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Climate Risk, Reinsurance Dependence and Insurer Profitability in Pakistan: Evidence from Listed Insurance and Takaful Firms

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ABSTRACT
Insurers balance their sheets due to the asset-liability risk of climate change, arising from portfolio repricing for transition on the liability side of the insurance business. The study employs an unbalanced panel of 18 listed conventional insurance and Takaful (Islamic Insurance) companies in Pakistan for the period 2013-2024 to examine the impact of physical and transition climate risks on the profitability of insurance companies. The study adjusts for unobserved factors that might affect estimates by using models that include time- and firm-fixed effects and reinsurance-channel tests. The study reveals that transition risk statistically significantly negatively affects return on equity and return on assets, and it has a substantial influence. When one-year reporting and settlement lags are added, contemporaneous physical risk is weaker but remains negative and significant. This addition implies that smaller insurance companies face greater transition risk shocks than larger ones, suggesting that capital buffers and diversification increase climate risk resilience. The level of mediation evidence is lower than seen in recent Chinese studies, suggesting that insurance companies may be able to skew risk transfer through this channel, but the results for reinsurance make sense. Finally, the paper also adds to the literature on climate finance/insurance risks by examining an emerging, climate-vulnerable market in Pakistan. These governance arrangements also have regulatory implications for the disclosure of climate risk, stress testing, reinsurance strategy and capital adequacy supervision.

***Keywords**: Climate Change, Insurance Profitability, Pakistan, Transition Risk, Physical Risk, Reinsurance Profit Drain, Econometric Analysis.*

1. Introduction

Climate change has become a real financial threat to insurers. According to the World Meteorological Organisation (WMO), 2024 was the warmest year in the 175-year observational record, with the global near-surface temperature estimated to be 1.55 ± 0.13 °C above the 1850-1900 average (WMO, 2025). This shift directly targets the insurance sector, since insurers price, pool, transfer and invest based on the historical stability of increasingly volatile risk distributions. As extreme weather events become more common and severe, the basis for underwriting, reserving, catastrophe modeling, and reinsurance pricing becomes less defensible (IAIS, 2025; Swiss Re Institute, 2025). There are recent instances of insurance companies losing information that support this concern. According to the Swiss Re Institute (2025), the global insured losses from natural catastrophes in 2024 were USD 137 billion, the total economic losses were USD 318 billion, and the protection gap was USD 181 billion. Munich Re (2025) also estimated total natural disaster losses at approximately USD 320 billion globally in 2024, with approximately USD 140 billion covered by insurance.

These are not just numbers that reflect global statistics; they are a reflection of growing structural pressure on the profitability of insurers: Secondary perils (flood, severe convective storms, wildfires) are driving losses and are more difficult to model and price than traditional peak perils (Munich Re, 2025; Swiss Re Institute, 2025). This climate risk is also a serious situation in Pakistan. The nation is highly vulnerable to flooding, heatwaves and climate unpredictability – as well as various limitations on climate financing.

Damages from the 2022 floods exceeded USD 14.9 billion (World Bank, 2022; Government of Pakistan et al., 2022), while losses amounted to USD 15.2 billion or more, and rehabilitation and reconstruction needs are estimated at USD 16.3 billion or more. The United Nations estimated the financing gap for climate change mitigation and adaptation in Pakistan by 2030 at USD 348 billion (2025). These broad statistics suggest that the climate risk exposure in the Pakistani insurance sector is growing faster than the institutional and financial capacity to address it. There are two types of insurance risk as set out in the literature, physical risk and transition risk. Physical risk is defined as actual losses resulting from the impact of acute and chronic climate-related events, such as floods, heatwaves, droughts, storms and changing rainfall patterns, on physical assets. Transition risk describes the financial risks arising from transitioning to a low-carbon economy, including policy changes, carbon pricing, disclosure pressures, technological substitution and the revaluation of carbon-intensive assets (NGFS, 2024; TCFD, 2017).

All of these are vulnerable to risk to the insurer. Physical risk will impact claims and reserves, loss ratios, underwriting margins and reinsurance costs. Transition risk can affect investment portfolios, asset valuations, solvency positions and shareholder returns (Gatzert & Oezdil, 2024; Jung et al., 2024). The most recent international evidence comes from Chen & Lin (2024), who concluded that the profitability of Chinese insurers is significantly affected by both physical and transition risks. In their study, they also found that physical risk has a major negative effect on profitability, primarily through higher reinsurance rates, while government climate protection performance negatively affects transition risk, and that the effect of climate risk on profitability varies with firm size and insurer type.

In a complementary study, Jung et al. (2024) present market-based evidence for the U.S. that confirms that insurers operating in regions with higher physical and transition climate risk sensitivity. Those with higher portfolio exposure to brown assets are more sensitive to physical and transition climate risks. Gatzert and Oezdil (2024) demonstrate that there may be strong dependencies between physical and transition risks, which can significantly impact a non-life insurer's default probability and profitability, especially when asset and liability risks complement one another. Notwithstanding this new body of literature, a significant empirical gap remains. Evidence of direct insurer profits stems from developed markets and/or large emerging markets (e.g., China), but is limited in South Asian climate-sensitive insurance markets.

Besides being highly vulnerable to climate risks, Pakistan's insurance market is relatively small, risk pooling is comparatively weak, disclosure practices are still underdeveloped, and it relies heavily on reinsurance from abroad. In this regard, the insurance sector in Pakistan differs from markets with greater capital buffers for insurers, wider catastrophe modeling infrastructure and more established risk transfer paths. So, the results obtained from China, Europe or the United States can not be extrapolated to Pakistan. This paper aims to fill that gap by analyzing the impact of physical climate and transition climate risks on the profitability of listed conventional insurers and Takaful companies in Pakistan. It's based on three profitability and risk measures: return on assets (ROA), return on equity (ROE), and underwriting risk (UW).

This study also examines the role of reinsurance as a transmission mechanism of climate-risk effects, the vulnerability of smaller firms relative to larger firms, and the effects of one-year lags on observed climate-risk effects. The paper's contribution is fourfold. First, it is one of the first country-level empirical studies to cover firms and their profits in Pakistan and assess their climate risk. Second, it distinguishes physical and transition risks to determine whether risks are primarily underwriting or investment risks. Third, it examines reinsurance dependence and firm-size heterogeneity, a topic discussed by Chen and Lin (2024) in the context of a large-scale reinsurance market but not yet explored in the South Asian context. Fourth, it offers policy-relevant evidence on climate-risk disclosure, stress testing and regulatory capital planning, based on the IAIS (2025) supervisory guidance and NGFS (2024) scenario-based climate-risk assessment approach.

The rest of the article is organized as follows. In Section 2, the existing literature on climate risk, insurance company profitability, reinsurance, and firm-size heterogeneity is reviewed. The data, variables, model specification and estimation strategy are explained in Section 3. The empirical results are presented and discussed in Section 4. The conclusion of the study is given in Section 5, with key implications.

literature review and hypotheses development

The impacts of climate change are increasingly discussed as a financial risk instead of an environmental externality. Newman and Noy (2023) estimated that the costs of extreme weather events in the United States over the past 20 years are USD 143 billion per year, due to anthropogenic climate change. Insurers act as a shock absorber and a risk-bearing institution, and they bear this cost. With rising losses, insurers are under pressure from increased claims, higher reinsurance costs, uncertain reserves, and underpricing and solvency issues (Collier et al., 2021; IAIS, 2025). Physically, climate-related risks impact insurers primarily on the liability side of the balance sheet. Floods, storms, heatwaves, and other extremes can drive up claim frequency and severity, affect loss reserving, and reduce underwriting profitability.

According to catastrophe-loss evidence from around the world, insured losses have been on an upward trend since the early 1900s, with exposure growth and asset concentration the two main drivers, as well as the intensification of hazards caused by climate change (Munich Re, 2025; Swiss Re Institute, 2025). However, because historical catastrophe models depend on past hazard distributions, non-stationary climate patterns can lead to underpricing and delayed claim recognition (Gatzert & Oezdil, 2024; Oquendo-Torres & Segovia-Vargas, 2024). Insurers are impacted by transition risk in their investment portfolios and strategic repositioning. Insurers have substantial financial assets to support future obligations and could invest in carbon-intensive assets vulnerable to carbon pricing, technological change, investor repricing and tightening policies. Faccini et al. (2023) demonstrate that the stock market is pricing the risk posed by climate policies, particularly since 2012.

Indeed, Jung et al. (2024) provide evidence that insurers with greater shares of brown assets are more responsive to transition-risk factors. The implication is that climate disasters need not immediately lead to claims, but that the shift to a low-carbon economy may diminish investment returns and shareholder value. Recent insurer studies reinforce these. Both physical and transition risks are significant factors that negatively affect insurers' profitability in China (Chen and Lin, 2024), partly by increasing reinsurance rates. In a climate-scenario study, Gatzert and Oezdil (2024) demonstrate that asset-liability dependence can increase default risk and decrease profitability for non-life insurers. According to Xu et al. (2025), the sustainable operational efficiency of insurers in China is negatively affected by climate risk.

While these studies offer a good guide to Pakistan, the need to test the country's market, the lack of catastrophe modeling expertise, and the susceptibility to floods and heatwaves further underscore the need for local testing. Reinsurance is one of the key tools for climate-risk management. Primary insurance companies can use reinsurance to cede responsibility for part of their risk to global reinsurers, helping maintain solvency in the aftermath of major losses. Reinsurance can, however, also be a profitability drain if ceded premiums increase faster than the retained technical profit. Swiss Re Institute (2025) states that reinsurers have a greater stake in peak-loss years, underscoring the significance of reinsurance. But with rising global reinsurance costs, emerging markets may see this risk factor shift back to domestic insurers, leading to higher treaty prices and tougher terms. The reinsurance channel, then, is protective and expensive. Another important factor is firm size.

Larger insurers tend to have more diversified portfolios, more flexible risk management processes, greater access to reinsurance, stronger capital buffers and better analytics. Smaller firms might have greater exposure to shocks due to limited portfolios and reduced ability to withstand negative underwriting (or investment) results. Chen and Lin (2024) find firm-size heterogeneity in China. Gatzert and Oezdil (2024) also demonstrate that resilient insurers need to make changes to their risk management design and pricing. Firm size is likely to be even more important in determining climate-risk exposure in Pakistan, where insurance penetration and capital depth are relatively shallow. Using this literature, the following hypotheses are tested in this study. The profitability of insurers in Pakistan is negatively affected by physical climate risks. Climate risks negatively impact insurer profitability in Pakistan. Physical and transition climate risks add to underwriting risk. Reinsurance serves as a channel through which climate risk impacts insurer profits. Smaller insurers are more likely to be negatively affected by climate risk than are larger insurers. Lagged physical, transition risks are more negative than contemporaneous risks since insurance claims, reserve adjustments and repricing assets are not recognized at the same time.

3. Data and Methodology

The study employs an unbalanced panel of 18 insurance and Takaful companies traded on the Pakistan Stock Exchange for the period 2013-2024. The study dataset includes 216 possible firm-years, but only 198 are usable due to missing data. Appropriateness of the use of panel data: It combines variation across firms with variation across time, thus increasing degrees of freedom and providing the opportunity to control for unobserved firm-specific heterogeneity (Baltagi, 2021; Wooldridge, 2010). The financial variables used in the study are obtained from the firms' annual reports, financial statements and official data sources. It generates climate variables based on meteorological and environmental databases, such as NASA, meteorological data and World Bank environmental indicators, as reported in the thesis database. The dependent variables are ROA, ROE and underwriting risk.

The main independent variables are physical risk (PR) and transition risk (TR). Control variables are log equity, log fixed assets, log revenue, log cash, GDP growth, inflation and oil price. This specification is based on the literature on insurer performance (Chen & Lin, 2024; Zinyoro & Aziakpono, 2024), which identifies profitability as a function of firm-specific balance-sheet variables and macroeconomic controls, adding climate-risk variables of interest to the specification. Physical risk is represented by standardized anomalies in meteorological data that reflect climate pressure anomalies beyond the historical series, in line with the climate-risk assessment logic, which uses forward-looking climate pressure anomalies rather than only historical climate data (NGFS, 2024; Oquendo-Torres & Segovia-Vargas, 2024). Transition risk is measured by carbon-related transition pressure, a proxy for the financial risk of transitioning to a lower-carbon policy and market environment.

That is in line with climate finance research that distinguishes between physical (impact) and transition and policy repricing effects (Faccini et al., 2023; Jung et al., 2024). Firm- and year-fixed effects are estimated in the baseline model. Firm fixed effects control for time-invariant insurer characteristics such as organizational history, business model, underwriting culture, geographic focus and management style. Macroeconomic and regulatory shocks common across firms in a year are adjusted using year fixed effects. A Hausman test is appropriate when unobserved heterogeneity in the data is correlated with the regressors (Hausman, 1978; Wooldridge, 2010). Standard errors are given in parentheses in the regression tables.

3.1 Econometric Model Equations

Baseline profitability model:

$$\Pi_{it} = \alpha_i + \beta_1 PR_{it} + \beta_2 TR_{it} + \gamma Controls_t + \epsilon_{it} \quad (1)$$

Where Π_{it} represents the financial performance of 18 insurance companies from 2013 to 2024, α represents parameters to be estimated, and ϵ is the random error term. The control variables include equity (lneq), Fixed Assets (lnfa), Revenue (lnrev), GDP growth (GDPG), and Inflation (INF).

ROA model:

$$ROA_{it} = \alpha_i + \beta_1 PR_{it} + \beta_2 TR_{it} + \gamma Controls_{it} + \epsilon_{it} \quad (2)$$

ROE model:

$$ROE_{it} = \alpha_i + \beta_1 PR_{it} + \beta_2 TR_{it} + \gamma Controls_{it} + \epsilon_{it} \quad (3)$$

Underwriting risk model:

$$UW_{it} = \alpha_i + \beta_1 PR_{it} + \beta_2 TR_{it} + \gamma Controls_{it} + \epsilon_{it} \quad (4)$$

The study examines the reinsurance channel to determine whether climate risks prompt insurers to cede more premiums, thereby reducing their net profits. This analysis takes place in three steps: Direct Effect: Regressing Profitability (Y) on Climate Risks (PR, TR). Mediator Effect: Regressing the Reinsurance Ratio (Rein) on Climate Risks (PR, TR). Total Effect: Regressing Profitability (Y) on both Climate Risks (PR, TR) and the Mediator (Rein).

$$Y_{it} = \alpha_i + \beta_1 PR_{it} + \beta_2 TR_{it} + \theta Rein_{it} + \sum \Phi Controls_{it} + \epsilon_{it} \quad (5)$$

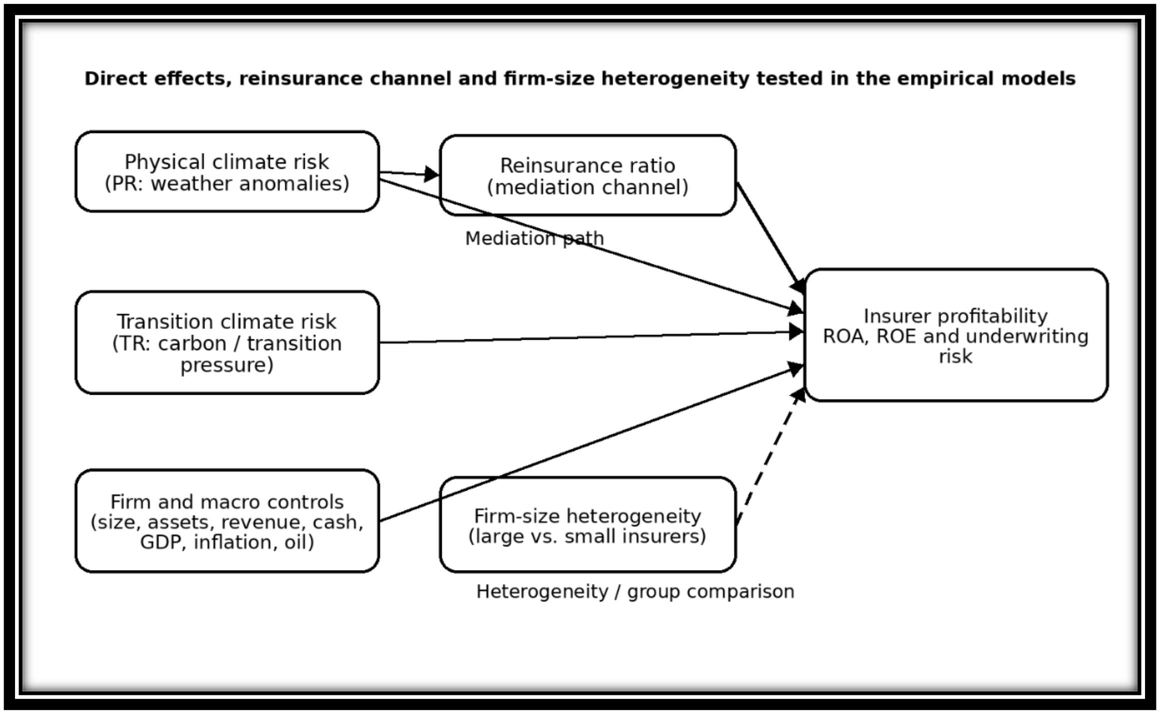
To account for asymmetric impacts, the sample is segmented by firm size for subgroup analysis. It categorizes companies as Large and Small based on median total assets to determine whether economies of scale lead to better resilience to risk. Asset Structure Heterogeneity was analyzed using asset concentration to assess whether physical infrastructure increases vulnerability to climatic shocks. A lagged model is estimated to account for the costs associated with disasters at the tail end and the insurance claim lag in claim settlements.

$$Y_{it} = \alpha_i + \Delta_t + \beta_1 PR_{it-1} + \beta_2 TR_{it-1} + \sum \Phi Controls_{it} + \epsilon_{it} \quad (6)$$

This extensive econometric package ensures that the research results are statistically valid and reliable, while controlling for time lags and firm-specific differences.

In Equations (1)-(6), i indexes insurer and t indexes year. $\boldsymbol{Y_{it}}$ is used twice to represent ROA, ROE and UW. $PR\ it$ denotes physical climate risk, $\boldsymbol{TR_{it}}$ denotes transition risk, $X\ it$ is a vector of firm and macroeconomic controls, mu_i captures firm fixed effects, lambda_t captures year fixed effects, and ϵit is the idiosyncratic error term. The mediation channel is analyzed by looking at the effect of PR and TR on the reinsurance ratio, which is followed by the examination of the effect of reinsurance on profitability, based on the logic of stepwise mediation testing, with cautious interpretation of the results when the coefficients of the models are not statistically significant (Baron & Kenny, 1986; Hayes, 2018).

Figure 1. Conceptual and Empirical Framework



In Figure 1, the model compares the profitability of insurers under physical and transition climate risks, both directly and via a reinsurance channel, and evaluates whether the impact of climate risks varies across insurer size.

3.2 Variable Measurement

Variable	Type	Measurement/interpretation
ROA	Dependent	Return on assets: net income relative to total assets, reflecting asset-based profitability.
ROE	Dependent	Return on equity: shareholder return relative to equity.
UW	Dependent/risk	Underwriting risk or technical underwriting outcome captures pressure from claims and underwriting volatility.
PR	Main independent	Physical climate risk based on standardized meteorological anomalies.
TR	Main independent	Transition-risk proxy based on carbon/transition pressure.
Rein	Mediator	Reinsurance ratio, used to test the reinsurance-profit-drain channel.
Lneq	Control	Natural log of equity/capital strength.

Lnfa	Control	Natural log of fixed assets.
Lnrev	Control	Natural log of revenue/premium income proxy.
Lncash	Control	Natural log of cash/liquidity.
GDPG, INF, Oilp	Macro controls	GDP growth, inflation and oil-price controls.

4. Empirical Results and Discussion.

The empirical results are reported here and contrasted with the most similar study available. The talk provides clarifications on whether the Pakistani evidence supports, qualifies, or refutes that presented by China, the United States, and the general climate finance literature.

4.1 Baseline Fixed-Effects Results

Table 1 gives the fixed-effects results at baseline. The most consistent result is the negative relationship between transition risk and ROE and ROA. As shown in the preferred specification, TR is negative and statistically significant in both ROE (-24.461, p<0.01) and ROA (-11.152, p<0.01). The findings in this study indicate that transition pressure is already reflected in the financial results of Pakistani insurance companies, likely through asset repricing, portfolio exposure and operating costs. This aligns with Jung et al. (2024), who find that insurers with higher brown-asset exposure are more exposed to transition risk factors, and with Chen and Lin (2024), who find that transition risk significantly reduces insurer profitability in China.

The negative relationship between contemporaneous PR and ROA is not observed in the baseline specification; however, this may indicate that physical shocks are not fully recognised in the same year, perhaps due to delays in claim settlement, reserve strengthening and reinsurance adjustments. This contrasts with the more pronounced contemporaneous PR effect observed by Chen and Lin (2024) in China. It is, however, consistent with the practical insurance logic that physical risks can be time-lagged, particularly in markets where processing claims, adjusting losses and recovering from catastrophes take time (Gatzert & Oezdil, 2024; IAIS, 2025).

Table 1. Baseline fixed-effects estimates

Variable	ROE (1)	ROE (2)	ROA (1)	ROA (2)	UW (1)	UW (2)
PR	0.171 (1.701)	0.098 (1.707)	-0.578 (0.728)	-0.575 (0.733)	0.203 (10.383)	0.749 (10.374)
TR	-24.696*** (4.718)	-24.461*** (4.772)	-11.233*** (2.019)	-11.152*** (2.048)	-19.255 (28.800)	-15.325 (29.000)
Lneq	5.565** (2.252)	5.758** (2.382)	2.708*** (0.964)	2.612** (1.020)	-26.797* (13.748)	-33.977** (14.470)
Lnfa	-3.528*** (1.284)	-3.198** (1.334)	0.306 (0.550)	0.330 (0.572)	-1.152 (7.838)	-1.392 (8.105)
Firm FE / Year FE	Yes / Yes	Yes / Yes	Yes / Yes	Yes / Yes	Yes / Yes	Yes / Yes
Observations	198	198	198	198	198	198
R-squared	0.232	0.237	0.201	0.202	0.075	0.089

Note. Standard errors are in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01.

4.2 Firm-Size Heterogeneity

As seen in Table 2, transition risk poses significant harm to small insurers. In the small-firm subsample, TR is strongly negative for ROE (-37.904, p < 0.01) and ROA (-15.906, p < 0.01). The

TR effect is smaller for ROE in the large-firm subsample. For ROA, it remains important, while for smaller insurers, it indicates less capacity to absorb a transition risk shock. This is consistent with Chen and Lin (2024) and the literature on insurer performance, which indicates that the impact of size, capitalisation and diversification on insurer profitability and resilience (Zinyoro & Aziakpono, 2024).

The Pakistani evidence is also relevant, given the diversity of capital bases and product mixes among firms in Pakistan's insurance market. One might therefore argue that a uniform climate-risk regulation would be less effective than a proportional approach, which would involve providing capacity-building assistance to smaller insurers while still requiring them to disclose their climate-risk exposures and enhance their risk management. This interpretation is also consistent with the IAIS (2025), which focuses on embedding climate risk into governance, internal controls, valuation and supervisory reporting.

Table 2. Firm-size heterogeneity

Variable	ROE Large	ROE Small	ROA Large	ROA Small	UW Large	UW Small
PR	-0.283 (1.565)	-1.168 (2.767)	-0.449 (0.436)	-0.888 (1.443)	2.109 (4.638)	3.162 (21.960)
TR	-7.965 (4.929)	-37.904*** (7.333)	-6.739*** (1.374)	-15.906*** (3.824)	11.703 (14.610)	-22.693 (58.170)
Lneq	-6.144** (2.903)	14.631*** (3.584)	0.513 (0.809)	4.810** (1.869)	3.530 (8.604)	-55.975* (28.430)
Observations	99	99	99	99	99	99
R-squared	0.557	0.360	0.373	0.281	0.225	0.139

Note. Standard errors are in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01.

4.3 Reinsurance Channel

The reinsurance channel is assessed in Table 3. This mechanism is referred to as a reinsurance profit drain by the study motivation because the domestic insurer is shifting more risk to the global reinsurer. Still, the cost of this transfer can lead to a decline in overall retained profitability. Both coefficients are positive, indicating that the larger the business scale and liquidity, the more likely the business is to use reinsurance, which, in turn, is negatively associated with revenue. The direct impact of PR and TR on the reinsurance ratio, however, cannot be statistically distinguished from zero in this fixed-effects specification, and the coefficient of Rein does not seem to be statistically distinguishable from zero in the profitability equations, either.

While suggestive, the Pakistani data are not as strong as those of Chen and Lin (2024), who reported that physical risk depresses profitability for Chinese insurers primarily through higher reinsurance rates. The difference could be attributed to differences in market structure: the insurance industry in Pakistan is smaller, leading to fewer firm-year observations, and reinsurance arrangements could be affected by treaty cycles and firm-specific arrangements that are not reported in annual financial statements. The findings remain useful, as they highlight areas of variation in Pakistan's experience vis-à-vis China and thus the need for more detailed reinsurance data for future research.

Table 3. Reinsurance-channel estimates

Variable	ROE baseline	Rein model	ROE + Rein	ROA baseline	ROA + Rein	UW baseline	UW + Rein
PR	0.171 (1.701)	-2.934 (4.500)	0.244 (1.704)	-0.578 (0.728)	-0.538 (0.729)	0.203 (10.380)	0.180 (10.426)
TR	-24.700*** (4.718)	15.190 (12.484)	-25.100*** (4.742)	-11.300*** (2.019)	-11.440*** (2.027)	-19.260 (28.800)	-19.133 (29.009)
Rein			0.025 (0.029)		0.013 (0.012)		-0.008 (0.177)
Observations	198	198	198	198	198	198	198
R-squared	0.232	0.143	0.235	0.201	0.207	0.075	0.075

Note. Standard errors are in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01.

4.4 Lagged Climate-Risk Effects

Table 4 has the best evidence of a lag in the impact of climate risk on Pakistani insurers. Lagged physical risk is negative and significant for ROE (-5.031, $p < 0.05$) and ROA (-1.671, $p < 0.10$). Lagged transition risk is also strongly negative for ROE (-32.013, $p < 0.05$) and ROA (-15.062, $p < 0.01$). The results confirm hypothesis H6 and indicate that climate shocks do not fully explain same-year profitability. Rather, they manifest as claim settlement delays, reserve changes, delayed asset repricing and reinsurance renewal periods. This time-lagged pattern aligns with the non-stationary risk perspective in NGFS (2024), the asset-liability dependence logic in Gatzert and Oezdil (2024), and the growing body of evidence on time-lagged climate risks in insurance markets (Chen & Lin, 2024).

The lagged results also support the paper's contribution by providing a clearer explanation of the baseline model's weakness in contemporaneous PR. Large-scale climate events, such as floods, may result in asset damage, generate short-term claims, and have accounting consequences for insurers across several reporting periods. Regulators and boards, this means that the loss estimates from climate stress testing should not be restricted to within the same year. It should include delayed claim development and multi-year solvency effects, in keeping with the recommendations of IAIS (2025) and NGFS (2024).

Table 4. Robustness: lagged climate-risk effects

Variable	ROE	ROA	UW
PR lag 1	-5.031** (2.201)	-1.671* (0.946)	-0.714 (13.568)
TR lag 1	-32.013** (6.133)	-15.062*** (2.636)	-1.086 (37.815)
Lneq	4.793** (2.172)	2.238** (0.934)	-29.900** (13.395)
Observations	198	198	198

R-squared	0.274	0.222	0.064

Note. Standard errors are in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01.

4.5 Synthesis of Results Against Prior Studies

Overall, the findings confirm the international finding that insurers are financially materially impacted by climate risk, with Pakistan adding nuance. In this paper, we show, like Chen and Lin (2024), that transition risk is a negative determinant of insurer profitability. As in Jung et al. (2024), the outcome supports the notion of transition exposure to work through asset-side repricing and through the brown-asset sensitivity. As with Gatzert and Oezdil (2024), the lagged results indicate that researchers should adopt a multi-period underwriting approach to assess climate risks rather than a single-period approach.

The evidence, however, on the reinsurance channel is different for Pakistan. According to Chen and Lin (2024), one important pathway by which physical risk impacts profitability is via reinsurance rates. In Pakistan, mediation coefficients are not statistically significant, but this does not imply that the channel is unimportant; it simply means the mediation effect can't be determined with firm-level annual data. Treaty-level or line-of-business data may be necessary for researchers to successfully test reinsurance treaties, ceded premium schedules, catastrophe layers, and international renewal cycles. It is helpful to distinguish this from other markets and to explain why the systems in emerging markets may differ from those in larger markets.

The firm-size result is also of policy relevance. The smaller insurers in Pakistan are more exposed to transition risk than the larger insurers, which aligns with the performance literature, which indicates that larger insurers are generally more resilient due to their greater capitalization, diversification and capacity to manage risk (Zinyoro & Aziakpono, 2024). It also reflects the IAIS (2025) guidance, which emphasizes the importance of insurers incorporating climate risk into their governance, risk management, internal controls and valuation processes. For Pakistan, it implies that climate-risk supervision should encompass proportionality, which does not imply that proportionality is a regulatory exemption. Lower standards in risk governance are not what smaller insurers need to support capacity or to improve their tools for managing climate risk.

The overall conclusion suggests that there is a profitability paradox in Pakistan's insurance industry. Climate exposure generates new claims volume and new investment losses, combined with delayed balance sheet impacts, reinsurance expenses, and claims pressure, reducing profitability. The paradox is especially relevant in a nation where the climate financing gap is large, and flood and heatwave risk exposure is high, such as Pakistan (United Nations in Pakistan, 2025; World Bank, 2022).

5. Conclusion and Policy Implications

The paper finds that transition risk has a significant negative impact on ROE and ROA, and that lagged effects of physical risks are significant. In contrast, transition-risk shocks have a more adverse effect on smaller companies from listed insurance and Takaful companies between 2013 and 2024, when using an unbalanced panel. Theoretically, and, at least in principle, it is plausible that the reinsurance-profit-drain channel is relevant and can still be significant; given the evidence in the fixed-effects specification available, this is, however, suggestive rather than conclusive. The results have several policy implications. On the one hand, the Securities and Exchange Commission of Pakistan can consider a phased climate-risk disclosure for insurers, physical-risk exposure, transition-risk exposure, reinsurance dependence and the concentration of climate-sensitive assets. Second, insurers need to conduct annual climate stress tests across several scenarios, not just on past loss distributions. Third, technical climate risk modelling, optimization in reinsurance and portfolio risk management can be needed by smaller insurers. Fourth, companies need to shift from actuarial hindsight to predictive foresight—including meteorological anomalies, catastrophe scenarios and transition risk indicators in their underwriting and investment processes. Fifth, regulators must collaborate with climate, financial and disaster-risk agencies to address protection gaps and facilitate market development.

The study has some limitations. The sample is restricted to listed insurers and Takaful firms, and annual data could mask in-year catastrophe effects and in-year reinsurance changes. The physical-risk proxy is based on standardized meteorological anomalies rather than geographic exposure within companies' portfolios. The transition-risk proxy is designed to reflect, more generally, the pressure from carbon-related issues. Still, it is not necessarily a true reflection of the pressure each insurer faces from its brown assets. Further research could be conducted using line-of-business claims, location-level exposure, treaty-level reinsurance data, and portfolio holdings to better test the mechanisms. Even with these constraints, the paper offers a solid foundation for further climate-risk studies of the insurance industry in Pakistan. It may be further developed and submitted to journals on climate finance, emerging-market finance, and risk management and insurance economics.

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