024, representing 25% of the overall (fitted) increase in premiums over this period. Much of the climate-driven increase in premiums is likely paid into increased reinsurance costs and premiums ceded to reinsurance, which are not reflected in the headline financial ratios reported by insurers. Data on reinsurance suggests that insurers are moving the reinsured portion of the loss distribution further into the tail, consistent with simultaneous increases in tail risk and a reduction in the return periods of somewhat large loss realizations.

1 Introduction

This paper estimates the effect of climate change on the home insurance premiums faced by homeowners in Canada. We use data from Intact Insurance, primarily their Personal Property Canada (PPC) segment, to estimate trends in catastrophic losses, non-catastrophic (non-CAT) losses, premiums, and reinsurance cash flows and coverages.

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We estimate that the growth rate in catastrophic (CAT) losses has exceeded that of non-catastrophic (non-CAT) losses by 6.7 percentage points per year from 2008 to 2024, and use this as our estimate for the contribution of climate change. Over the period 2008–2024, we estimate that climate change has increased CAT losses per policy by $113 (in 2024 CAD), representing 66% of the overall increase in CAT losses over this period.

Using data on financial ratios, we estimate that an additional dollar of CAT losses (before reinsurance) leads to $1.61 of increased premiums faced by households. We therefore estimate that climate change has raised premiums by $182 from 2008–2024, in 2024 CAD, representing 25% of the overall increase in premiums over this period.

Our approach uses differences between trends in CAT and non-CAT losses as estimates for the contribution of climate change to overall losses. There are limitations to this approach. First, climate-caused increases in losses may not be contained within CAT losses. In other words, CAT losses may not capture all losses caused by climate. Second, the climate-unrelated trend in CAT losses may differ from the climate-unrelated trend in non-CAT losses. We assume that the climate-unrelated trends—such as trends in maintenance costs and inflation—in CAT and non-CAT losses move in parallel, but this may not be the case. Third, regulatory constraints and firms' joint price decisions across multiple business lines may cause climate-caused losses to be cross-subsidized by other lines, as Oh et al. (2024) document for the U.S. homeowners' market. Climate-caused losses may not pass through to increased premiums in the way we calculate in Section 5. Fourth, climate change may lead to differences in participation and selection in home insurance markets, both on the insurer and the policyholder sides, which may cause time trends to be contaminated by composition effects.

In terms of methodology, our paper relates most closely to the literature estimating the overall monetary costs of climate change. Bouwer (2011) reviews this literature, which includes studies that compare trends in climate losses to overall trends in climate-unrelated costs, in order to isolate costs due to climate change. More recent papers have made strides using the same approach, namely Coronese et al. (2019), which finds that most of the cost of climate change is due to damages from catastrophic events. We use a similar approach, but focus specifically on insured costs in Canada, as opposed to estimating climate damages more generally.

Another related stream of literature has focused specifically on catastrophic risk in the

insurance market, and its interaction with reinsurance and costs faced by homeowners. Topics of particular relevance include the market's capacity to pay catastrophic losses (Dionne and Desjardins, 2022), how the market prices in ambiguity inherent to catastrophic events (Dietz and Niehörster, 2021), and demand for reinsurance by insurers (Froot, 2001). A recent paper by Boomhower et al. (2024) brings these topics together in a comprehensive analysis of how insurers price and offer homeowners' insurance in response to wildfire risk. They consider the margin of participation in insurance markets more deeply than we do (see limitation 4, above). McGillivray (2024) undertakes a similar exercise to us, describing the relationship between catastrophic claims and the Canadian homeowners' insurance market specifically. Their report finds that extreme weather events in 2022 and 2023 totaled $6.4 billion in insured CAT losses for Canadian insurers. However, they do not employ a strategy for estimating the climate-related component of the CAT loss trend as we do. By using historical Canadian insurance data to effectively estimate a counterfactual where there are no climate-caused losses, we are able to estimate the costs of climate change to insurers and policyholders in Canada.

This paper proceeds as follows. Section 2 outlines our data sources and imputation methods. Section 3 discusses our methodology, including our estimation strategy and necessary assumptions. Section 4 presents results for climate-driven losses, costs, whole company CAT losses, financial ratios, and reinsurance retention and coverage. Section 5 provides analysis of these results. Section 6 concludes.

2 Data

2.1 Sources

The data for this analysis comes from regulatory filings by publicly traded insurance companies operating in Canada. We collected insurance data from quarterly and annual filings from Intact Financial Corporation and Definity Financial Corporation. Most of the quantitative data was extracted from quarterly Supplementary Financial Information Forms that insurers must file with regulatory authorities. These standardized forms provide detailed financial and operational metrics that enable consistent analysis over time.

Intact Financial Corporation, Canada's largest property and casualty insurer, provides extensive segmentation of its operational and financial results. Both the company's An-

nual Reports and its Supplementary Financial Information documents disaggregate results across geographic markets and distinct business lines. Geographically, Intact separately reports operations across three primary jurisdictions: Canada, the United States, and the United Kingdom. From a business line perspective, the company segments its activities into personal property insurance, personal auto insurance, and commercial lines.

The time series of this research includes several significant corporate transformations that have reshaped Intact's market position and operational scale. In 2009, ING Insurance Company of Canada formally became Intact Financial Corporation. 2011 saw Intact complete its acquisition of AXA Insurance's Canadian operations, substantially expanding its market presence. The company's growth continued with the 2015 acquisition of Canadian Direct Insurance Inc. (CDI). Intact completed its acquisition of the global RSA Insurance Group in 2021, expanding its international footprint. These corporate events create structural breaks in the data series that require careful consideration when conducting longitudinal analysis. To mitigate this, our focus is strictly on the Canadian personal property business segment.

Definity Financial reports the majority of metrics via its Supplementary Financial Information. It separates metrics for personal auto, personal property and commercial lines, currently operating only in Canada.

For this research, we extracted data specifically pertaining to Canadian personal property insurance operations from Intact Financial Corporation's segmented reporting, which isolates the domestic home insurance business from other business segments. For Definity Financial Corporation, we used the personal property segment data.

The period this research covers spans three separate reporting standards. The International Financial Reporting Standards (IFRS) are globally recognized accounting standards, which became mandatory in Canada in 2011. These replaced the Canadian Generally Accepted Accounting Principles (GAAP). IFRS 17 was adopted in 2023. These three reporting regimes—Canadian GAAP before 2011, IFRS from 2011 to 2022, and IFRS 17 from 2023 onward—create two potential structural breaks in the time series data examined in this research.

The practical implication for interpreting this research is that trend analysis spanning either the 2011 or 2023 transition points will be viewed with appropriate caution. Sharp changes occurring around these transition years will be subject to additional scrutiny. Where possible, we have used restated figures provided by the company in transition years to main-

tain consistency. Where restatements were unavailable, we acknowledge that the accounting transitions may introduce some measurement discontinuity in the time series.

Several important limitations regarding data scope and representativeness exist. First, this analysis involves data from just two insurance companies operating in Canada. The availability of this granular operational and financial data exists solely because these companies are publicly traded entities, which subjects them to enhanced disclosure requirements. The broader Canadian insurance market includes numerous privately held insurers, mutual insurance companies, and smaller regional carriers that face no comparable public disclosure obligations, rendering their data inaccessible for research purposes.

Second, the data examined in this study reflects the operations and strategic responses of two of the largest property and casualty insurance companies in Canada. While this provides insight into how major market participants are addressing climate-related risks, it is not indicative of how smaller insurance companies facing different capital constraints and limitations are responding to the same climate challenges.

Third, both companies demonstrate significant representation in Ontario relative to their presence in other Canadian provinces. Definity Financial's business concentration is particularly pronounced, with 59% of its operations based in Ontario, followed by 14% in Alberta and the Prairies region, and only 8% in Quebec. Intact Financial Corporation still maintains 40% of its Canadian business in Ontario, with 29% in Quebec and 15% in Alberta. This Ontario-centric distribution means that the trends identified in this research will disproportionately reflect dynamics specific to Ontario, potentially limiting the generalizability of findings to other provinces. Provinces with distinct climate risk profiles—such as coastal British Columbia with its earthquake and flood risks, or Atlantic Canada with its hurricane exposure—may be inadequately represented in this dataset.

2.2 Imputations and Estimations

We perform the following imputations and transformations to transform reported variables into values of interest. We use $X \mathrel{\widehat{=}} Y$ to denote estimation, equivalent to $\hat{X} = Y$.

2.2.1 Total CAT and Non-CAT Losses

First, we calculate reported CAT and non-CAT losses, CAT_t and NONCAT_t, for each year based on the reported CAT ratio CATRAT_t and NONCAT ratio NONCATRAT_t. These

are the losses that are estimated in the year of occurrence.

$$\mathrm{CAT}_t^{\mathrm{Rep}} \mathrel{\widehat{=}} \mathrm{CATRAT}_t \cdot \mathrm{NETPREM}_t \tag{1}$$

$$\mathrm{NONCAT}_t^{\mathrm{Rep}} \mathrel{\widehat{=}} \mathrm{NONCATRAT}_t \cdot \mathrm{NETPREM}_t \tag{2}$$

We verify this for $\mathrm{CAT}_t^{\mathrm{Rep}}$, which is separately reported in Intact's Annual Reports (ARs), and find that it holds exactly. We cannot verify this for $\mathrm{NONCAT}_t^{\mathrm{Rep}}$, as it is not separately reported in ARs, but the results for $\mathrm{CAT}_t^{\mathrm{Rep}}$ suggest that it should also hold exactly.

However, the claims associated with these losses are not yet fully resolved at time of reporting. The adjustments to these losses resulting from the resolution of claims are captured by Prior-Year Development (PYD) variables, which are reported in the following year. Following Assumption 1, we attribute PYD to CAT and non-CAT losses proportionally:

$$\mathrm{CAT}_t \mathrel{\widehat{=}} \mathrm{CAT}_t^{\mathrm{Rep}} \cdot \left(1 + \frac{\mathrm{PYDCAT}_t}{\mathrm{CAT}_t^{\mathrm{Rep}} + \mathrm{NONCAT}_t^{\mathrm{Rep}}}\right) \tag{3}$$

$$\mathrm{NONCAT}_t \mathrel{\widehat{=}} \mathrm{NONCAT}_t^{\mathrm{Rep}} \cdot \left(1 + \frac{\mathrm{PYDNONCAT}_t}{\mathrm{CAT}_t^{\mathrm{Rep}} + \mathrm{NONCAT}_t^{\mathrm{Rep}}}\right) \tag{4}$$

The validity of this imputation is a consequence of the following assumption:

Assumption 1 (Prior-Year Development)**.** The expected value of Prior Year Development (PYD) ratio for any individual claim is equal for CAT and non-CAT claims.

2.2.2 Premiums and Claims Ceded to Reinsurance

Intact Annual Reports only report the whole-business figures for premiums ceded to reinsurance and claims ceded to reinsurance. We impute values for Personal Property Canada (PPC) by assigning ceded premiums and claims to PPC proportional to the average share of Operating Net Earned Premiums (NEP) attributable to PPC, relative to the entire business, in the period.

$$\mathrm{CededPremiums}_t^{\mathrm{PPC}} \mathrel{\widehat{=}} \frac{\sum_t \mathrm{NEP}_t^{\mathrm{PPC}}}{\sum_t \mathrm{NEP}_t^{\mathrm{Total}}} \cdot \mathrm{CededPremiums}_t^{\mathrm{Total}} = 0.1943 \cdot \mathrm{CededPremiums}_t^{\mathrm{Total}}$$

$$\mathrm{CededClaims}_t^{\mathrm{PPC}} \mathrel{\widehat{=}} \frac{\sum_t \mathrm{NEP}_t^{\mathrm{PPC}}}{\sum_t \mathrm{NEP}_t^{\mathrm{Total}}} \cdot \mathrm{CededClaims}_t^{\mathrm{Total}} = 0.1943 \cdot \mathrm{CededClaims}_t^{\mathrm{Total}}$$

3 Methodology

We estimate geometric (or "log") trends in CAT and non-CAT losses by regressing the log of each variable on a linear time trend, estimated by OLS. Intuitively, we interpret the difference between the time trends as the climate-driven growth in losses. Formally, we consider a model in which trends we estimate from the data are able to provide an unbiased estimate of the contribution of climate change to losses, relative to a counterfactual without climate change.

3.1 Climate-Driven Losses

For any year t and empirical variable X, let X_t^{CF} denote the value of X that would have occurred in the absence of a climate-driven trend. Ultimately, we are interested in estimating how current observations X_t differ from the values they would have had in the absence of a climate-driven trend,[1] X_t^{CF}.

In order for the difference in estimated trends to constitute estimates of the contribution of climate change to losses, relative to a counterfactual without a climate-driven trend, we require the following assumptions:

Assumption 2 (No Non-CAT Climate Trend)**.** The observed trend in non-CAT losses is an unbiased estimate of the trend in non-CAT losses that would have been observed in the absence of a climate-driven trend.

Assumption 3 (Parallel Non-Climate Trends)**.** The (geometric) trend in non-CAT losses is an unbiased estimate of the trend in CAT losses that would have been observed in the absence of a climate-driven trend.

In particular, we can decompose each series into its trend and idiosyncratic component as follows,

$$\log \text{CAT}_t = \log A^{\text{CAT}} + t \log \gamma + \epsilon_t^{\text{CAT}} \tag{5}$$

$$\log \text{NONCAT}_t = \log A^{\text{NONCAT}} + t \log \delta + \epsilon_t^{\text{NONCAT}} \tag{6}$$

$$\log \text{CAT}_t^{\text{CF}} = \log A^{\text{CAT}^{\text{CF}}} + t \log \delta + \epsilon_t^{\text{CAT}^{\text{CF}}} \tag{7}$$

$$\log \text{NONCAT}_t^{\text{CF}} = \log A^{\text{NONCAT}^{\text{CF}}} + t \log \delta + \epsilon_t^{\text{NONCAT}^{\text{CF}}}, \tag{8}$$

[1] That is, without the influence of climate change on the trend during the study period.

where the trend δ is shared among the observed non-CAT series and both counterfactual series. Only the observed CAT series has a different trend γ.

Because this model is not intended to accurately extrapolate beyond the study period to a true *pre*-climate change baseline period, we allow the baseline levels of CAT losses, A^{CAT} and A^{NONCAT}, to differ from the counterfactual baseline level, $A^{\text{CAT}^{\text{CF}}}$.

We do allow for climate change to affect non-CAT losses, but only if this effect is constant over the study period. This is consistent with non-CAT climate impacts representing more slowly-propagating effects of climate change, such as through increased maintenance costs and inflation, rather than manifesting as a sudden increase in losses over the study period. Thus, we allow the baseline level of non-CAT losses, A^{NONCAT}, to differ from the counterfactual baseline level, $A^{\text{NONCAT}^{\text{CF}}}$.

Furthermore, these estimates translate to estimates of average changes in losses per policy, under the following assumption, as long as all loss variables are transformed into real, per-policy terms.

Assumption 4 (No Composition Effects)**.** Changes in average premiums and losses are an unbiased estimate of changes in premiums and losses for the set of policyholders in the market at any given time.

Estimation

We estimate the geometric trend in non-CAT losses, δ, by estimating Equation 6 by OLS. Similarly, we estimate the geometric trend in CAT losses, γ, by estimating Equation 5 by OLS.

3.2 Reinsurance

A significant portion of premiums paid by households are ceded to reinsurers (10.6% of Entire Company NEP in 2024). The reinsurer is then responsible for a share of CAT losses: this equalled 51.9% of Entire Company CAT Losses[2] before insurance in 2024, sharply increasing over time. We thus redo the analysis described in Section 3.1 using the imputed CAT loss data described in Section 2.2.2.

[2]Unceded CAT losses: $1,539m. Ceded claims: $1,660m.

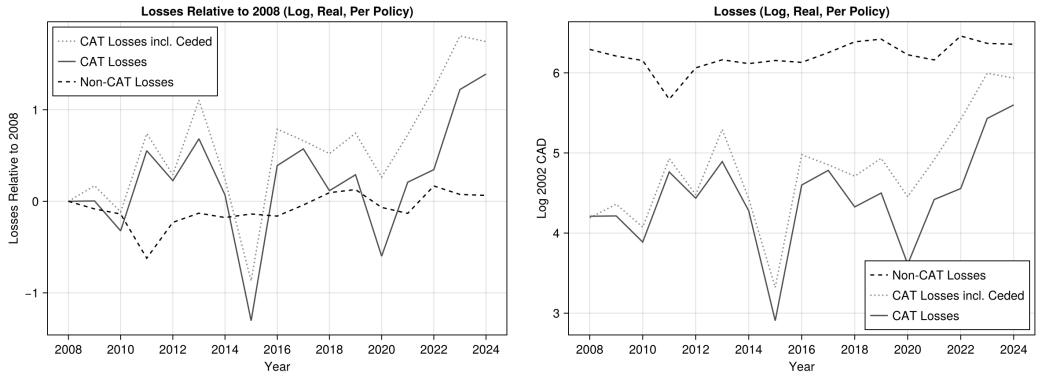
4 Results

4.1 Climate-Driven Losses

Figure 1a shows the trends in CAT and non-CAT losses over time, relative to 2008. Figure 1b shows the same trends in absolute terms. Table 1 shows the estimated trends in CAT and non-CAT losses. The noise in the CAT trend is high, so that despite having a higher estimated trend (4.9% per year) than non-CAT losses (1.97% per year), the trend in the CAT series is not statistically significant at the 0.05 level. However, when including imputed ceded losses, the CAT trend is larger (8.8% per year) and statistically significant at the 0.05 level.

Table 2 reports the results of the same analysis, but before reinsurance, that is combining net premiums with ceded premiums, and combining net CAT losses with ceded CAT losses, as described in Section 2.2.2. When including imputed ceded losses, the difference between the CAT and non-CAT trends is also statistically significant at the 0.05 level, with CAT losses growing 6.7pp per year faster than non-CAT losses.

Following the methodology described in Section 3, these estimates suggest that climate change has driven an increase in CAT losses of 6.7pp per year, relative to a counterfactual without climate change.



(a) Relative to 2008

(b) In Absolute Terms (2024 CAD)

Figure 1: Trends in CAT and non-CAT losses (Log, Real, Per Policy)

	CAT Losses (log)	Non-CAT Losses (log)	CAT minus Non-CAT (log)
	(1)	(2)	(3)
Intercept	-91.569	-33.200	-58.369
	(59.669)	(15.802)	(63.034)
Year	0.048	0.020*	0.028
	(0.030)	(0.008)	(0.031)
N	17	17	17
R^2	0.147	0.293	0.051

Table 1: Trends in CAT and Non-CAT Losses (Log, Real, Per Policy)

	CAT incl. Ceded (log)	CAT incl. Ceded minus Non-CAT (log)
	(1)	(2)
Intercept	-164.761**	-131.561*
	(52.705)	(56.325)
Year	0.084**	0.065*
	(0.026)	(0.028)
N	17	17
R^2	0.408	0.262

Table 2: Trends in CAT and Non-CAT Losses Before Reinsurance (Log, Real, Per Policy). "CAT incl. Ceded" adds imputed ceded CAT claims to net CAT losses.

4.2 Costs

Figure 2 shows Net Earned Premiums over time, together with its decomposition into claims, expenses, and income, in 2024 CAD per policy. These values are related by:

$$\text{Net Earned Premiums} = \text{Claims} + \text{Expenses} + \text{Income}.$$

Table 3 shows the estimated trends in these values. Net Earned Premiums per policy have increased at an estimated rate of 3.6% per policy, while expenses have increased at estimated rates of 3.4% per year. Claims, net of reinsurance, have increased at an estimated rate of 2.5% per year. Income cannot be estimated in logs, as there are years of negative income, but increases at an estimated arithmetic rate of $10.81 2024 CAD per policy per year.

Figure 3a shows the trends in premiums and claims ceded to reinsurance. Both premiums ceded and claims ceded have accelerated sharply since 2018. In 2024, premiums ceded to reinsurance account for 12.7% of earned premiums before reinsurance, representing a significant increase in costs to policyholders.

Figure 3b shows trends in premiums and claims before reinsurance, that is NEP added to premiums ceded, and claims added to claims ceded.

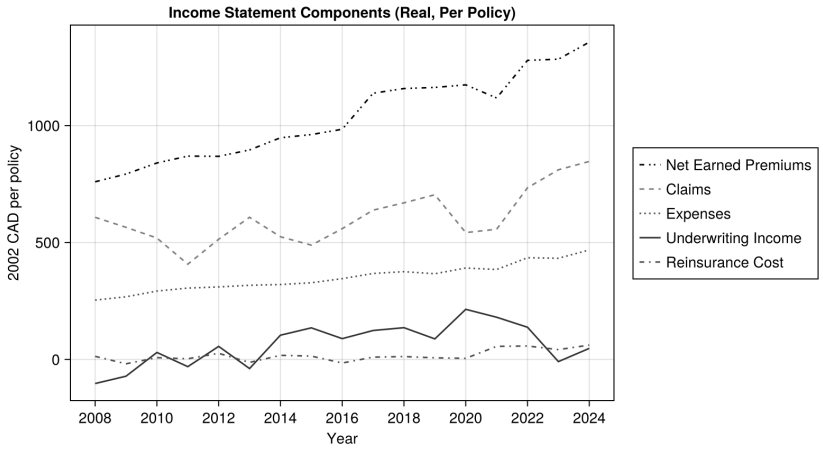
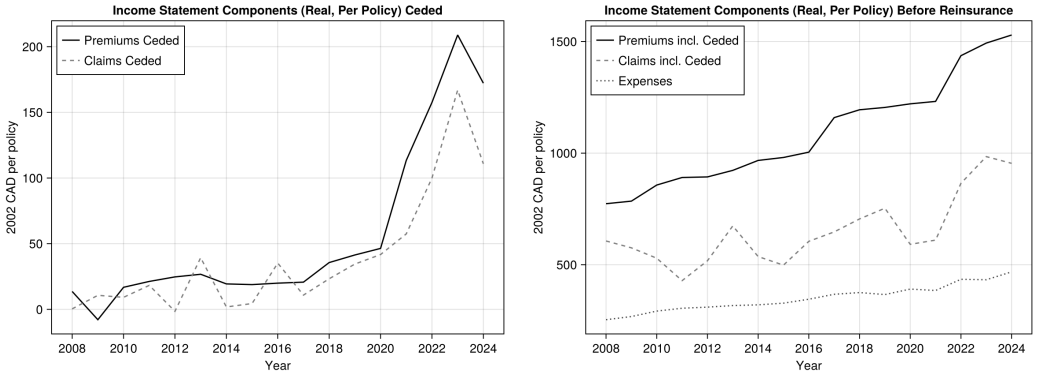


Figure 2: Trends in Income Statement Components (Log, Real, Per Policy)

	Net Earned Premiums (log)	Expenses (log)	Underwriting Income (CAD)	Total Claims (log)
	(1)	(2)	(3)	(4)
Intercept	-63.989***	-61.269***	-21728.717*	-44.191**
	(3.698)	(3.167)	(7434.044)	(14.431)
Year	0.035***	0.033***	10.810*	0.025**
	(0.002)	(0.002)	(3.688)	(0.007)
N	17	17	17	17
R^2	0.961	0.968	0.364	0.450

Table 3: Trends in Income Statement Components (Real, Per Policy). Net Earned Premiums, Expenses, and Total Claims are estimated in logs; Underwriting Income is estimated in 2024 CAD per policy because it takes negative values.



(a) Ceded Claims and Premiums

(b) Cash Flows Before Reinsurance

Figure 3: Reinsurance Cash Flows: Ceded Premiums and Claims, and Pre-Reinsurance Premiums and Claims (Real, Per Policy)

4.3 Whole Company CAT Losses

Intact annual reports also contain data on anticipated CAT losses across the entire company, reported in the previous year. Figure 4 shows these reported anticipated losses, along with actual CAT losses, net, ceded, and net+ceded. Anticipated CAT losses are projections of

CAT losses net of reinsurance in the following year. It appears to be the case that reported anticipated CAT losses have consistently undershot net CAT losses.

This is despite the fact that, as reported in Table 4, anticipated CAT losses increased at a rate of approximately 11.5% per year between 2017 and 2024.

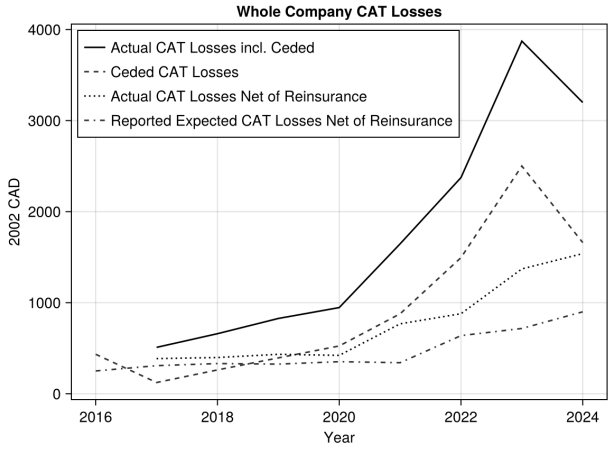


Figure 4: CAT Losses Across Entire Company (Log, Real, Per Policy)

	Anticipated CAT Losses (log)
Intercept	-214.756**
	(56.826)
Year	0.109**
	(0.028)
N	9
R^2	0.681

Table 4: Trends in Expected CAT Losses (Log, Real, Per Policy)

4.4 Financial Ratios

Figure 5 shows the expense ratio, claims ratio, and income ratio from 2002 to 2024. During this period, the expense ratio remained very stable at an average level of 34%. Table 5

reports the estimated trends. The claims ratio decreases over time at a rate of 0.42pp per year, offset by an increase in the income ratio of 0.51pp per year. In the line of best fit, the fitted value for the income ratio—the share of net premiums going towards profit—is 10.3% in 2024. The estimated trend in the income ratio comes with two caveats, however. First, fitting a linear increasing trend implies that values before a certain date will be negative, which is unrealistic and makes extrapolation challenging. Second, higher observed income ratios in later years may indicate positive skewness of the distribution of annual claims. That is, as tail risk increases, larger median annual profits may be consistent with stable mean annual profits.

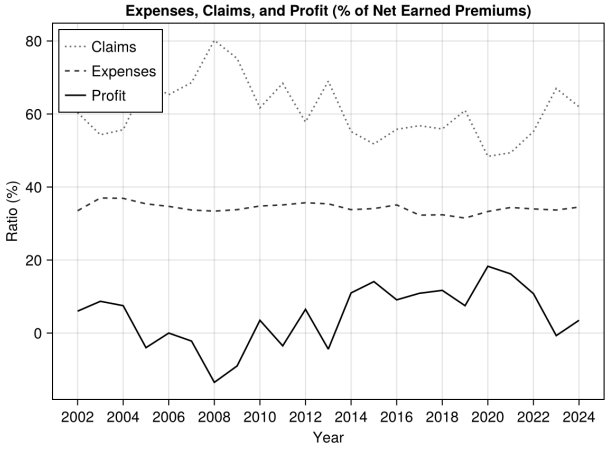


Figure 5: Expense, Claims, and Income Ratios (% of Net Earned Premiums)

	Expense Ratio	Claims Ratio	Income Ratio
	(1)	(2)	(3)
Intercept	2.195**	9.084	-10.261*
	(0.767)	(4.942)	(4.797)
Year	-0.001*	-0.004	0.005*
	(0.000)	(0.002)	(0.002)
N	23	23	23
R^2	0.217	0.123	0.180

Table 5: Trends in Expense, Claims, and Income Ratios (% of Net Earned Premiums)

Figure 6 and Tables 6 and 7 report the same data for values computed before premiums ceded to reinsurance are subtracted, that is in which the denominator is NEP + premiums ceded. This claims ratio is likely a better estimate of the share of premiums paid by households that go toward paying claims. Over the period 2002–2024, 60.2% of pre-reinsurance premiums went toward claims.

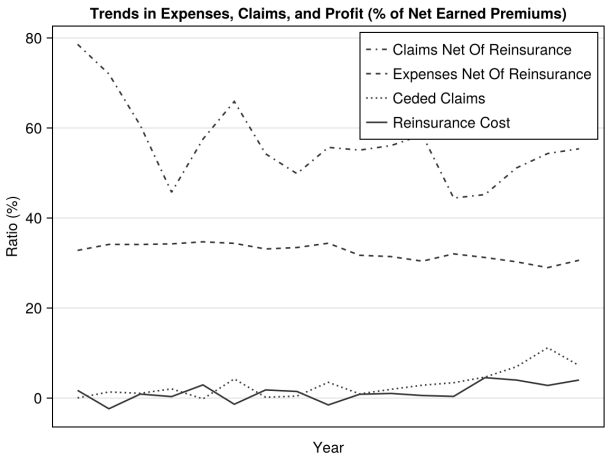


Figure 6: Pre-Reinsurance Ratios (% of Net Earned Premiums plus Ceded Premiums)

	Claims Ratio incl. Ceded	Ceded Claims Ratio
	(1)	(2)
Intercept	12.441	-9.305***
	(8.574)	(2.058)
Year	-0.006	0.005***
	(0.004)	(0.001)
N	17	17
R^2	0.113	0.578

Table 6: Trends in Pre-Reinsurance Claims and Ceded Claims Ratios (% of Net Earned Premiums plus Ceded Premiums)

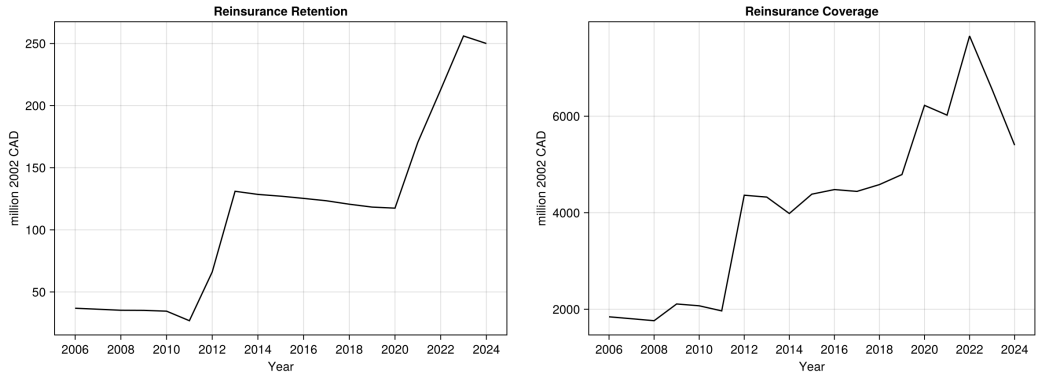
	Expense Ratio	Reinsurance Cost Ratio
	(1)	(2)
Intercept	6.233***	-4.325*
	(1.016)	(1.689)
Year	-0.003***	0.002*
	(0.001)	(0.001)
N	17	17
R^2	0.693	0.305

Table 7: Trends in Pre-Reinsurance Expense and Reinsurance Cost Ratios (% of Net Earned Premiums plus Ceded Premiums)

4.5 Reinsurance Retention and Coverage

Figure 7 reports Intact's reinsurance whole-company retention threshold and coverage limit over time. Panel (a) reports the reinsurance retention threshold over time, the maximum loss

amount paid out by the insurer, not including ceded claims, before reinsurance covers losses[3] (i.e. the deductible). Panel (b) reports the reinsurance coverage limit over time, defined as the maximum payout by the reinsurer. Both accelerate sharply over the period 2006–2024. The growth in reinsurance coverage suggests that Intact is increasing its protection against high-loss (> $2bn CAD) tail events. However, the simultaneous increase in retention suggests that Intact is also increasing the upper bound of the "typical" range of CAT loss levels.[4]



(a) Retention

(b) Coverage

Figure 7: Reinsurance Retention and Coverage. Panel (a) shows the reinsurance net retention, excluding reinstatement premium, tax impacts, and co-participations between the retention level and coverage limit. Panel (b) shows the reinsurance coverage limit, representing the ground up limit before co-participations and retention level.

[3]Intact reports nonzero ceded claims every year, but also reports that retention thresholds are usually not reached. In private correspondence, they confirm that they have proportional treaties and facultative reinsurance in addition to the catastrophe treaties to which the retention thresholds and coverage limits apply. However, the details of their exact structure is proprietary information.

[4]See 2023 Intact Annual Report, p. 24, "Our catastrophe treaties are primarily designed as a capital safeguard against catastrophic events and are not intended to manage quarter to quarter volatility."

5 Analysis

5.1 Incidence of Climate-Driven Losses

How much of increases in CAT losses are ultimately borne by households? The answer is likely to be over 100%, in the sense that every dollar of increased losses imposes additional costs through higher expenses. Furthermore, if income ratios (i.e. profit margins) as a percentage of premiums remain steady, additional losses also generate larger absolute (if not relative) profits for insurers.

Table 8 reports the fitted values of the claims, expenses, ceded claims, reinsurance cost, and income ratios for 2024. That is, the 2024 values of the lines of best fit of the specifications reported in Tables 6 and 7. The denominator of the ratios reported in Table 8 are net earned premiums + premiums ceded.

In order to interpret trends in losses as trends in insurance costs ultimately borne by households, we require the following assumption:

Assumption 5 (No Cross-Subsidization)**.** Changes in expected losses are fully capitalized into the premiums of the insurance line in which they occur, and not cross-subsidized by other insurance lines.

Under this assumption, these ratios suggest that for every dollar of increased average annual losses, premiums would increase by $1.61. Of this, $0.89 would go to claims, $0.48 to expenses, $0.11 to ceded claims, $0.05 to reinsurance costs, and $0.07 to profit.[5]

[5]The balance may be slightly different for CAT losses, with a potentially greater resulting increase in ceded claims and reinsurance costs, and a smaller resulting increase in claims and expenses. We do not believe that this would cause the $1.61 figure to be substantially different for CAT or non-CAT losses, however.

	Fitted 2024 Ratio (%)	Implied Response to $1 Additional Loss (Before Reinsurance)
Claims	55.5%	$0.89
Expenses	30.1%	$0.48
Ceded Claims	6.8%	$0.11
Reinsurance Cost	3.0%	$0.05
Profit	4.6%	$0.07
Total	100%	$1.61

Table 8: Fitted 2024 Pre-Reinsurance Ratios and Implied Response to $1 Additional CAT Loss. Ratios before reinsurance are computed by multiplying each component by NEP then dividing by NEP plus ceded premiums. Implied responses are computed by dividing each ratio by claims ratio plus ceded claims ratio.

5.2 Climate-Driven Losses

As reported in Section 4.1, over the period 2008–2024, CAT losses increased by 8.8% per year, with an estimated 6.7pp or 66% of this increase attributable to climate change.[6] Over this period, CAT losses increased from $66 per policy to $378 per policy in 2024 CAD. Out of the total increase of $312 per policy, we estimate that $113 is attributable to climate change.

As reported in Section 5.1, we estimate that each dollar of increased CAT losses (before reinsurance) leads to $1.61 of increased premiums. We therefore estimate that climate change has raised premiums by $\$113 \times 1.61 = \$182$ from 2008-2024. Over this period, overall earned premiums per policy before reinsurance increased from $773 per policy to $1,529 per policy in 2024 CAD. Of this $756 increase, we attribute $182, or 25%, to climate change. In percentage points (pp), of this 97.7% increase in premiums, we attribute 64.1pp to climate change.

[6] That is, in excess of the growth rate of non-CAT losses.

	2008 Value (2024 CAD)	2024 Value (2024 CAD)	Overall Change (%)	Overall Change ($)	Climate-Driven Change ($)	Climate-Driven Change (pp)	Climate-Driven Change (% of Overall Change)
CAT Losses	$66	$378	472%	$312	$113	310pp	66%
Premiums	$773	$1,529	97.7%	$756	$182	64.1pp	25%

Table 9: Changes in home insurance premiums, 2008–2024, and estimated climate change contributions thereof. Premiums are Net Earned Premiums + Premiums Ceded, which is our estimate of total premiums paid by households. All values are in 2024 CAD. Note that these changes are given as the differences between the realized 2024 and 2008 values, rather than the fitted increases which are used in some other analyses.

6 Conclusion

This paper estimates and interprets trends in home insurance financial variables to estimate the impact of climate change on the home insurance market in Canada. Using data from the Personal Property Canada segment of Intact Insurance, we estimate the effect of climate change on home insurance premiums faced by homeowners in Canada.

We estimate that climate change has increased CAT losses by 6.7 percentage points per year, relative to a counterfactual without climate change. Over the period 2008–2024, we estimate that climate change has driven a $113 increase in CAT losses per policy, in 2024 CAD, representing 66% of the overall increase in CAT losses over this period.

Using data on financial ratios, we estimate that an additional dollar of CAT losses leads to $1.61 of increased premiums faced by households. We therefore estimate that climate change has raised premiums by $182 from 2008–2024, in 2024 CAD, representing 25% of the overall increase in premiums over this period.

Although there are limitations to our approach, we believe climate change is the most likely driver of the observed spread between the growth rates of CAT and non-CAT losses. Catastrophic events are among the most costly aspect of climate change to date and have already led to heavy losses, borne largely by insurers and homeowners. Insurance markets are on the front line of managing and bearing costs related to climate change, making it crucial to understand their ability to bear climate exposure, and how they pass on costs and risks to households and reinsurers. Moreover, for Canadian policymakers, it is critical to have estimates of climate-caused losses in Canada.

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Appendix

A Results for Definity

Definity Financial reports many of the same variables as Intact, though with some differences in accounting conventions. The time series that we are able to collect for Definity is also shorter, 2018–2024. We separately run our analyses in Section 4 on data from Definity, where feasible. The patterns in Definity's data are broadly consistent with those we find for Intact: CAT losses increase faster than non-CAT losses, when taking ceded claims into account. The income ratio appears to increase weakly over time. Reinsurance retention and coverage both increase significantly over the period 2020–2024.

A.1 CAT and Non-CAT Losses

Table 10 reports the estimated trends in CAT and non-CAT losses per policy for Definity. Table 11 reports the same analysis including imputed ceded losses. Figure 8 shows the trends in CAT and non-CAT losses relative to the first available year.

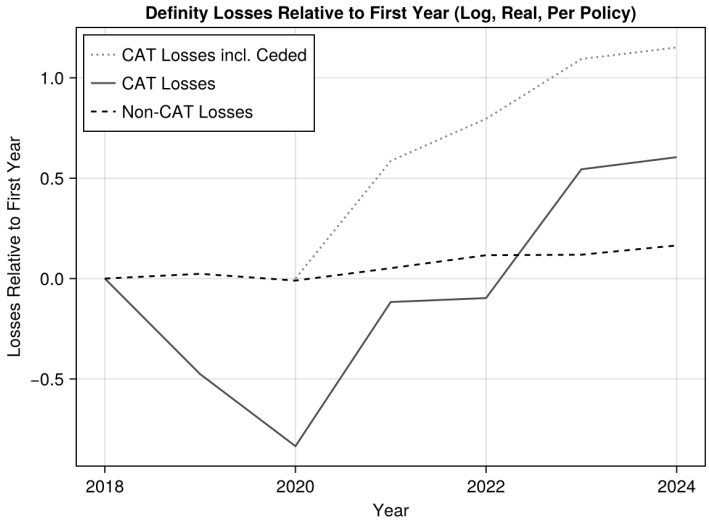


Figure 8: Definity: Trends in CAT and Non-CAT Losses (Log, Real, Per Policy), Relative to First Available Year

	CAT Losses (log)	Non-CAT Losses (log)	CAT minus Non-CAT (log)
	(1)	(2)	(3)
Intercept	-326.900	-52.228**	-274.672
	(156.108)	(10.408)	(149.586)
Year	0.164	0.029**	0.135
	(0.077)	(0.005)	(0.074)
N	7	7	7
R^2	0.474	0.864	0.400

Table 10: Definity: Trends in CAT and Non-CAT Losses (Log, Real, Per Policy)

	CAT incl. Ceded (log)	CAT incl. Ceded minus Non-CAT (log)
	(1)	(2)
Intercept	-562.519*	-484.590*
	(103.005)	(96.913)
Year	0.281*	0.239*
	(0.051)	(0.048)
N	5	5
R^2	0.910	0.893

Table 11: Definity: Trends in CAT and Non-CAT Losses Before Reinsurance (Log, Real, Per Policy)

A.2 Income Statement Components

Figure 9 and Table 12 report trends in income statement components for Definity. Figures 10a and 10b show ceded cash flows and pre-reinsurance totals, respectively.

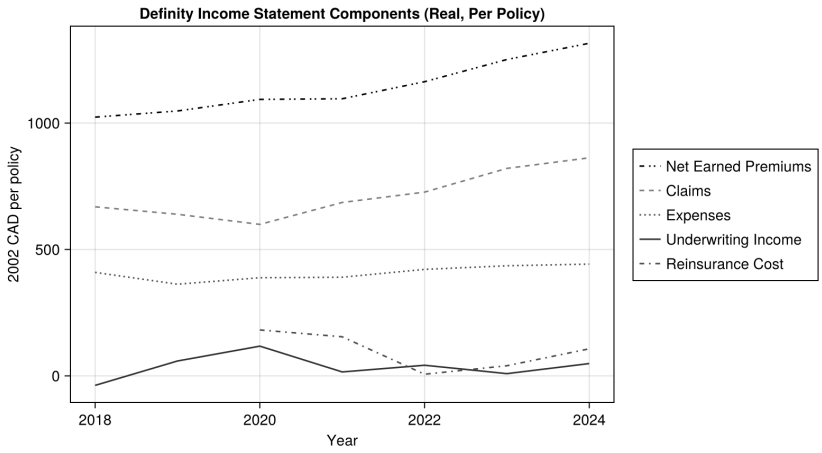
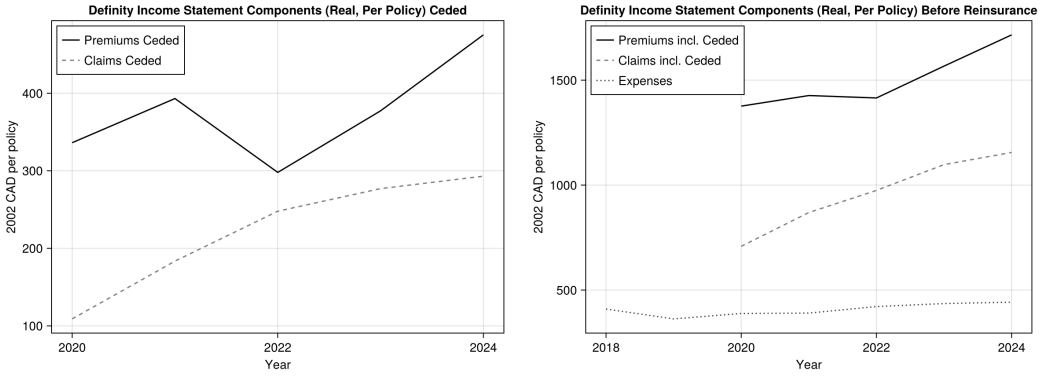


Figure 9: Definity: Trends in Income Statement Components (Real, Per Policy)

	Net Earned Premiums (log)	Expenses (log)	Underwriting Income (CAD)	Total Claims (log)
	(1)	(2)	(3)	(4)
Intercept	-77.456***	-42.974	-5961.225	-98.556*
	(8.841)	(19.853)	(19986.038)	(28.707)
Year	0.042***	0.024	2.968	0.052*
	(0.004)	(0.010)	(9.889)	(0.014)
N	7	7	7	7
R^2	0.948	0.549	0.018	0.728

Table 12: Definity: Trends in Income Statement Components (Real, Per Policy). Net Earned Premiums, Expenses, and Total Claims are estimated in logs; Underwriting Income is estimated in 2024 CAD per policy because it takes negative values.



(a) Ceded Claims and Premiums

(b) Cash Flows Before Reinsurance

Figure 10: Definity: Ceded and Pre-Reinsurance Cash Flows

A.3 Financial Ratios

Figure 11 and Table 13 report expense, claims, and profit ratios for Definity. Figure 12 and Tables 14 and 15 report the pre-reinsurance versions.

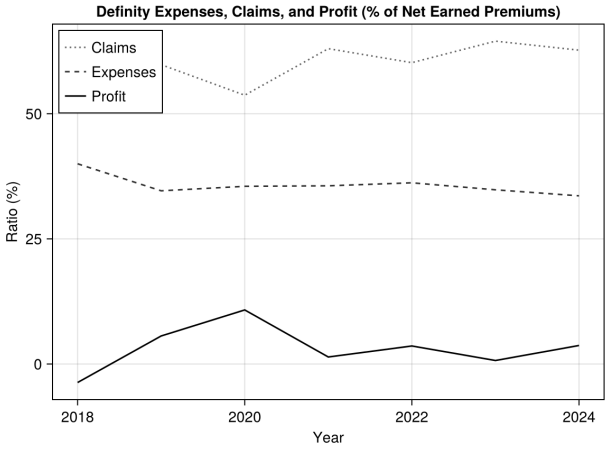


Figure 11: Definity: Expenses, Claims, and Profit (Percentage of Net Earned Premiums)

	Expense Ratio	Claims Ratio	Income Ratio
	(1)	(2)	(3)
Intercept	13.422	-8.700	-3.722
	(6.275)	(14.871)	(18.715)
Year	-0.006	0.005	0.002
	(0.003)	(0.007)	(0.009)
N	7	7	7
R^2	0.464	0.073	0.008

Table 13: Definity: Trends in Expense, Claims, and Income Ratios (% of Net Earned Premiums)

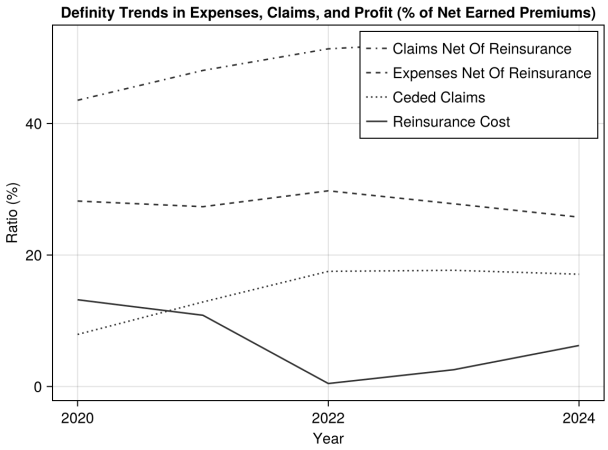


Figure 12: Definity: Pre-Reinsurance Ratios (% of Net Earned Premiums plus Ceded Premiums)

	Claims Ratio incl. Ceded	Ceded Claims Ratio
	(1)	(2)
Intercept	-82.059	-46.625
	(31.034)	(15.762)
Year	0.041	0.023
	(0.015)	(0.008)
N	5	5
R^2	0.703	0.746

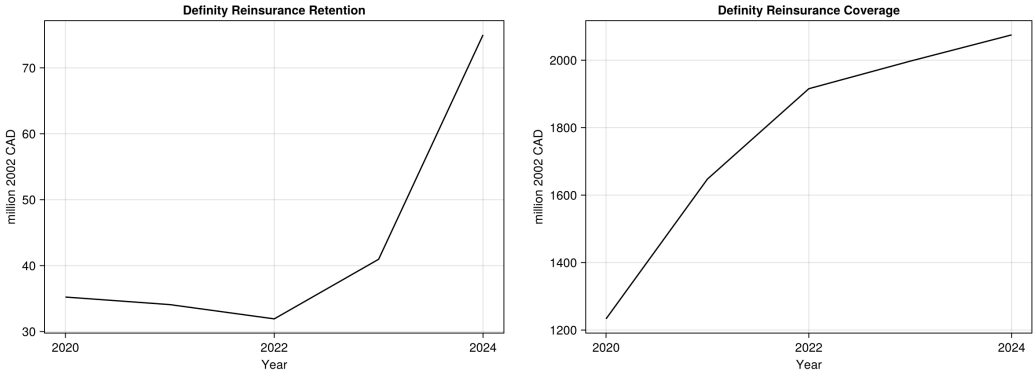
Table 14: Definity: Trends in Pre-Reinsurance Claims and Ceded Claims Ratios (% of Net Earned Premiums plus Ceded Premiums)

	Expense Ratio	Reinsurance Cost Ratio
	(1)	(2)
Intercept	9.270	44.933
	(9.336)	(30.082)
Year	-0.004	-0.022
	(0.005)	(0.015)
N	5	5
R^2	0.236	0.426

Table 15: Definity: Trends in Pre-Reinsurance Expense and Reinsurance Cost Ratios (% of Net Earned Premiums plus Ceded Premiums)

A.4 Reinsurance Retention and Coverage

Figure 13 reports Definity's reinsurance retention threshold and coverage limit over time.



(a) Retention (b) Coverage

Figure 13: Definity: Reinsurance Retention and Coverage.