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The Munich Re Programme: *Evaluating the Economics of Climate Risks and Opportunities in the Insurance Sector*

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New research results of normalised loss trends from natural disasters

Climate Change Symposium

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Normalisation of (insured) disaster losses

$$Norm.\ Loss_t^s = Loss_t$$

$$\cdot \frac{GDPdefl_s}{GDPdefl_t}$$

$$\cdot \frac{Pop_s}{Pop_t}$$

$$\cdot \frac{Wealth\ pc_s}{Wealth\ pc_t}$$

$$[\cdot \frac{Ins.\ penetration_s}{Ins.\ penetration_t}]$$

Wealth proxies used

- Global analysis: Change in wealth per capita approximated by GDP per capita at country level
- Germany: GDP per capita at the Landkreis/Kreisfreie Städte level
- US: Personal income at the county level (not shown) or value of housing stock at state level (shown)

Proxies used for insurance penetration

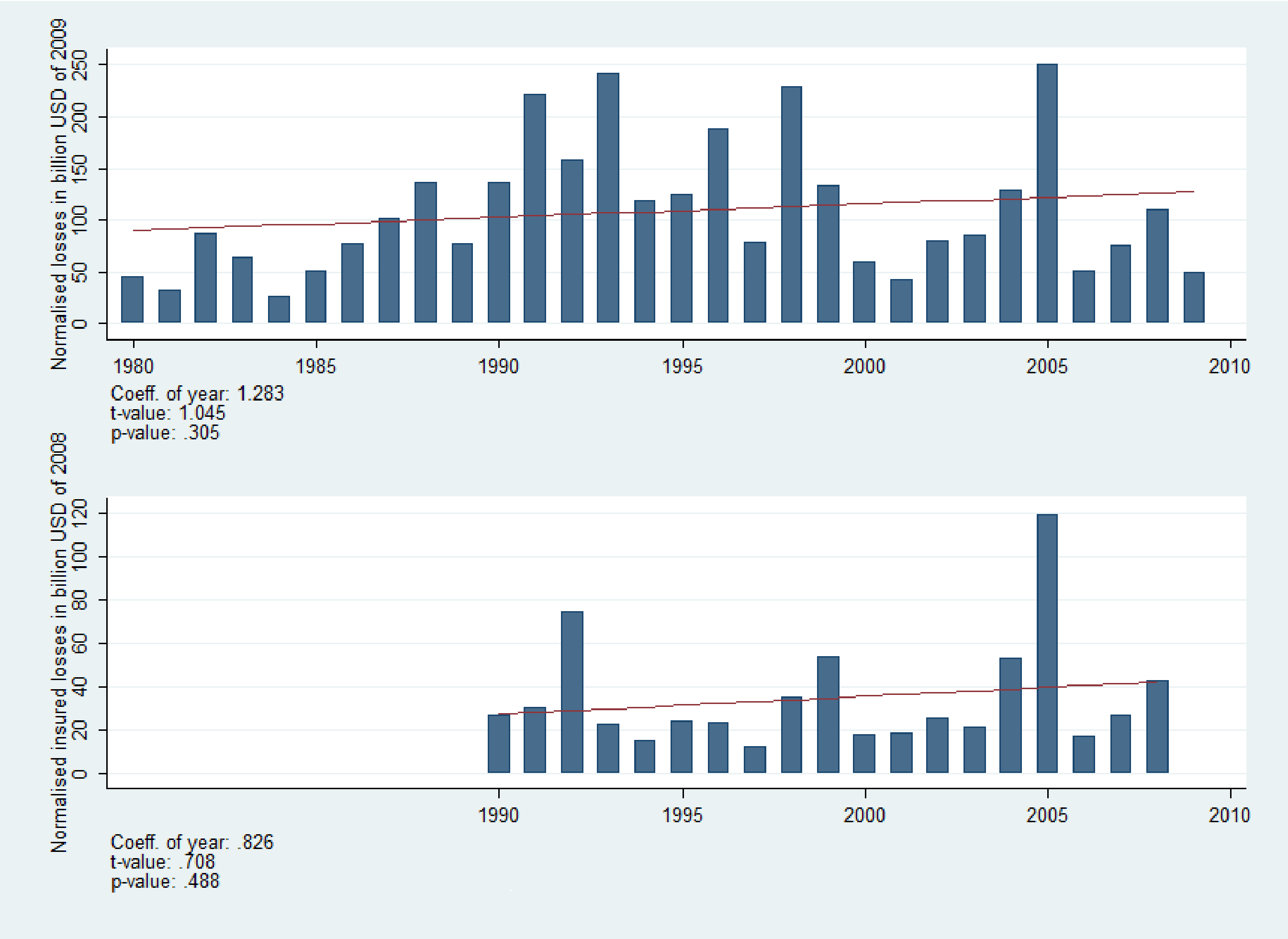
- Insurance penetration: Insurance premia/ GDP
- Insurance premia used:
  - Global analysis: Property (and engineering) premia
  - US and Germany: subset of property and engineering premia plus motor physical damage, which are affected by natural disasters

Statistical test for the existence of a trend

$$Normalized\ Loss_t^{2008} = \alpha_0 + \beta_1 \mathrm{year}_t + \varepsilon_t$$

- Left hand side variable: annual sum of insured or economic losses
- Test for linear trend
- Trend statistically significant if null hypothesis: $\beta_1 = 0$ can be rejected at the 10 percent level or lower

Global non-geophysical disasters: econ. (top) and ins. (bottom)



Based on 16,645 (economic analysis) and 10,434/ 1,531 (insured analysis) disasters; geophysical events: earthquake, land slide, rock fall, subsidence, tsunami, volcano.

Convective events: economic (top) and insured (bottom)

Based on 5,869 (economic analysis) and 3,783/ 770 (insured analysis) disasters; Includes damages from flash floods, hail storms, tempest storms, tornados and lightning.

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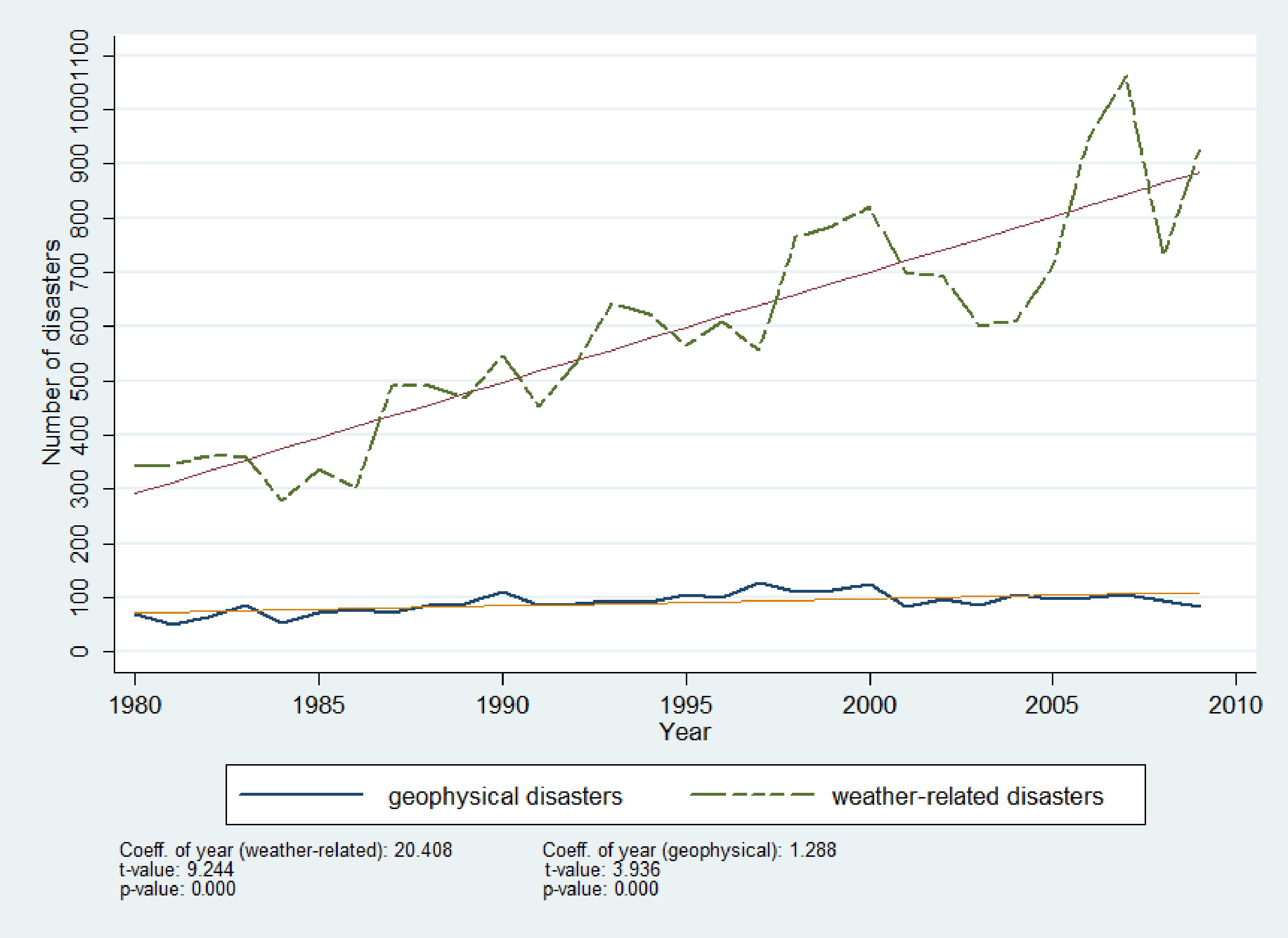
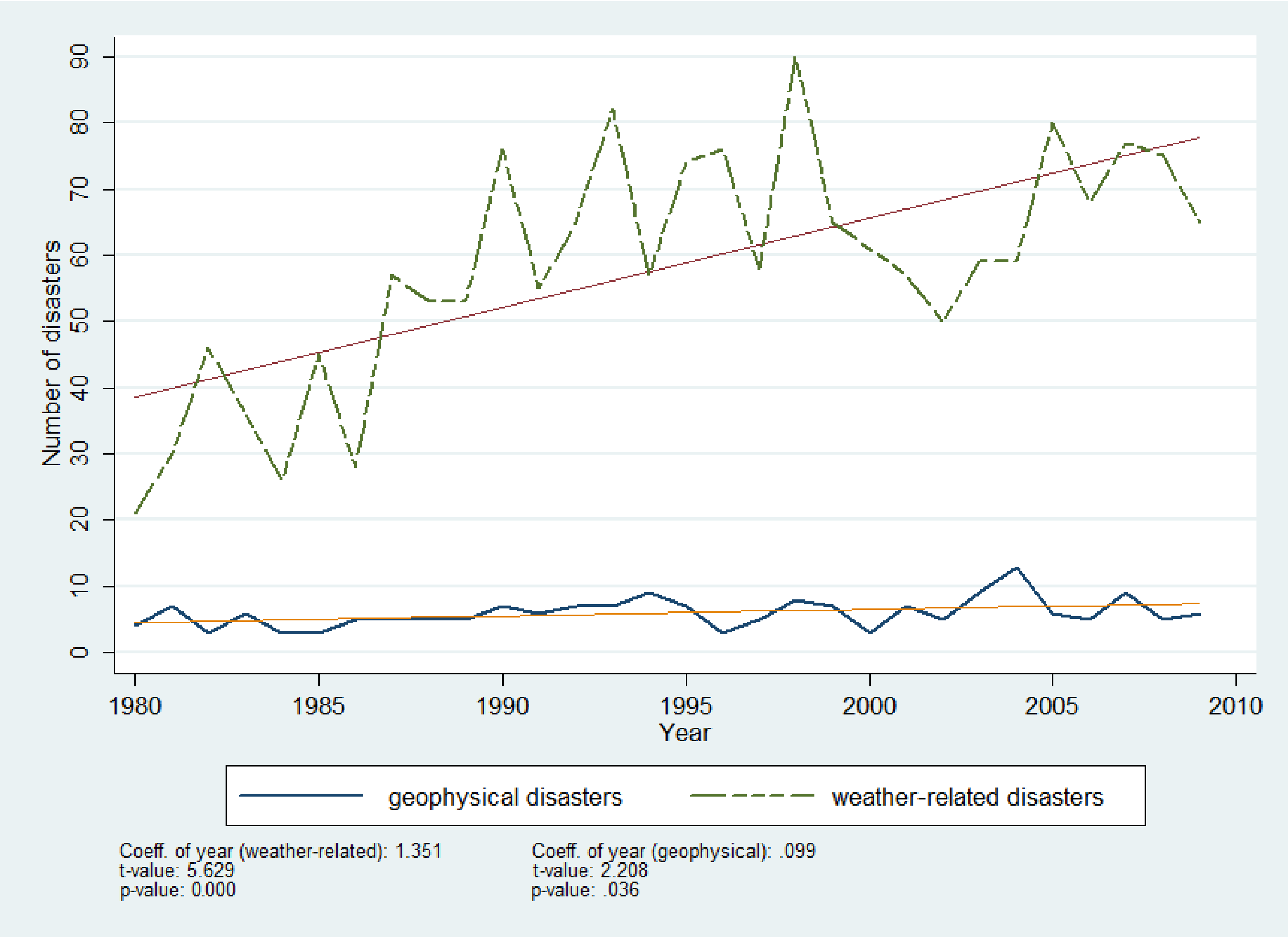
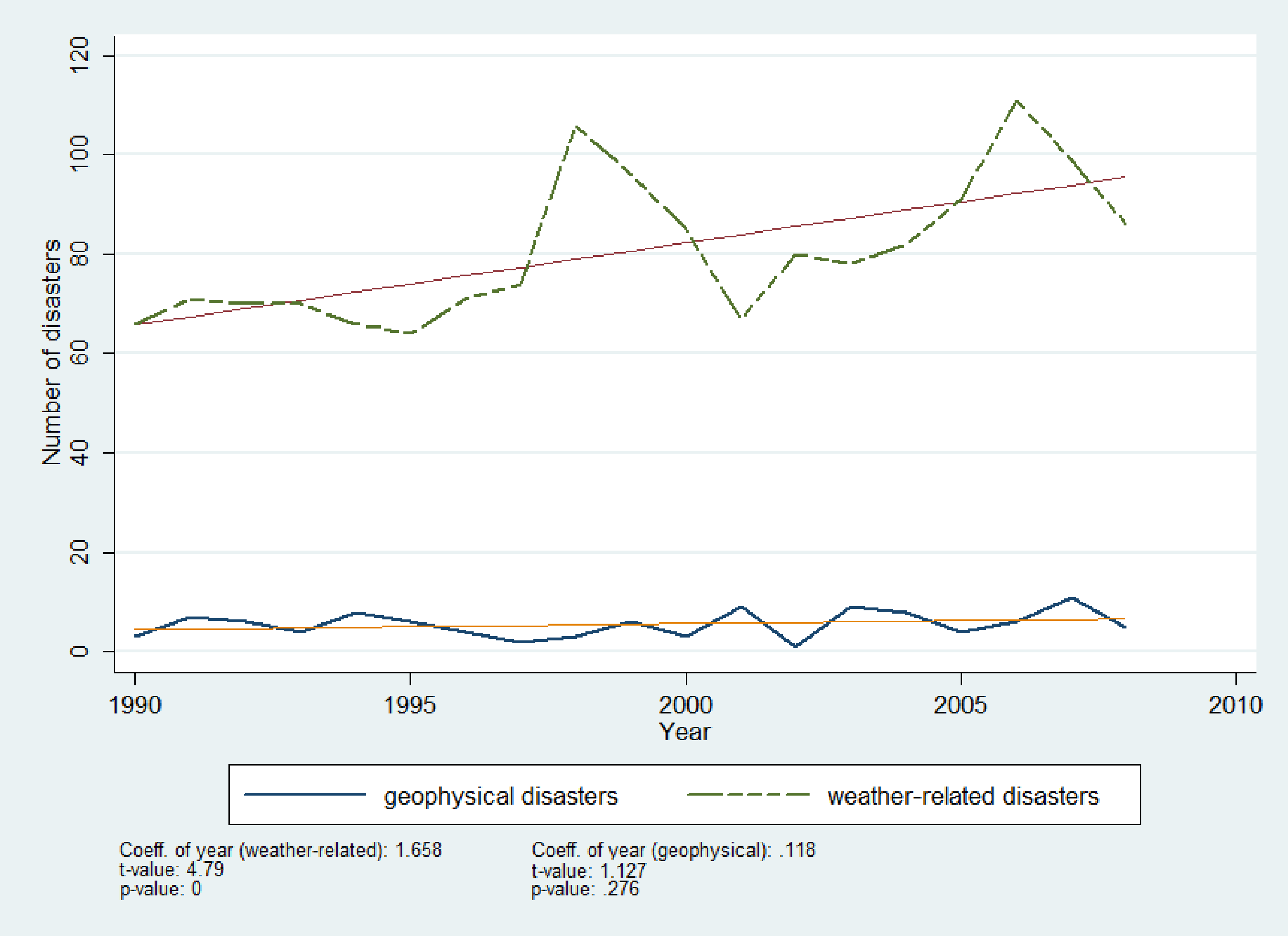
Frequency trends of reported disasters (with economic loss)



Frequency trends of reported MAJOR disasters (with economic loss)



Frequency trends of reported disasters (with insured loss)



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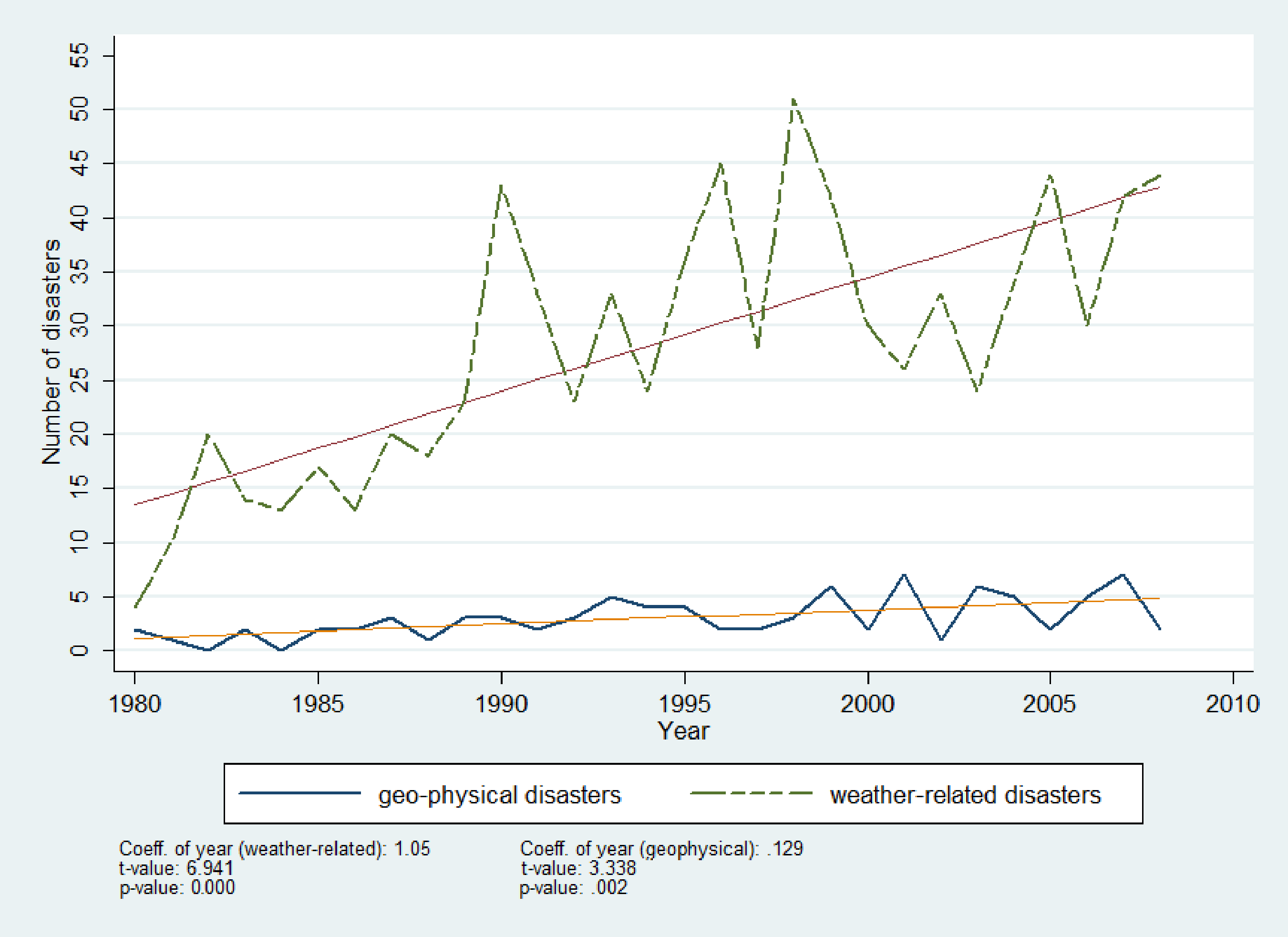
Frequency trends of reported MAJOR disasters (with insured loss)



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Detailed Results for Normalised Losses in the United States

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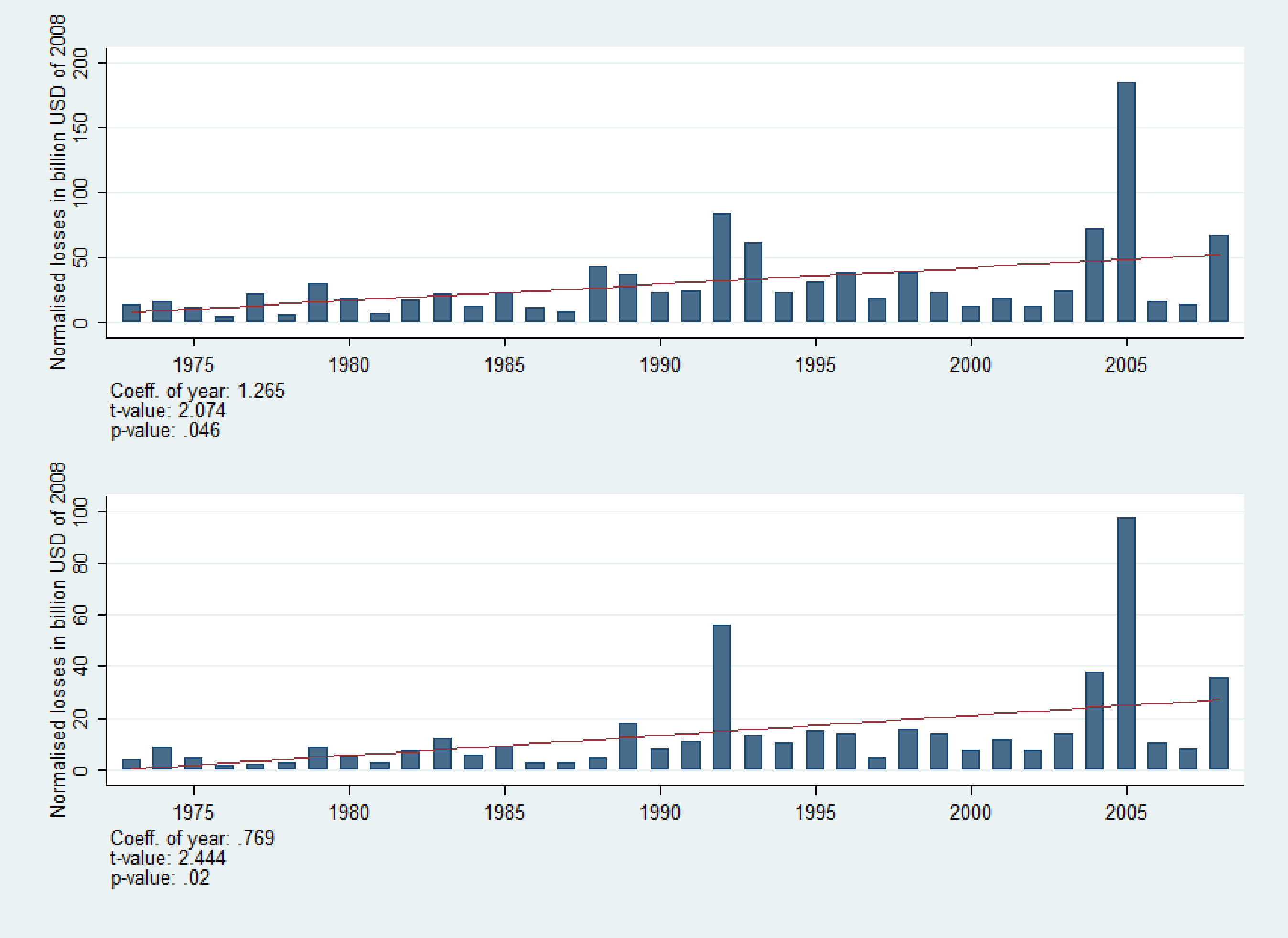
Non-geophysical disasters: economic (top) and insured (bottom)



Geophysical events: earthquake, land slide, rock fall, subsidence, tsunami, volcano.

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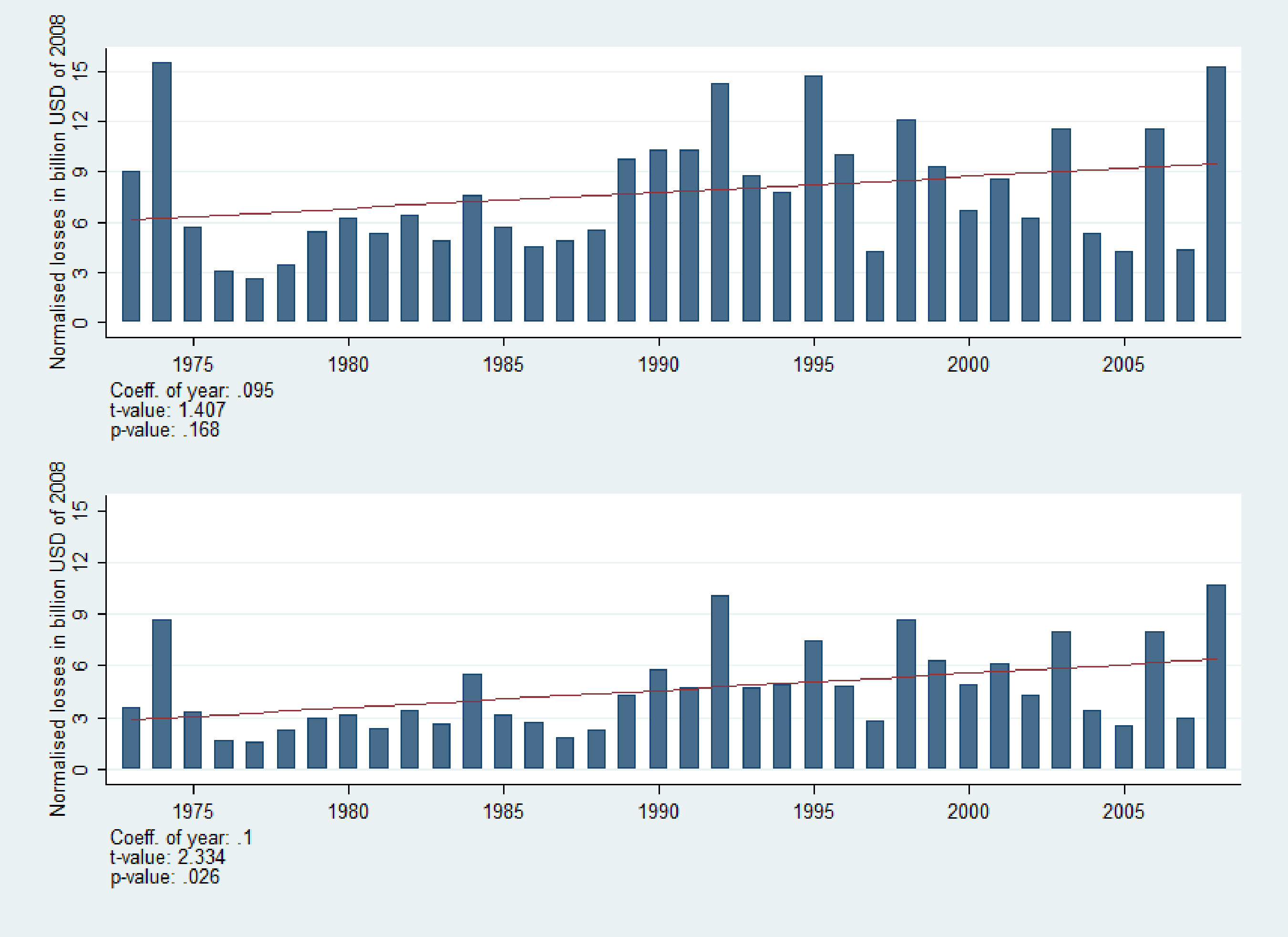
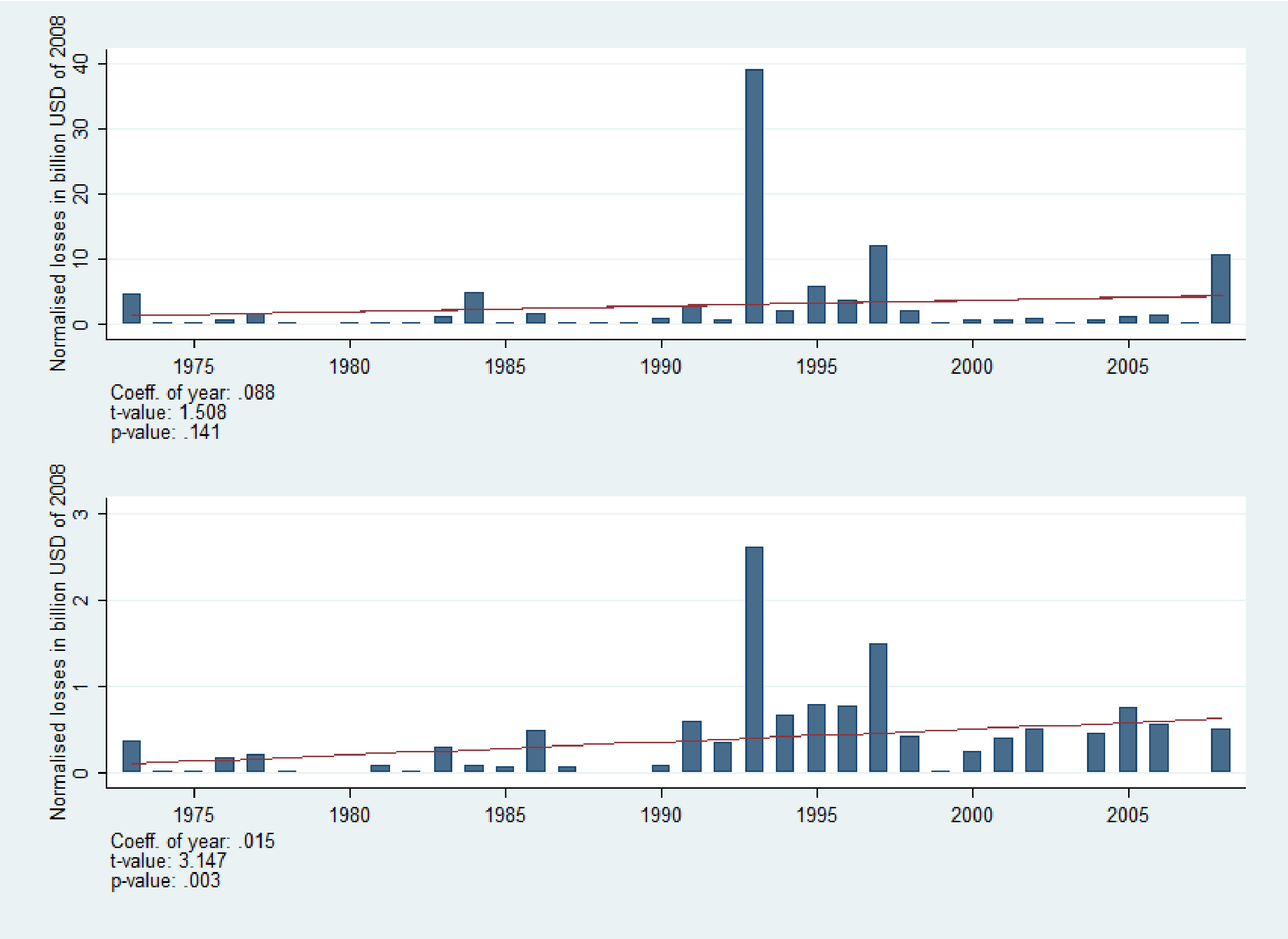
Convective events: economic (top) and insured (bottom)



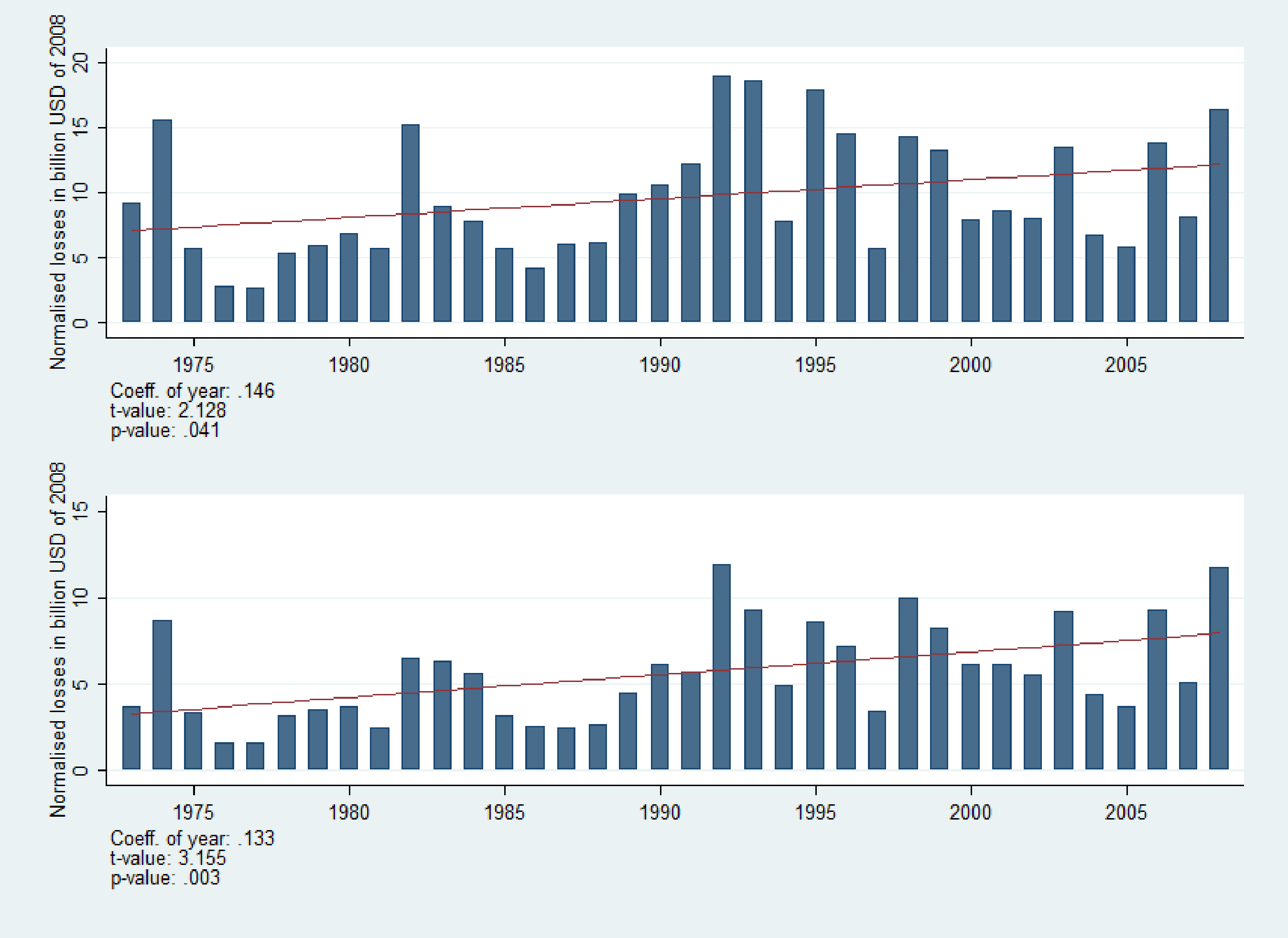
Includes damages from flash floods, hail storms, tempest storms, tornados and lightning.

Flooding: economic (top) and insured (bottom)



Includes damages from flash floods and general floods.

All storm events: economic (top) and insured (bottom)



Includes damages from winter storms, blizzards, snow storms, hail storms, tempest storms, tornado, lighting, sand storms and storm surges.

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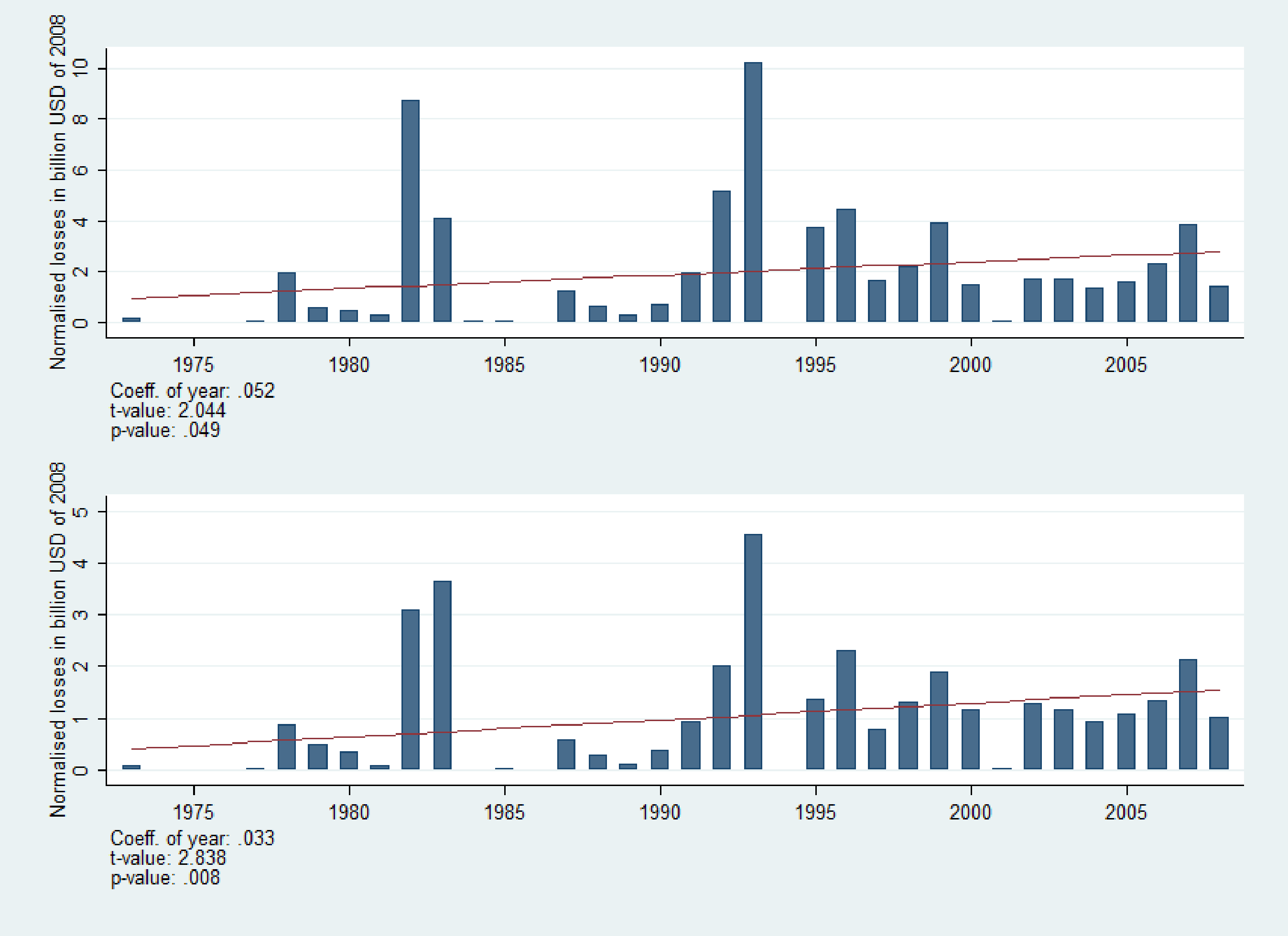
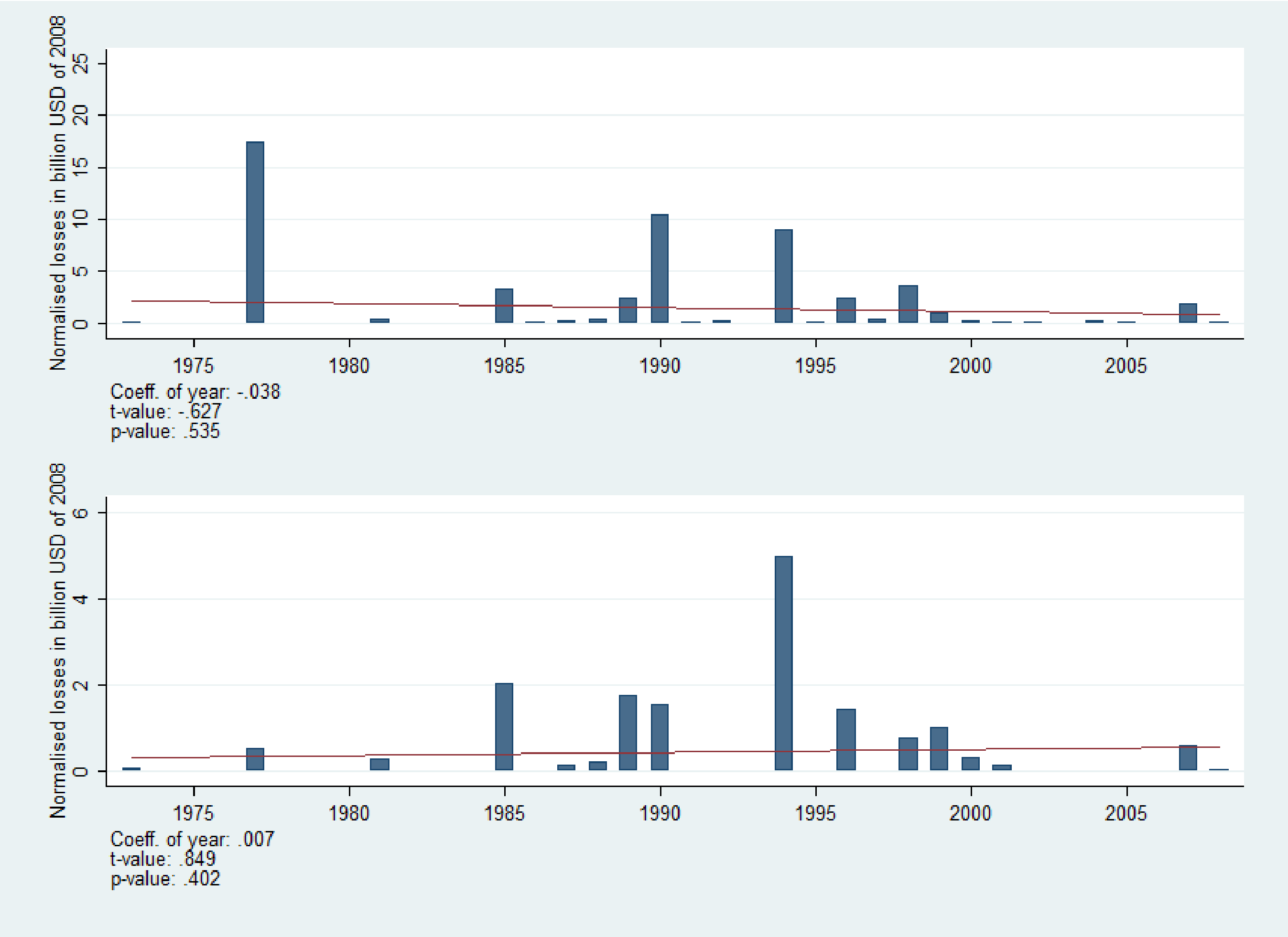
Winter storms: economic (top) and insured (bottom)



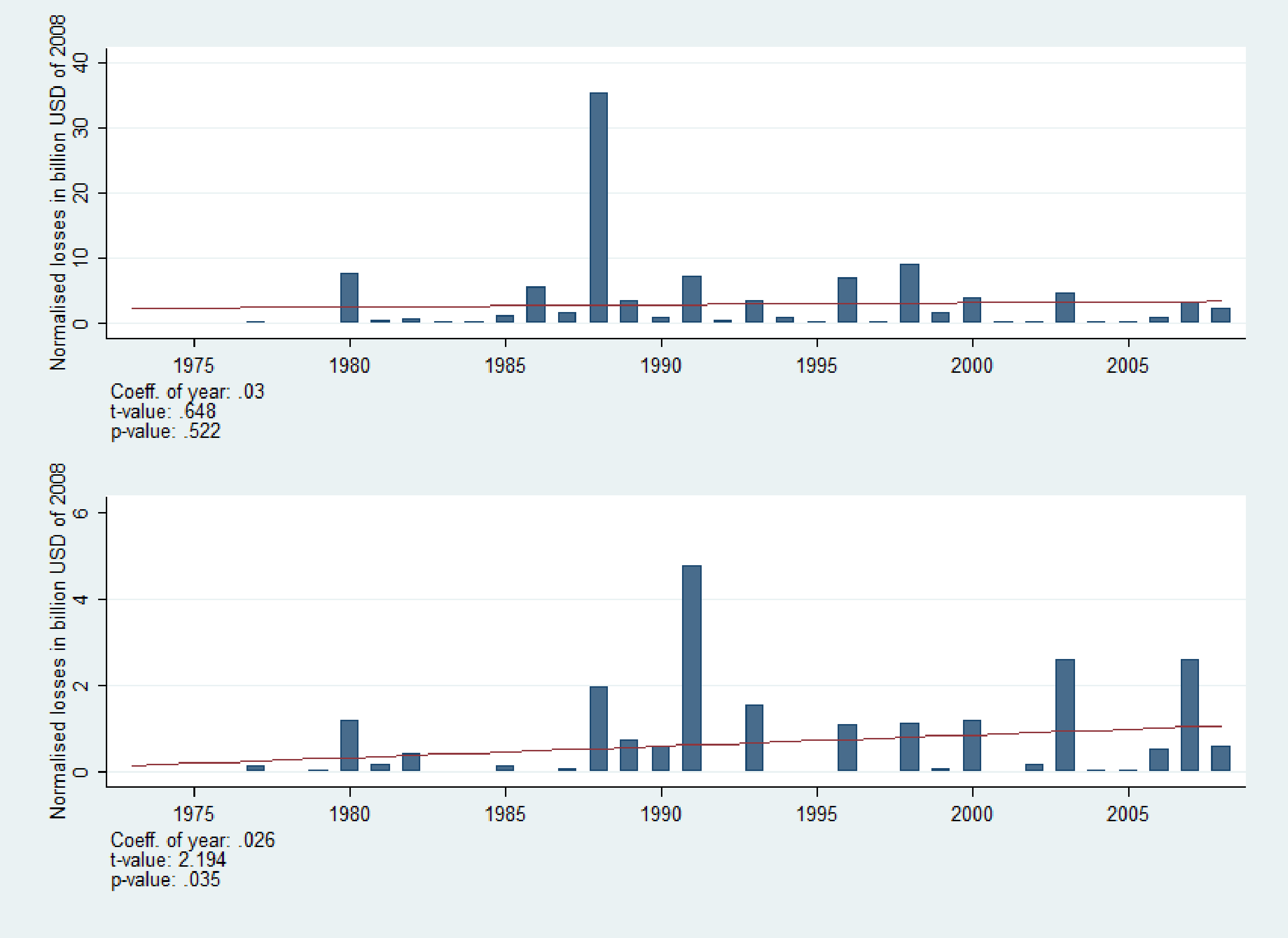
Includes damages from winter storms, blizzards and snow storms.

Temperature lows: economic (top) and insured (bottom)



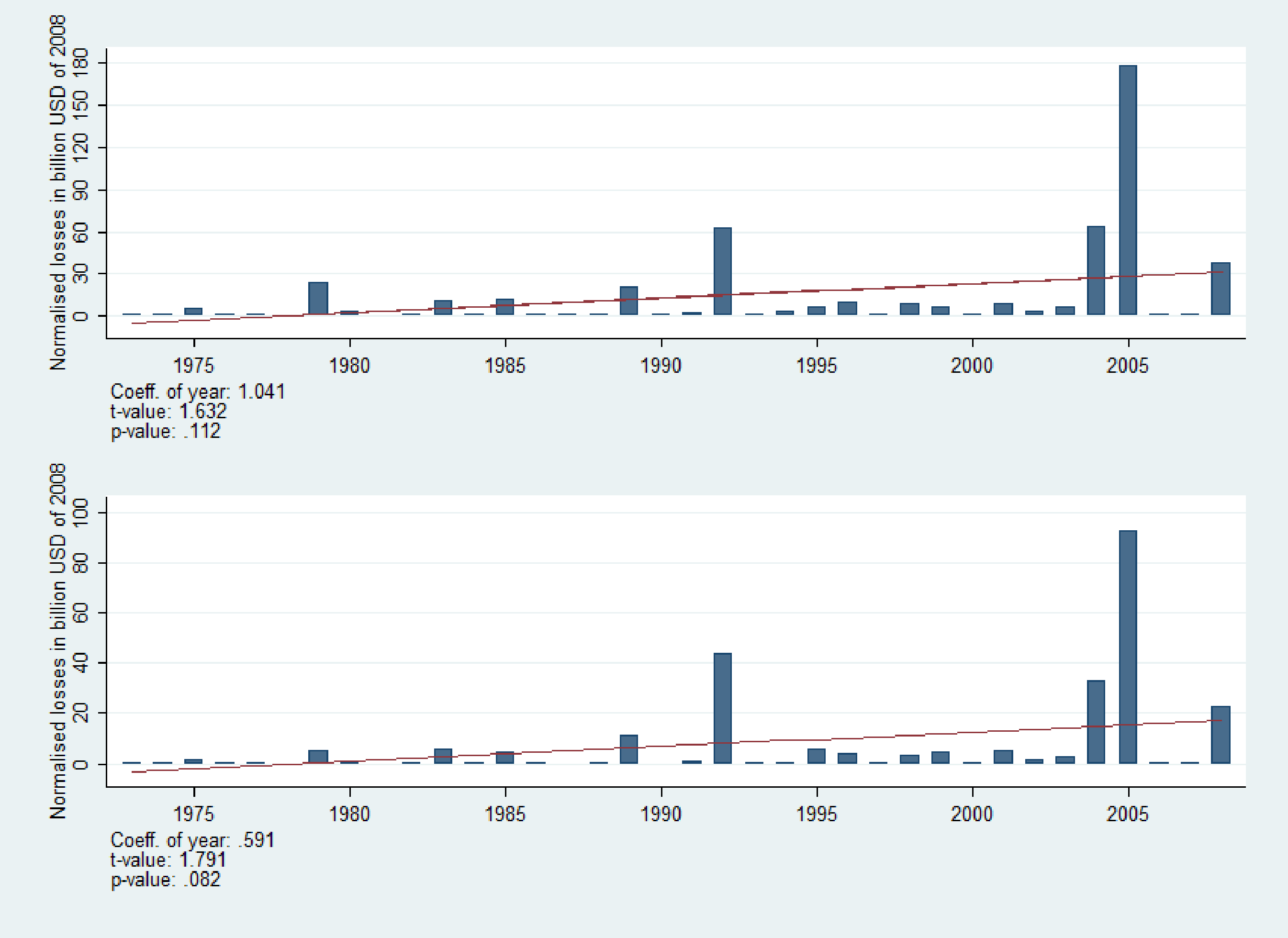
Includes damages from winter damages and cold waves.

Temperature highs: economic (top) and insured (bottom)



Includes damages from heat waves, droughts and wild fires.

Hurricanes: economic (top) and insured (bottom)



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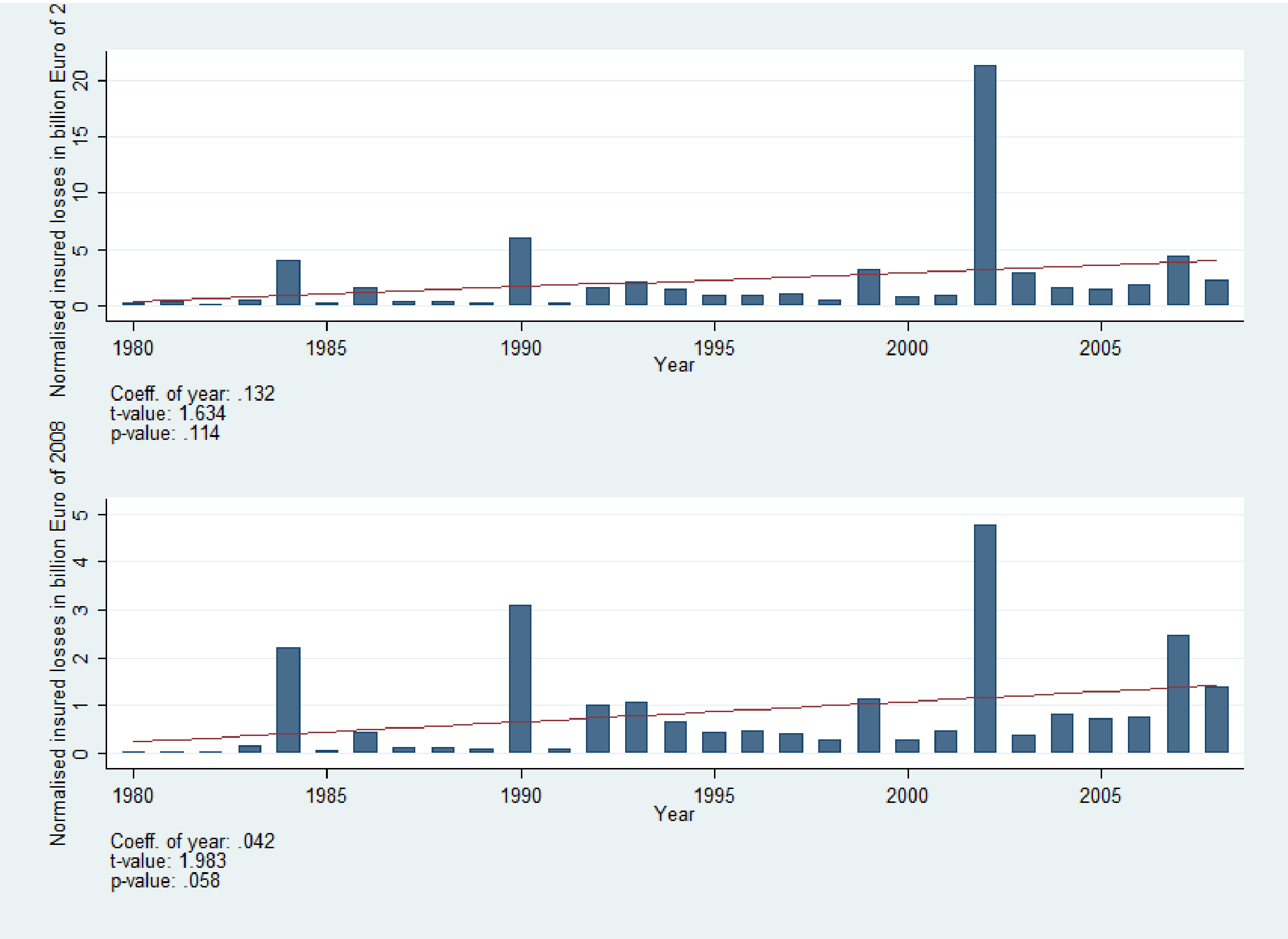
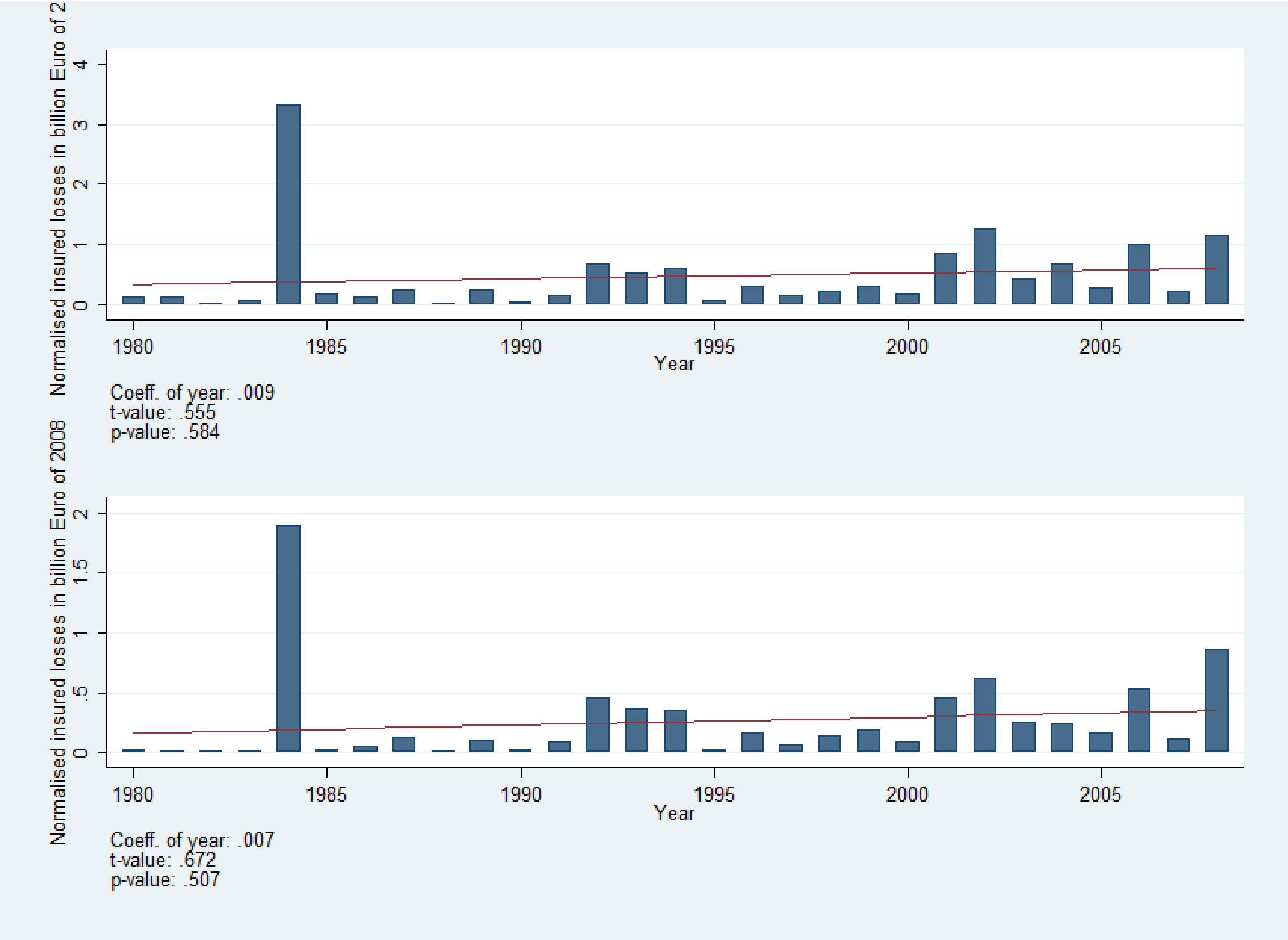
Detailed Results for Normalised Losses in Germany

Non-geophysical disasters: economic (top) and insured (bottom)



Geophysical events: earthquake, land slide, rock fall, subsidence, tsunami, volcano.

Convective events: economic (top) and insured (bottom)



Includes damages from flash floods, hail storms, tempest storms, tornados and lightning.

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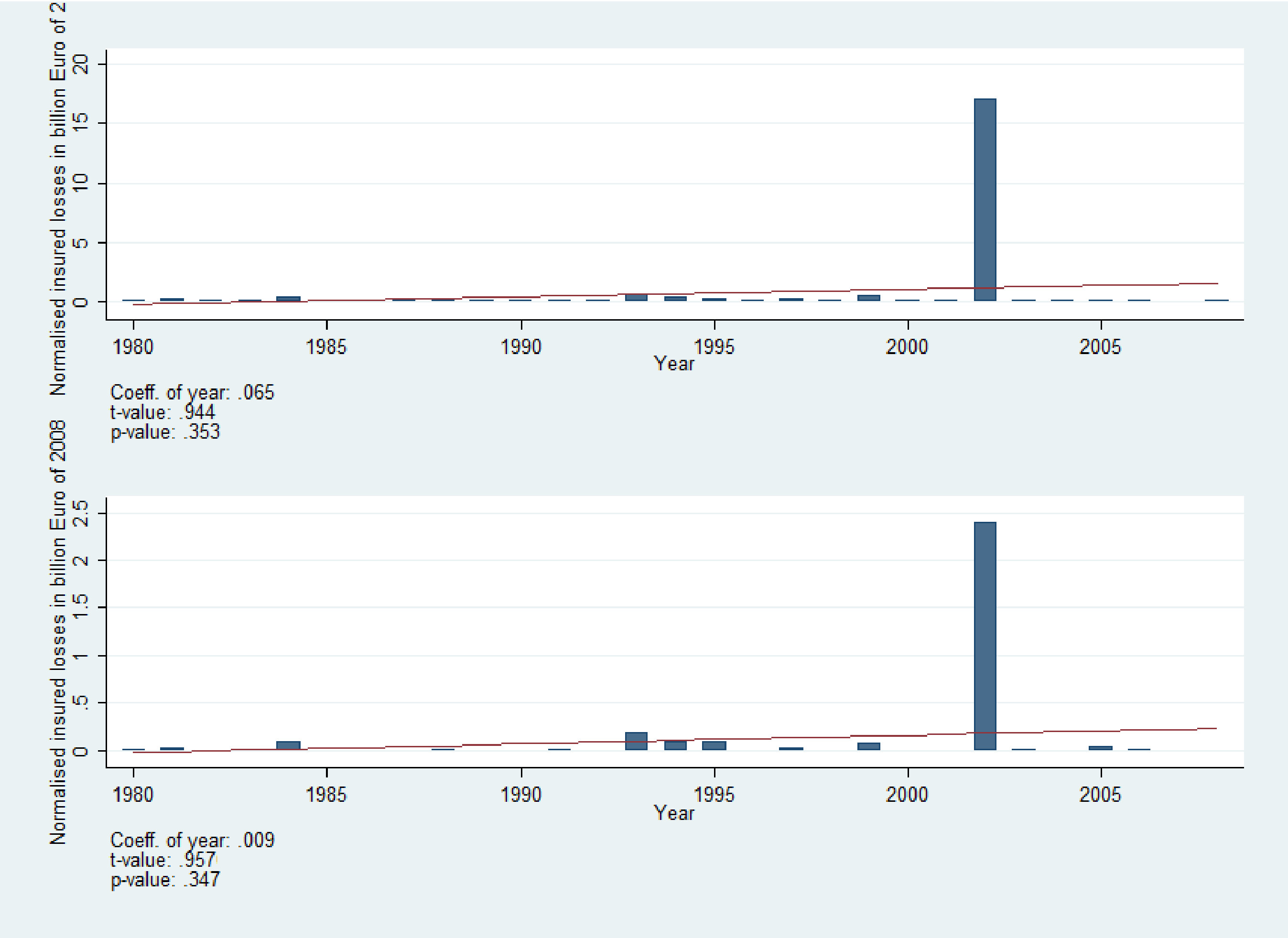
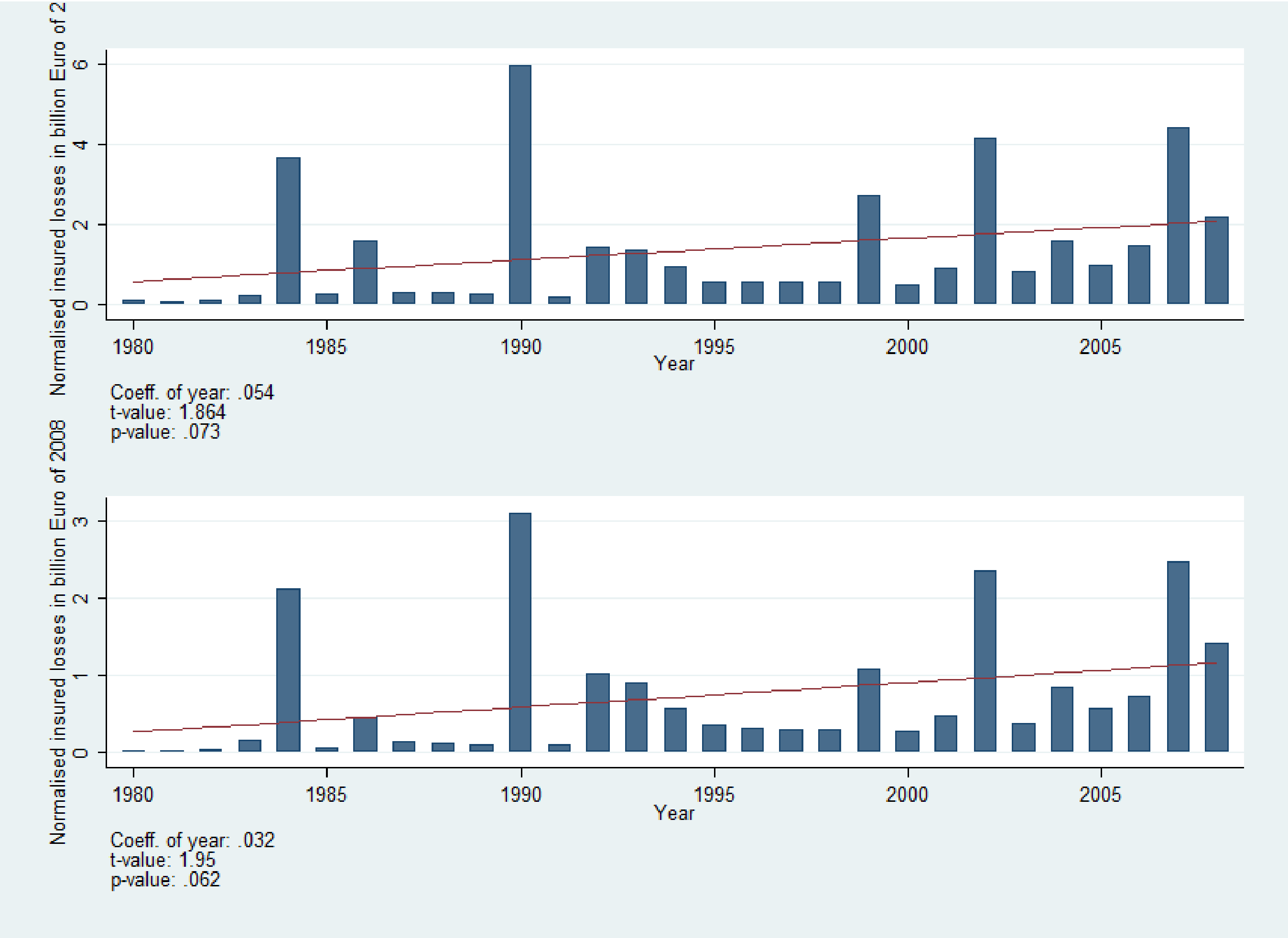
Flooding: economic (top) and insured (bottom)



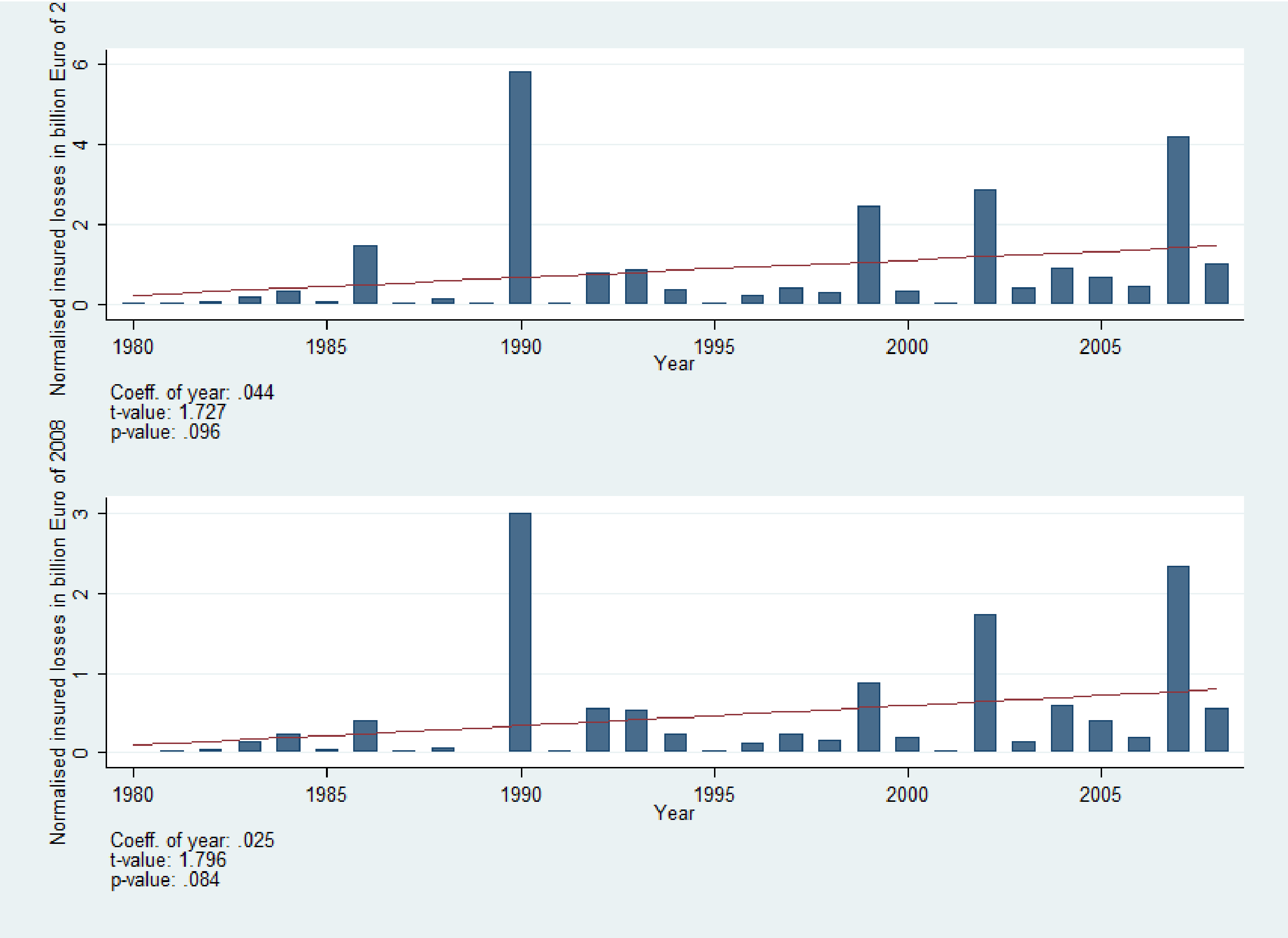
Includes damages from flash floods and general floods.

All storm events: economic (top) and insured (bottom)



Includes damages from winter storms, blizzards, snow storms, hail storms, tempest storms, tornado, lighting, sand storms and storm surges.

Winter storms: economic (top) and insured (bottom)



Includes damages from winter storms, blizzards and snow storms.

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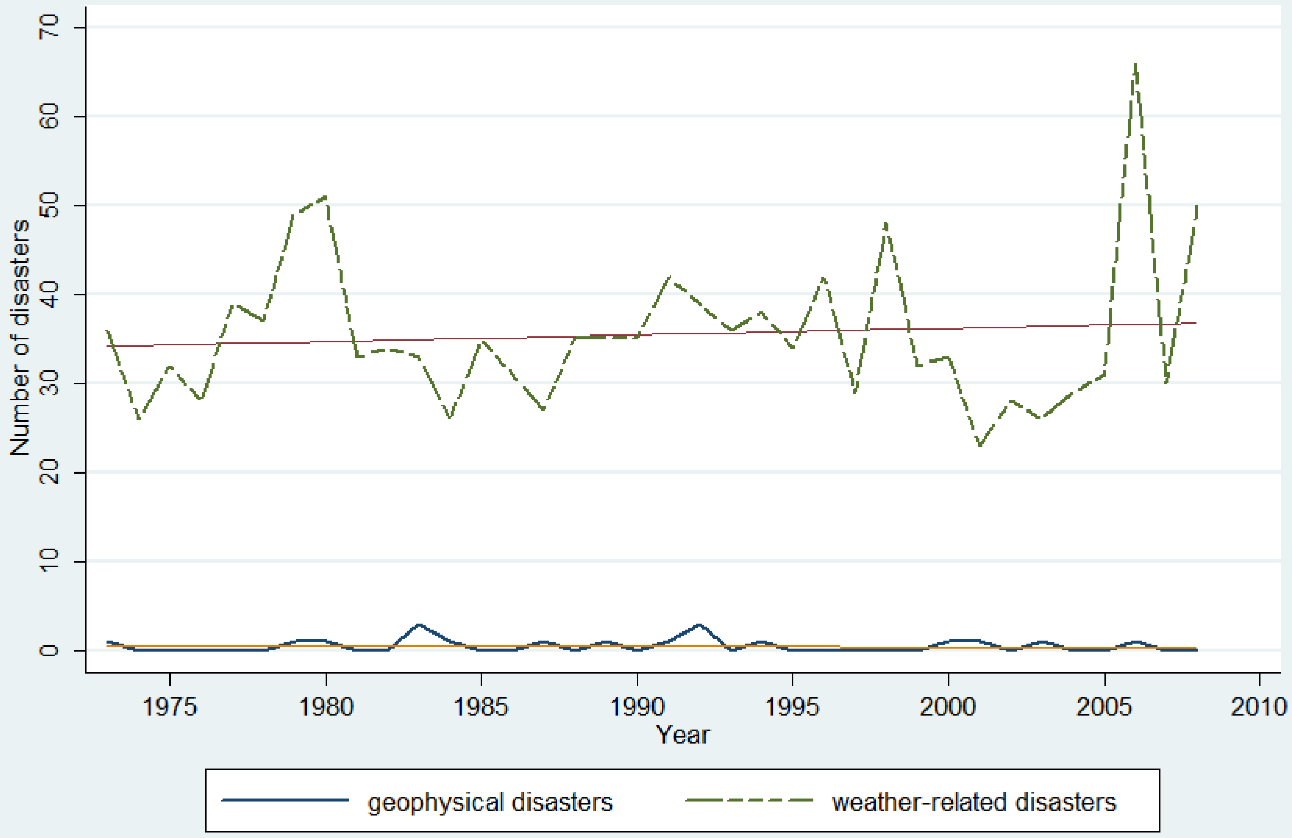
Limitations of the analysis (I)

- Period for global losses potentially too short to detect a trend
- Trend *cannot* be attributed directly to anthropogenic climate change as it represents but one possible explanation
- Natural climate variability as driving factor?
- Trends in insured losses could be driven by changes in insurance penetration unaccounted for
- Other drivers affecting insured losses (e.g., changes in insurance claims handling procedures)
- Potential reporting bias

Limitations of the analysis (II)

- Problem: inability to control for defensive mitigating measures which reduce a country's vulnerability
- Examples: flood defence measures in Germany, Netherlands, UK; stricter building codes in Florida
- Counteract potential positive trend in disaster losses
  prevent detection of a positive trend

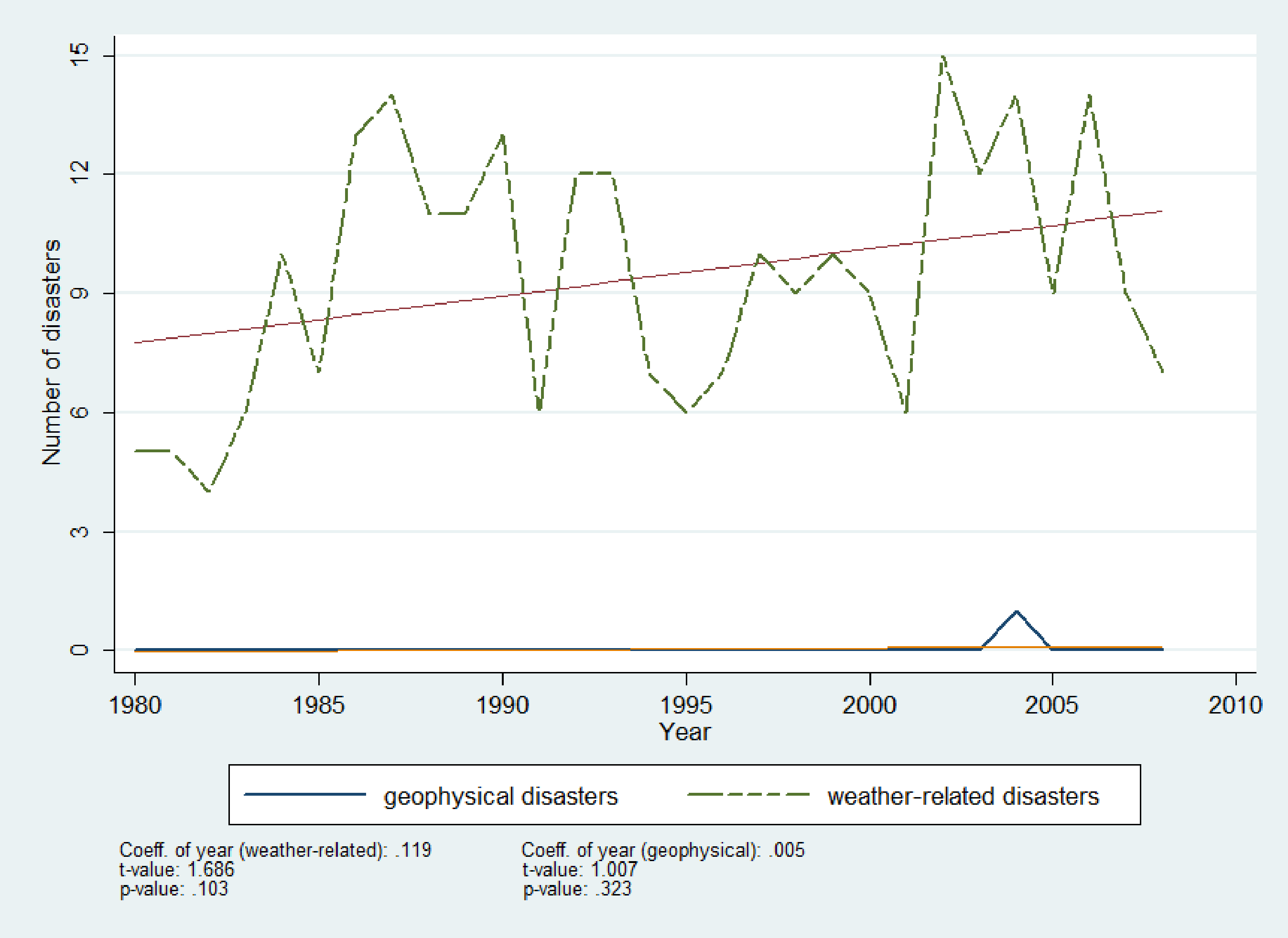
Frequency trends of reported disasters (with insured loss) - USA



Coeff. of year (weather-related): .075
t-value: .424
p-value: .674

Coeff. of year (geophysical): -.004
t-value: -.455
p-value: .652

Frequency trends of reported disasters (with insured loss) - GER



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Conclusion

- Findings are interesting and novel, but before any firm conclusions can be drawn from them, more research is needed to analyze which of these potential explanatory factors, of which anthropogenic climate change is but one possibility, or which combination of factors drive the observed upward trends.
- With these caveats in mind, our findings only provide *tentative* evidence that anthropogenic climate change may possibly already have triggered more frequent and/or more intensive relevant natural disasters affecting Germany as well as the US