# *The Effect of War Risk on Managerial and Investor Behavior:*

***Evidence from the Brussels Stock Exchange in the Pre-1914 Era***

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# Appendix 1: Control variables

To ensure that *Threat* and *Act* is not fully captured by other risk, I introduce several control variables (Lettau and Ludvigson 2001). I introduce the relative-risk-free rate, which is the commercial paper yield minus its 12-month moving average, and term-spread, which is the long-term government bond yield minus the risk-free rate. I use the Belgian Outstanding Debt 2 ½ (or “Dette Active Belge 2 ½”) as the long-term government bond yield.

For each country, I use dividend yield, which is the 12-month rolling sum of dividends scaled by current prices, and political uncertainty, which is a dummy that yields one 1 year before the legislative election. For example, the dummy captures a large part of the Russian Revolution of 1905 due to its election of March 1906, January and December 1907.

I include a hot-IPO dummy to capture potential IPO waves. The dummy yields one if (number of IPOs in month *t* / historical average of monthly number of IPOs up to year *t*) ≥ 1.5, as in Gönül Çolak, Art Durnev and Yiming Qian (2017).

# Appendix 2: War risk measures

## Table A1: Conflicts

|  |  |  |
| --- | --- | --- |
| Conflict | Start date | Countries involved |
| Serbo-Bulgarian War | November 1885 | Serbia | Bulgaria |
| Franco-Dahomean War | February 1890 | France | Dahomey |
| Cuban War of Independence | February 1895 | SpainUnited States | Cuban nationalists |
| Greco-Turkish War | April 1897 | Ottoman Empire | Greece |
| Spanish-American War | April 1898 | United StatesCuban revolutionaries | Filipino revolutionariesSpain |
| Second Boer War | October 1899 | United KingdomCanadaIndiaNew Zealand | AustraliaBritish CeylonSouth African Republic |
| Boxer Rebellion | November 1899 | United KingdomRussian EmpireFranceJapanGermanyUnited StatesItaly | Austria-HungaryNetherlandsBelgiumSpainBoxerQing dynasty |
| Venezuelan crisis | December 1902 | VenezuelaArgentinaUnited StatesUnited KingdomGermanyItaly | SpainMexicoNetherlandsDenmark |
| Russo-Japanese War | February 1904 | Empire of Japan | Russian Empire |
| Russian Revolution | January 1905 | Russia |  |
| First Moroccan Crisis | March 1905 | GermanyFrance | United Kingdom |
| Bosnian crisis  | October 1908 | Austria-Hungary | Bosnia and Herzegovina |
| Agadir Crisis | April 1911 | German EmpireUnited Kingdom | FranceSpain |
| Italo-Turkish War | September 1911 | Italy | Ottoman Empire |
| First Balkan War | October 1912 | BulgariaSerbiaOttoman Empire | GreeceMontenegro |
| Second Balkan War | June 1913 | BulgariaSerbiaRomania | Ottoman EmpireGreeceMontenegro |

The table lists the most important conflicts involving, at least, one European country in the 1885-1914 period. In bold are the countries of interest to the war risk measures.

Source: Ferguson (1998); Ferguson (2006), Ferguson (1992), Keegan (2000), Van Evera (1984) and Broadberry and Harrison (2018)

## Table A2: Search term frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Key term | News | Editorial | Business news |
| Threat | Risk | 0.100 | 0.143 | 0.055 |
| Tension | 0.011 | 0.011 | 0.016 |
| Concern | 0.094 | 0.110 | 0.049 |
| Uncertain | 0.042 | 0.022 | 0.085 |
| Fear | 0.145 | 0.154 | 0.075 |
| Threat | 0.018 | 0.000 | 0.010 |
| Act | Invasion | 0.020 | 0.154 | 0.009 |
| Outbreak | 0.049 | 0.044 | 0.112 |
| Beginning | 0.253 | 0.231 | 0.534 |
| Start | 0.051 | 0.055 | 0.030 |
| Battle | 0.035 | 0.055 | 0.016 |
| Army | 0.182 | 0.022 | 0.010 |
|  |  | 1.000 | 1.000 | 1.000 |

The table reports the relative frequency of search terms in *WRM*. All search terms are weighted in their respective section (*News*, *Column and Editorial* and *Business News*).

Results are based on the time period from January 1885 to July 1914.

Source: The Economist

## Table A3: Unigram analysis

|  |  |  |  |
| --- | --- | --- | --- |
| “The First World War”  | Count | “The History of the First World War”  | Count |
| German | 1166 | War | 2715 |
| Army | 1016 | German | 1504 |
| War | 924 | British | 1094 |
| French | 657 | Germany | 986 |
| British | 612 | Allies | 985 |
| Front | 503 | French | 844 |
| Russian | 431 | Army | 840 |
| Divisions | 420 | First | 819 |
| First | 399 | New | 632 |
| Attack | 373 | France | 617 |
| Line | 372 | Britain | 605 |
| Command | 363 | Against | 593 |
| Against | 354 | Government | 572 |
| Force | 347 | World | 562 |
| Day | 335 | Even | 507 |
| Offensive | 318 | Powers | 503 |
| General | 312 | Peace | 497 |
| Battle | 295 | Russia | 497 |
| Austrian | 287 | Front | 496 |
| Germany | 281 | Attack | 466 |
| Plan | 280 | Military | 461 |
| Two | 270 | Russian | 461 |
| Great | 264 | Forces | 461 |
| Advance | 264 | London | 460 |
| Military | 262 | American | 450 |
| Even | 252 | Although | 425 |
| France | 245 | Political | 408 |
| Russia | 243 | General | 394 |

The table reports a unigram analysis of two books, *The First World War* by Keegan (2000) and *The History of the First World War* by Stevenson (2012).

# Appendix 3: Robustness tests

In this section, I provide some further analysis on the war risk indices to complement the main findings. First, I introduce earnings data from the 106 largest Belgian companies and GDP growth to test the relationship on *Threat* and *Act*. In the main analysis, I document that dividend growth decreases when *Act* increases. If there is no relationship with earnings, then this suggests that the dividend cut was mainly a precautionary measure rather than the result of the drop in earnings.

I follow Ang, Piazzesi and Wei (2006), who show that the term spread and risk-free rate have predictive ability on GDP growth. Since earnings or GDP data are only available on an annual level, I use *Act* on the annual level by summing up the scaled-monthly values of *Act* and taking the average of all scaled-monthly valued of *Act*.

Second, I apply a standardized regression, as in Jonathan Brogaard and Andrew Detzel (2015) to highlight the dependence of *Threat* and *Act* on the control variables. In this regression, I also introduce the cross-sectional volatility and skewness to test their relationship with the war risk metrics. I define

* Cross-sectional volatility: $\sqrt{\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{2}}$, as in Paulo Maio (2016)
* Cross-sectional skewness: $\frac{\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{3}}{\left[\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{2}\right]^{3/2}}$, similar to Sangmin Oh and Jessica Wachter (2018).

where $N$ is the number of stocks, $R\_{it}$ is the return on stock *i* and $\overbar{R}\_{it}$ is the cross-sectional mean at time *t*.

Third, I offer insights from other stock exchanges, industry portfolios and Belgian expected risk-free rates.

## Table A4: Earnings growth and war risk

|  |  |  |  |
| --- | --- | --- | --- |
|  | SUM |  | AVERAGE |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |
| $$Z\_{t}$$ | -0.03(-1.43) | -0.04(-1.22) | -0.04(-1.24) |  | -0.21(-0.98) | -0.39(-1.32) | -0.40(-1.29) |
| $$Z\_{t}^{ε}$$ |  | 0.00(0.12) | 0.01(0.27) |  |  | -0.02(-0.10) | 0.00(0.01) |
| Term spread |  | -35.34(-1.33) | -45.03(-0.96) |  |  | -31.37(-1.15) | -34.89(-0.75) |
| Relative risk-free rate |  | -0.25(-0.01) | -5.64(-0.18) |  |  | 3.89(0.16) | 2.21(0.07) |
| Dividend yield |  | -9.21(-1.16) | 0.03(0.00) |  |  | -8.23(-1.01) | -4.78(-0.13) |
| Election year |  | -0.04(-0.20) | -0.10(-0.32) |  |  | -0.06(-0.31) | -0.08(-0.27) |
| Recession |  |  | -0.09(-0.25) |  |  |  | -0.04(-0.09) |
| AR² | 0.00 | -0.02 | -0.02 |  | 0.00 | -0.01 | -0.02 |
| Firm FE | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Country FE | Yes | Yes | Yes |  | Yes | Yes | Yes |
| N | 2,120 | 2,120 | 2,120 |  | 2,120 | 2,120 | 2,120 |

The table presents the results from regression: $eg\_{t}=α+β\_{1}Z\_{t}+β\_{2}Z\_{t}^{ε}+γX\_{t}+ε\_{t}$. The dependent variable is the annual earnings growth rate. The independent variables are $Z\_{t}$, that denotes *Act*. In regression specification 1-3, I sum up the scaled monthly values for *Act*. In regression specification 4-5, I take the average of monthly values for *Act*. $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa. The *term spread* is the difference between the Belgian long-term government bond and commercial paper yield. The *Relative risk-free rate* is the difference between the commercial paper yield and its 12-month moving average. *Dividend yield* is the smoothed dividend yield. *Election year*, which is a dummy that yields 1 the year of legislative elections. *Recession* yields 1 if the annual Belgian GDP growth rate is negative. *T*-statistics are in parentheses are computed with firm, year and country fixed effects. AR² is the adjusted R-squared. I limit the sample to 200 Belgian and foreign companies due to data limitations. All regressions include a constant (not reported).

Results are based on the period 1902-1911. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), Receuil Financier, The Economist

## Table A5: GDP growth and war risk

|  |  |  |  |
| --- | --- | --- | --- |
|  | SUM |  | AVERAGE |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |
| $$Z\_{t}$$ | 0.00(0.38) | -0.00(-0.15) | -0.00(-0.81) |  | 0.00(0.10) | -0.00(-0.46) | -0.01(-1.09) |
| $$Z\_{t}^{ε}$$ |  | 0.00(0.13) | -0.00(0.23) |  |  | 0.00(0.19) | -0.00(-0.26) |
| Term spread |  | 0.52(0.49) | -0.00(-0.00) |  |  | 0.46(0.45) | -0.12(-0.11) |
| Relative risk-free rate |  | 0.79(0.90) | 0.65(0.77) |  |  | 0.83(0.95) | 0.65(0.79) |
| Dividend yield |  |  | -0.72\*\*\*(-2.47) |  |  |  | -0.74\*\*\*(-2.54) |
| Election year |  |  | -0.00(-0.71) |  |  |  | -0.01(-0.81) |
| AR² | 0.00 | -0.11 | 0.01 |  | 0.00 | -0.10 | 0.01 |

The table presents the results from regression: $gdp\_{t}=α+β\_{1}Z\_{t}+β\_{2}Z\_{t}^{ε}+γX\_{t}+ε\_{t}$. The dependent variable is annual Belgian GDP growth rate. The independent variables are $Z\_{t}$, that denotes *Act*. In regression specification 1-3, I sum up the scaled monthly values for *Act*. In regression specification 4-5, I take the average of monthly values for *Act*. $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa. The *term spread* is the difference between the Belgian long-term government bond and commercial paper yield. *Relative risk-free rate* is the difference between commercial paper yield and its 12-month moving average. *Dividend yield* is the smoothed dividend yield. *Election year*, which is a dummy that yields one the year of legislative elections. *T*-statistics are in parentheses are computed using Hodrick standard errors. AR² is the adjusted R-squared. All regressions include a constant (not reported).

Results are based on the period 1902-1911. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), The Economist

## Table A6: Bankruptcy and war risk

|  |  |  |  |
| --- | --- | --- | --- |
|  | SUM |  | AVERAGE |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |
| $$Z\_{t}$$ | -0.01(-0.10) | -0.01(-0.12) | -0.01(-0.08) |  | -0.01(-0.01) | -0.02(-0.15) | -0.02(-0.14) |
| $$Z\_{t}^{ε}$$ |  | -0.06(-0.86) | -0.04(-0.58) |  |  | -0.06(-0.82) | -0.03(-0.56) |
| Term spread |  |  | -0.20(-0.59) |  |  |  | -0.20(-0.75) |
| Relative risk-free rate |  |  | 0.12(0.90) |  |  |  | 0.12(0.95) |
| Dividend yield |  |  | 0.06\*\*\*(2.98) |  |  |  | 0.05\*\*\*(2.95) |
| Election year |  |  | -0.01(-0.08) |  |  |  | -0.01(-0.08) |
| AR² | 0.00 | 0.00 | 0.01 |  | 0.00 | 0.00 | 0.01 |

The table presents the results from the regression: $bankruptcy\_{t}=α+β\_{1}Z\_{t}+β\_{2}Z\_{t}^{ε}+γX\_{t}+ε\_{t}$. The dependent variable is the number of bankruptcies for joint-stock companies listed on the BSE. The independent variables are $Z\_{t}$, that denotes *Act*. In regression specification 1-3, I sum up the scaled monthly values for *Act*. In regression specification 4-5, I take the average of monthly values for *Act*. $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa. The *term spread* is the difference between the Belgian long-term government bond and commercial paper yield. *Relative risk-free rate* is the difference between commercial paper yield and its 12-month moving average. *Dividend yield* is the smoothed dividend yield. *Election year*, which is a dummy that yields one the year of legislative elections. *T*-statistics are in parentheses are computed using Hodrick standard errors. AR² is the adjusted R-squared. All regressions include a constant (not reported).

Results are based on the period 1855-1914. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), The Economist

## Table A7: Merger and acquisition activity and war risk

|  |  |  |
| --- | --- | --- |
|  | Threat | Act |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $$Z\_{t}$$ | -0.03\*\*(-2.29) | -0.03\*\*(-2.07) | -0.03\*\*(-2.06) | -0.02\*\*(-2.01) | -0.09\*\*\*(-3.16) | -0.09\*\*\*(-3.21) | -0.08\*\*\*(-2.65) | -0.07\*\*\*(-2.51) |
| $$Z\_{t}^{ε}$$ |  | -0.06\*\*\*(-2.65) | -0.05\*\*\*(-2.56) | -0.05\*\*\*(-2.54) |  | -0.06\*\*\*(-3.73) | -0.03\*\*\*(-3.61) | -0.03\*\*\*(-3.57) |
| Risk-free risk |  |  | 0.00(0.21) | 0.00(0.15) |  |  | 0.01(0.36) | 0.01(0.43) |
| Term spread |  |  | 0.01(0.01) | 0.00(0.00) |  |  | 0.04(0.09) | 0.00(0.00) |
| Dividend yield |  |  | -0.06\*\*\*(-2.77) | -0.05\*\*\*(-2.70) |  |  | -0.07\*\*\*(-2.93) | -0.07\*\*\*(-2.79) |
| M&A |  |  |  | 0.00(0.07) |  |  |  | 0.04(0.79) |
| Election year |  |  |  | 0.01(0.06) |  |  |  | 0.01(0.01) |
| Adjusted R² | 0.02 | 0.02 | 0.05 | 0.04 | 0.03 | 0.02 | 0.07 | 0.07 |

The table presents the results from regression: $M\&A\_{t}=α+β\_{1}Z\_{t}+β\_{2}Z\_{t}^{ε}+γX\_{t}+ε\_{t}$. The dependent variable is the number of mergers and acquisitions of joint-stock companies listed on the BSE. The independent variables are $Z\_{t}$, that denotes *Act*. $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa. The *term spread* is the difference between the Belgian long-term government bond and commercial paper yield. The *Relative risk-free rate* is the difference between the commercial paper yield and its 12-month moving average. *Dividend yield* is the smoothed dividend yield. *Election year*, which is a dummy that yields 1 the year of legislative elections. *T*-statistics are in parentheses. AR² is the adjusted R-squared.

Results are based on the period 1885-1914. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), Receuil Financier, The Economist

## Table A8: Economic determinants of *Threat* and *Act*

|  |
| --- |
| Panel A: Standardized regressions of *Threat* on uncertainty and business cycle variables |
| CVOL | 0.11\*(1.67) |  |  |  |  |  | 0.10(1.54) |
| CSKEW |  | 0.21\*\*\*(2.35) |  |  |  |  | 0.19\*\*(2.21) |
| Term spread |  |  | -0.04(-0.94) |  |  |  | -0.00(-0.01) |
| Risk-free rate |  |  |  | -0.01(-0.12) |  |  | -0.05(-0.21) |
| Dividend yield |  |  |  |  | 0.05(0.81) |  | 0.02(0.72) |
| Election year |  |  |  |  |  | -0.28\*\*\*(-3.36) | -0.20\*\*\*(-3.21) |
| Adj. R² | 0.04 | 0.08 | 0.01 | 0.00 | 0.01 | 0.08 | 0.09 |
| Panel B: Standardized regressions of *Act* on uncertainty and business cycle variables |
| CVOL | 0.46\*\*\*(4.41) |  |  |  |  |  | 0.38\*\*\*(3.22) |
| CSKEW |  | 0.55\*\*\*(7.38) |  |  |  |  | 0.45\*\*\*(4.05) |
| Term spread |  |  | -0.10(-1.54) |  |  |  | -0.03(-0.22) |
| Risk-free rate |  |  |  | 0.08(0.87) |  |  | 0.16(1.21) |
| Dividend yield |  |  |  |  | 0.04(0.43) |  | 0.09\*(1.69) |
| Election year |  |  |  |  |  | -0.39\*\*\*(-4.45) | -0.30\*\*\*(-4.55) |
| Adj. R² | 0.11 | 0.17 | 0.00 | 0.00 | 0.00 | 0.12 | 0.22 |

The table reports the regression coefficients of a standardized linear regression of *Threat* (panel A) and *Act* (panel B) on a set of state variables: I define volatility (CVOL) as cross-sectional standard deviations between returns, $CVOL\_{t}=\sqrt{\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{2}}$, where $N$ is the total number of stocks, $R\_{it}$ is the return on stock i at time t and $\overbar{R}\_{it}$ is the cross-sectional mean at time t. I measure skewness (CSKEW) as the cross-sectional skewness between returns, as $CSKEW\_{t}=\frac{\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{3}}{\left[\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{2}\right]^{3/2}}$. Since the metrics are sensitive to outliers, I winsorize the data below/above the 5th percentile, as in Maio (2016). *Term spread* is the difference of the Belgian long-term government bond and commercial paper yield; *RREL* is the Belgian commercial paper yield minus its 12-month moving average; *Dividend yield* is a smoothed dividend yield of country *j* and *Election year* is a dummy variable that yields one 12 months before a legislative election.

\*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), The Economist

## Table A9: Cross-sectional volatility and skewness predictability

|  |  |  |
| --- | --- | --- |
|  | Cross-sectional volatility | Cross-sectional skewness |
| Panel A: Threat |
| $$Z\_{t}$$ | 0.10\*\*\*(2.62) | 0.11\*\*\*(2.62) | 0.10\*\*\*(2.32) | 0.10\*\*\*(2.19) | 0.80\*\*\*(4.82) | 0.55\*\*\*(4.13) | 0.54\*\*\*(4.18) | 0.42\*\*\*(3.45) |
| $$Z\_{t-1}$$ |  | -0.00(-0.40) | -0.00(-0.46) | -0.00(-0.09) |  | 0.53\*\*\*(3.91) | 0.52\*\*\*(3.89) | 0.39\*\*\*(4.01) |
| $$CVOL\_{t-1}$$ |  |  | 0.01\*(1.66) | 0.00(0.94) |  |  |  |  |
| $$CSkew\_{t-1}$$ |  |  |  |  |  |  | -0.02(-0.86) | -0.02(-0.97) |
| $$TS\_{t}$$ |  |  |  | 0.30\*\*\*(5.41) |  |  |  | 0.30\*\*\*(5.41) |
| $$RREL\_{t}$$ |  |  |  | 0.15\*\*\*(6.45) |  |  |  | 0.09\*\*\*(3.59) |
| $$DY\_{t}$$ |  |  |  | 0.00(0.18) |  |  |  | -0.01(-0.15) |
| $$Elec\_{t}$$ |  |  |  | 0.04\*\*\*(4.54) |  |  |  | 0.43\*\*\*(4.24) |
| Adj. R² | 0.02 | 0.01 | 0.01 | 0.34 | 0.15 | 0.20 | 0.19 | 0.30 |
| Panel B: Act |
| $$Z\_{t}$$ | 0.12\*\*\*(2.31) | 0.09\*(1.86) | 0.07\*(1.67) | 0.08\*(1.89) | 3.32\*\*\*(4.09) | 2.56\*\*\*(3.73) | 2.49\*\*\*(3.76) | 1.65\*\*\*(2.48) |
| $$Z\_{t-1}$$ |  | 0.09\*(1.72) | 0.10\*\*(2.03) | 0.02(1.48) |  | 2.21\*\*\*(3.18) | 2.23\*\*\*(3.18) | 1.46\*\*\*(3.15) |
| $$CVOL\_{t-1}$$ |  |  | 0.10\*(1.66) | 0.04(0.94) |  |  |  |  |
| $$CSkew\_{t-1}$$ |  |  |  |  |  |  | -0.00(-0.94) | -0.00(-1.02) |
| $$TS\_{t}$$ |  |  |  | 0.29\*\*\*(5.11) |  |  |  | 0.32\*\*\*(4.79) |
| $$RREL\_{t}$$ |  |  |  | 0.15\*\*\*(6.56) |  |  |  | 0.08\*\*\*(3.23) |
| $$DY\_{t}$$ |  |  |  | 0.00(0.14) |  |  |  | -0.01(-0.23) |
| $$Elec\_{t}$$ |  |  |  | 0.03\*\*\*(3.69) |  |  |  | 0.36\*\*\*(3.45) |
| Adj. R² | 0.02 | 0.03 | 0.04 | 0.33 | 0.10 | 0.14 | 0.12 | 0.25 |

The table reports the estimated coefficients from a pooled regression of the form: $y\_{t, t+h}=α+β\_{1}Z\_{t}+γX\_{t}+ϵ\_{t+h}$, where $y\_{t, t+h}$ denotes cross-sectional volatility and cross-sectional skewness. Cross-sectional volatility (*CVOL*) is the standard deviations between returns $\sqrt{\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{2}}$, where $N$ is the total number of stocks, $R\_{it}$ is the return on stock i at time t and $\overbar{R}\_{it}$ is the cross-sectional mean at time t. Cross-sectional skewness (*CSKEW*) is the-skewness between returns, as $\frac{\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{3}}{\left[\frac{1}{N}\sum\_{i=1}^{N}\left(R\_{it}-\overbar{R}\_{it}\right)^{2}\right]^{3/2}}$.

The independent variables are $Z\_{t}$, that denotes *Threat* and *Act*; $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa; term spread is the difference between the Belgian long-term government bond and commercial paper yields; relative risk-free rate is the difference between commercial paper yield and its 12-month moving average; the dividend yield is the smoothed dividend yield of country *j* and Election year, which is a dummy that yields one 12 months before a legislative election in country *j*. The *T*-statistics are in parentheses, estimated using Ang and Bekaert's (2007) Seemingly Unrelated Regression standard errors. AR² is the adjusted R-squared. I focus on Belgium, France, Germany, Italy, Spain, Russia and the Netherlands.

Results are based on the period January 1885 until July 1914. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), The Economist

## Table A10: Other stock exchanges

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | h = 0 | h = 1 | h = 2 | h = 4 | h = 6 | h = 8 | h = 12 |
| Panel A: United Kingdom |
| $$Threat\_{t}$$ | -0.08\*(-1.95) | 0.01\*(1.85) | 0.02\*(1.83) | 0.02\*\*\*(2.10) | 0.03\*\*\*(2.47) | 0.04\*\*\*(2.62) | 0.07\*\*\*(3.58) |
| Adj. R² | 0.01 | 0.02 | 0.02 | 0.03 | 0.04 | 0.06 | 0.07 |
| $$Act\_{t}$$ | -0.10\*\*(-2.01) | -0.05\*(-1.72) | -0.08\*(-1.89) | -0.12\*\*(-2.03) | -0.14\*(-1.74) | -0.15\*(-1.69) | -0.16\*(-1.68) |
| Adj. R² | 0.02 | 0.02 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 |
| Panel B: Russia |
| $$Threat\_{t}$$ | -0.07\*(-1.88) | 0.02\*(1.87) | 0.03\*(1.84) | 0.04\*\*\*(2.21) | 0.04\*\*(2.01) | 0.06\*\*\*(2.44) | 0.09\*\*\*(2.67) |
| Adj. R² | 0.01 | 0.01 | 0.02 | 0.04 | 0.05 | 0.06 | 0.07 |
| $$Act\_{t}$$ | -0.05\*\*(-1.93) | -0.08\*\*(-1.94) | -0.11\*\*(-2.05) | -0.15\*\*\*(-2.94) | -0.19\*\*\*(-3.01) | -0.20\*\*\*(-2.23) | -0.21\*\*(-1.99) |
| Adj. R² | 0.01 | 0.01 | 0.03 | 0.04 | 0.04 | 0.03 | 0.05 |
| Panel C: United States*Panel C1: Cowles data* |
| $$Threat\_{t}$$ | -0.01(-0.69) | -0.02(-1.04) | -0.00(-0.86) | -0.00(-0.06) | -0.03(-0.45) | -0.06(-0.94) | -0.09(-1.15) |
| Adj. R² | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $$Act\_{t}$$ | -0.03(-0.58) | -0.04(-0.77) | -0.09(-1.18) | -0.11(-0.83) | -0.07(-0.80) | -0.03(-0.48) | -0.02(-0.23) |
| Adj. R² | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *Panel C2: NYSE data* |
| $$Threat\_{t}$$ | -0.01(-1.07) | -0.01(-0.96) | -0.01(-0.71) | -0.00(-0.48) | -0.03(-1.31) | -0.04(-1.48) | -0.04(-1.05) |
| Adj. R² | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $$Act\_{t}$$ | -0.02(-0.86) | -0.02(-1.14) | -0.07(-1.46) | -0.04(-1.27) | -0.08(-0.82) | -0.10(-0.52) | -0.02(-0.09) |
| Adj. R² | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

The table reports results from the regression: $y\_{t, t+h}=α+β\_{1}Z\_{t}+γX\_{t}+ϵ\_{t+h}$, where $y\_{t, t+h}$ denotes the log market return from the British share price index (panel A), St. Petersburg Stock Exchange (panel B) or the United States (panel C). $Z\_{t}$ denotes the search-based indices *Threat* and *Act.*$ $Regressions include a constant (not reported). The *T*-statistics are in parentheses, estimated using Hodrick's (1992) Seemingly Unrelated Regression standard errors. AR² is the adjusted R-squared.

Results are based on the period January 1885 until July 1914. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Federal Reserve of St. Louis, international Center for Finance, The Economist

## Table A11: Expected Interest rates

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | h = 0 | h = 1 | h = 2 | h = 4 | h = 6 | h = 8 | h = 12 |
| $$Threat\_{t}$$ | -0.01(-0.31) | -0.00 (-0.14)  | -0.00 (-0.22)  | -0.00 (-0.05)  | -0.01 (-0.57)  | -0.01 (-0.59)  | -0.02 (-0.62)  |
| Controls | Yes  | Yes | Yes | Yes | Yes | Yes | Yes |
| AR² | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $$Act\_{t}$$ | -0.02(-0.92) | -0.00(-0.81) | -0.00(-0.55) | -0.00(-0.21) | -0.00(-0.07) | 0.00(0.19) | 0.01(0.64) |
| Controls | Yes  | Yes | Yes | Yes | Yes | Yes | Yes |
| AR² | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |

Table 5 presents the results from equation (6). Panel A reports the predictive relationship with expected interest rates. Independent variables are $Z\_{t}$, which denotes *Threat* and *Act*; $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa; term spread is the difference between the Belgian long-term government bond and commercial paper yields; dividend yield is the Belgian smoothed dividend yield and Election year, which is a dummy that yields 1 12 months before a legislative election in Belgium. *T*-statistics are in parentheses are computed using Hodrick (1992) standard errors. AR² is the adjusted R-squared. Regressions include a constant (not reported). The dependent variable is the Belgian commercial paper yield.

Results are based on the period January 1885 until July 1914. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

Source: Studiecentrum voor Onderneming en Beurs (SCOB), The Economist

## Table A12: Industry portfolios

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Returns**  |  | **Dividend Growth** |
|  | h = 0 | h = 1 | h = 2 | h = 4 | h = 6 | h = 8 | h = 12 |  | h = 0 | h = 1 | h = 2 | h = 4 | h = 6 | h = 8 | h = 12 |
| Panel A: Financials |  |
| Threat | -0.00(-0.11) | 0.04\*\*\*(2.12) | 0.05\*(1.80) | 0.05\*(1.69) | 0.06\*(1.61) | 0.07(1.44) | 0.08(0.96) |  | 0.04(1.46) | 0.03(1.42) | 0.01(0.69) | 0.01(0.44) | 0.00(0.02) | 0.04(1.10) | -0.04(-0.65) |
| Act | -0.01(-0.40) | -0.04\*(-1.73) | -0.06\*(-1.70) | -0.08\*\*(-1.99) | -0.08\*(-1.76) | -0.07\*(-1.72) | -0.11\*\*\*(-2.01) |  | -0.07\*(-1.68) | 0.02(1.13) | 0.02(1.22) | 0.01(0.40) | 0.00(0.16) | 0.00(0.60) | 0.01(0.44) |
| Panel B: Transportation |  |
| Threat | 0.02(1.18) | 0.01(0.54) | 0.02(1.19) | 0.02(1.07) | 0.04(1.01) | 0.04(1.05) | 0.02(0.30) |  | -0.00(-0.18) | 0.00(0.17) | -0.02(-0.64) | -0.02(-0.65) | -0.00(-0.14) | -0.03(-0.80) | -0.11\*(-1.70) |
| Act | -0.07\*(-1.85) | -0.11\*\*\*(-2.12) | -0.12\*\*(-1.97) | -0.11\*(-1.89) | -0.15\*(-1.69) | -0.08(-1.38) | -0.01(-0.02) |  | -0.09\*(-1.82) | -0.01(-0.23) | -0.03(-1.44) | -0.03(-1.26) | -0.04(-1.58) | -0.02(-0.99) | -0.01(-0.98) |
| Panel C: Industrials |  |
| Threat | -0.06\*(-1.64) | 0.00(1.22) | 0.04\*\*(1.97) | 0.06\*(1.91) | 0.09\*\*(1.97) | 0.08\*(1.77) | 0.06\*(1.67) |  | -0.02(-0.26) | -0.03(-0.83) | -0.01(-0.15) | 0.01(0.13) | 0.01(0.31) | 0.05(0.88) | 0.05(0.43) |
| Act | -0.10\*\*\*(-2.48) | -0.10\*(-1.81) | -0.14\*\*\*(-2.38) | -0.19\*\*\*(-2.72) | -0.17\*\*\*(-2.28) | -0.21\*\*\*(-2.31) | -0.28\*(-1.76) |  | -0.06\*(-1.76) | -0.01(-1.16) | -0.03\*(-1.66) | -0.04(-1.20) | -0.01(-0.48) | -0.00(-0.15) | -0.00(-0.18) |
| Panel D: Others |  |
| Threat | -0.07\*\*(-1.99) | 0.02\*(1.85) | 0.04\*(1.89) | 0.07\*\*\*(2.10) | 0.11\*\*\*(2.47) | 0.12\*\*\*(2.62) | 0.15\*\*\*(3.58) |  | -0.01(-0.26) | 0.03(0.85) | 0.03(0.81) | 0.06(1.24) | 0.06(0.95) | 0.08(1.14) | 0.09(1.00) |
| Act | -0.12\*\*(-2.01) | -0.05\*(-1.72) | -0.08\*(-1.89) | -0.12\*\*\*(-2.13) | -0.19\*(-2.12) | -0.22\*\*(-1.99) | -0.24\*(-1.98) |  | -0.07\*\*(-2.05) | -0.02(-1.14) | -0.07(-1.46) | -0.04(-1.27) | -0.08(-0.82) | -0.10(-0.52) | -0.02(-0.09) |

I use a panel regression with country fixed effects to capture unobserved heterogeneity across countries. The independent variables are $Z\_{t}$, that denotes *Threat* and *Act*; $Z\_{t}^{ε}$ is the residual from the regression $Threat\_{t}=α+β\_{1}Act\_{t}+ε\_{t}$ in *Act* and vice versa; term spread is the difference between the Belgian long-term government bond and commercial paper yields; relative risk-free rate is the difference between commercial paper yield and its 12-month moving average; the dividend yield is the smoothed dividend yield of country *j* and Election year, which is a dummy that yields one 12 months before a legislative election in country *j*. *T*-statistics are in parentheses are computed with standard errors clustered by country. I focus on stock returns from Belgium, France, Germany, Italy, Russia, Spain and the Netherlands. All regressions include a constant (not reported).

Results are based on the period January 1885 until July 1914. \*, \*\*, and \*\*\* represent significance at the 10%, 5%, and 1% levels, respectively.

# Appendix 4: Comparison

I am not the first to construct a search-based measure or an index of (potential) disaster risk. In this section, I compare *Threat* and *Act* with its most important counterparts in finance literature, such as geopolitical risk, the international crisis behavior project, news volatility index and economic policy index.

## Geopolitical risk

The geopolitical risk index of Caldara and Iacoviello (2018) is related to the risk measures. However, the index contrasts in three important points. First, the geopolitical risk index covers a broader definition of wars. They include additional key words, such as terrorist attacks, nuclear threat and geopolitical. However, in the 1885-1914 period, there are no news articles that contain the additional search words. Therefore, I do not include them in the glossary. In this period, the word *anarchist* was a synonym for *terrorist*. However, there are little mentions of this word in The Economist in the sample period.

Second, I apply the European perspective. In contrast, Caldara and Iacoviello (2018) target Canada, the United Kingdom and the United States. They potentially miss several important European conflicts, such as the Italo-Turkish War (1911-1912) and First Balkan War (1911-1912). In comparison, the geopolitical risk index spiked in July 1900, when Robert Charles fatally shot a police officer.[[1]](#footnote-1) This event lead to huge civil unrest in the U.S. Therefore, this index is not perfectly applicable to European stock markets. This is shown in lower correlations between *Threat* or *Act* by Caldara and Iacoviello (2018) and, respectively *Threat* (0.05) or *Act* (0.09) measured in this paper.[[2]](#footnote-2) In addition, there is no relationship between the geopolitical risk index and BSE stock returns and dividend growth.

Finally, Caldara and Iacoviello (2018) limit their analysis to the relationship between the geopolitical risk index and future stock returns. In this article, I consider all channels that could have an effect on stock returns, that is, changes in expected returns, dividend growth or interest rates. Furthermore, I focus on multiple countries in my analysis relative to a world market index. In sum, this provides a more comprehensive analysis for stock returns.

## International crisis behavior project

Another measure that is related to the war risk measures is the International Crisis Behavior (ICB) index from Berkman et al. (2011). The ICB database consists of more than 400 individual crises. This approach differs in three ways. First, I do not focus on political crises that have a potential to turn into military conflicts. A related drawback, however, is that the database does not include civil wars, crises identified by ICB as “international crises” and other disasters that may have consumption effects (Berkman, Jacobsen, and Lee 2011). In turn, I focus on potential military conflicts and the start of war directly. I use what is perceived by investors through the news. Therefore, *Threat* and *Act* are not constructed with the benefit of hindsight. They focus on potential conflicts to which investors can react, even when no actual event took place.

Second, I untangle war risks into its two most important components, *Threat* and *Act*. This allows me to make a comprehensive analysis of stock price reactions to war news. Therefore, this study is an extension over the ICB database. Caldara and Iacoviello (2018) document low correlations between their news-based measures and the index of Berkman et al. (2011), which highlights the potential of news-based measures in the disaster-risk literature (e.g. Barro 2006; Gabaix 2012).

## News implied volatility

Asaf Manela and Alan Moreira (2017) introduce a search-based index to extend option metrics of uncertainty. They limit their analysis on title and abstract from front-page articles. In addition, the source for news articles is *Wall Street Journal*. My approach thus differ in two different aspects. First, I do not limit my analysis on the front-page news but include all types of news. Second, and more importantly, I apply a different glossary. For instance, the words “stock”, “stocks” or “market”, respectively receive weights of 9%, 7% and 6%. The words, however, do not have war (or a disaster) as their predominately meaning. More specifically, war has a weight of 3%. This shows is the lower correlation between war-related NVIX and *Threat* (0.05) and *Act* (0.26)[[3]](#footnote-3). There is no relationship between NVIX and BSE stock returns and dividend growth.

## Economic policy uncertainty

In their seminal work, Baker et al. (2016) use three inputs to create Economic Policy Uncertainty metric (EPU): newspaper coverage, federal tax code provisions set to expire and disagreements between forecasters. Since there is no data on financial forecasters, and federal tax code provisions are not relevant in the measurement of war risk, I focus exclusively on newspaper coverage.

The most important difference between EPU and *Threat* or *Act* is obviously the form of risk that one tries to capture. EPU is constructed through a textual analysis of economic policy search terms, such as congress and deficit. In this article, I capture risks concerning potential military conflicts. Another difference between the risk measures is their geographical coverage. The historical database for EPU is focused on United Kingdom and United States, where the war risk metrics focus on continental Europe.[[4]](#footnote-4) The correlations between *Threat* or *Act* and EPU are low, respectively 0.16 (*Threat*) and -0.07 (*Act*) for the United Kingdom.

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1. #  I refer to the book “Carnival of fury: Robert Charles and the New Orleans race riot of 1900” by William Ivy Hair.

 [↑](#footnote-ref-1)
2. The geopolitical index of Caldara and Iacoviello (2018) is only available from 1899. [↑](#footnote-ref-2)
3. The NVIX, including the specific categories such as war, is only available from July 1889. [↑](#footnote-ref-3)
4. The historical economic policy uncertainty index of Baker et al. (2016) is only available from 1900. [↑](#footnote-ref-4)