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The effect of the Japan 2011 disaster on nuclear and alternative energy stocks worldwide

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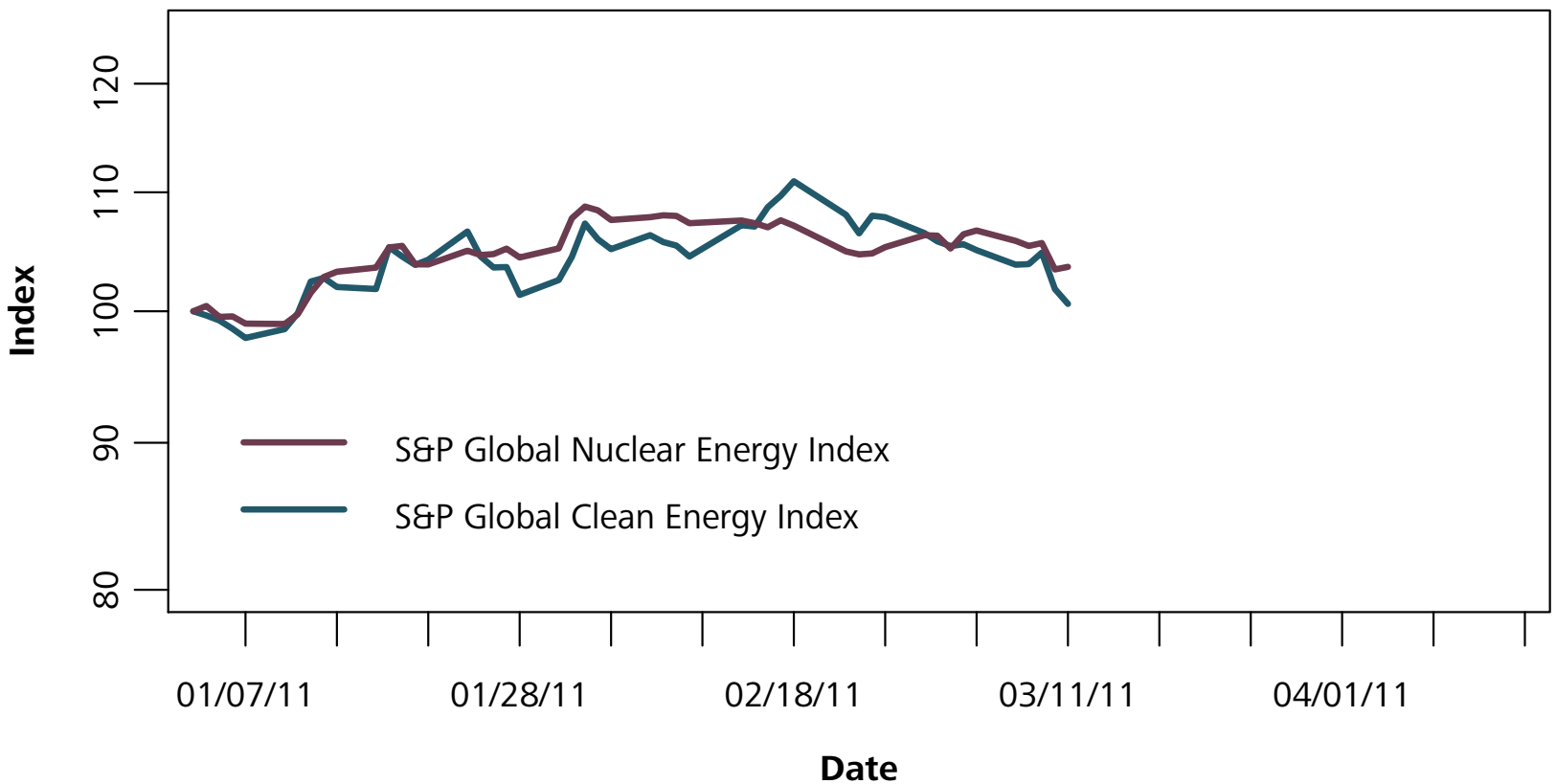
Motivation



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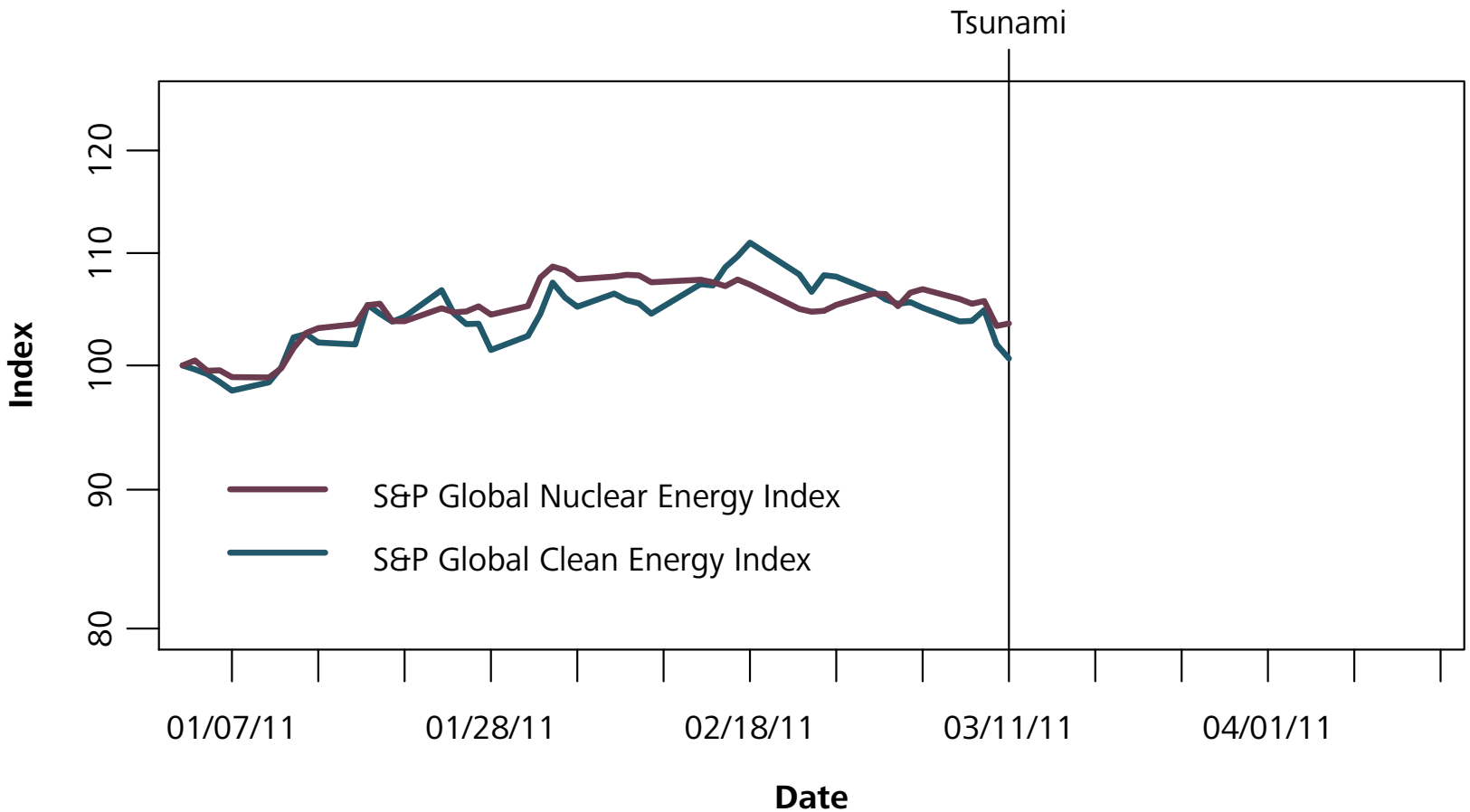

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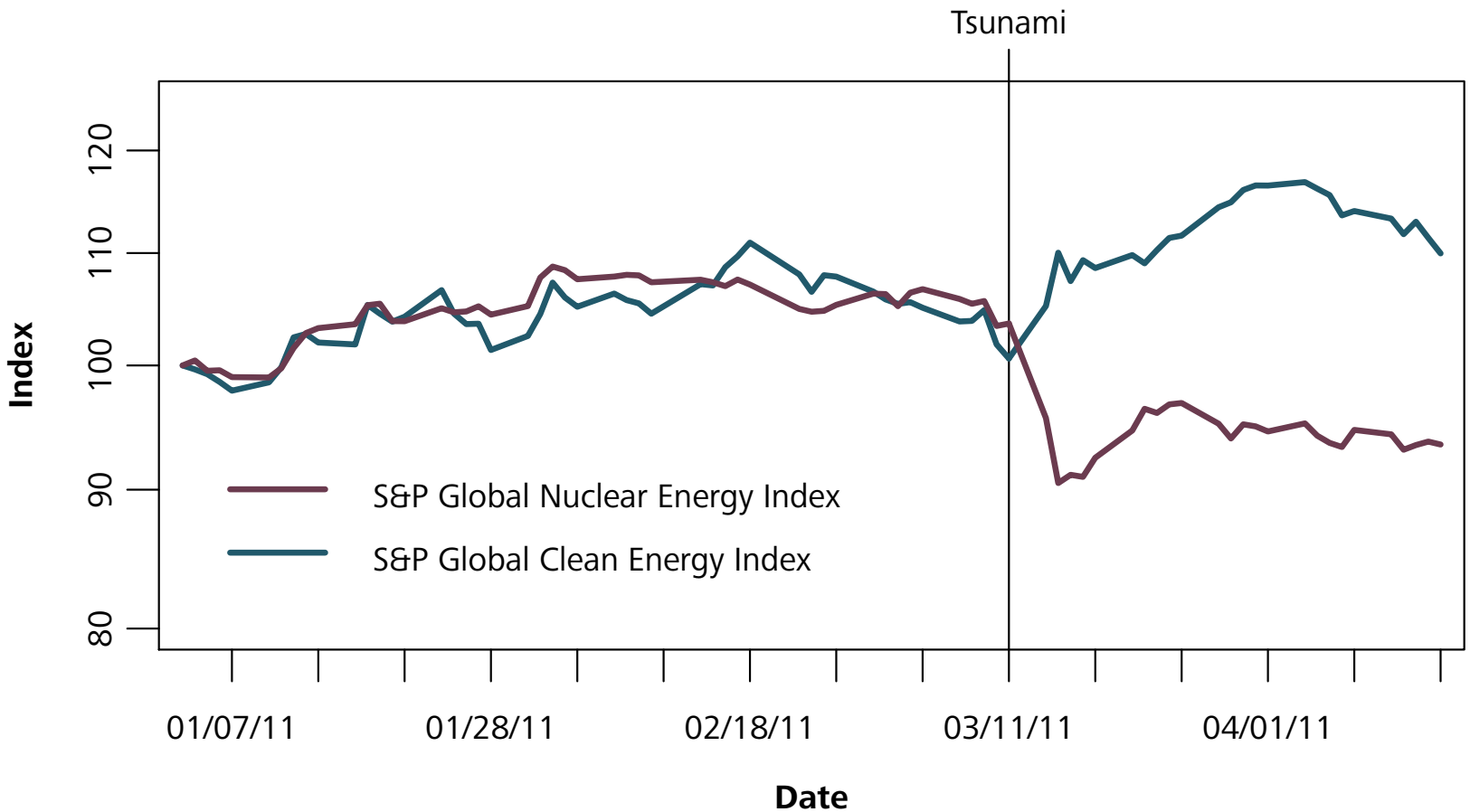

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Outline

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Related Literature—Three Miles Island, March 1979

- **Bowen et al. (1983)**, J. Finan. Quant. Anal.
  - Data: Daily U.S. utility stock prices
  - Negative abnormal retruns, esp. for nulcear-related firms
  - Upward shift in market risk
- **Hill and Schneeweis (1983)**, J. Finance
  - Data: Monthly U.S. utility firms stock prices
  - Negative abnormal returns 1–2 months after TMI for nuclear firms
  - No significantly abnormal returns for non-nuclear firms
- **Barrett et al. (1986)**, J. Finance
  - Data: U.S. utility bond prices
  - Increase in risk premia, esp. for nuclear-related firms

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Related Literature—Chernobyl, April 1986

- **Fields and Janjigian (1989)**, J. Bus. Res.
  - Data: Daily U.S. electric utility stock prices
  - Negative abnormal returns during a 20-day period after Chernobyl, esp. for nuclear-related firms
  - No significant upward shift in market risk
- **Kalra et al. (1993)**, Quart. J. Bus. Econ.
  - Data: Grouped U.S. utility stocks by their nuclear capacity
  - Negative returns in all groups
  - Mixed group with 10–20% nuclear capacity performs worst
- **Aktar (2005)**, Sosyoekonomi
  - Data: U.S. electric utility stocks
  - Chernobyl: Greater impact for firms with nuclear power plants under construction
  - TMI: Greater impact for firms with plants near population centers

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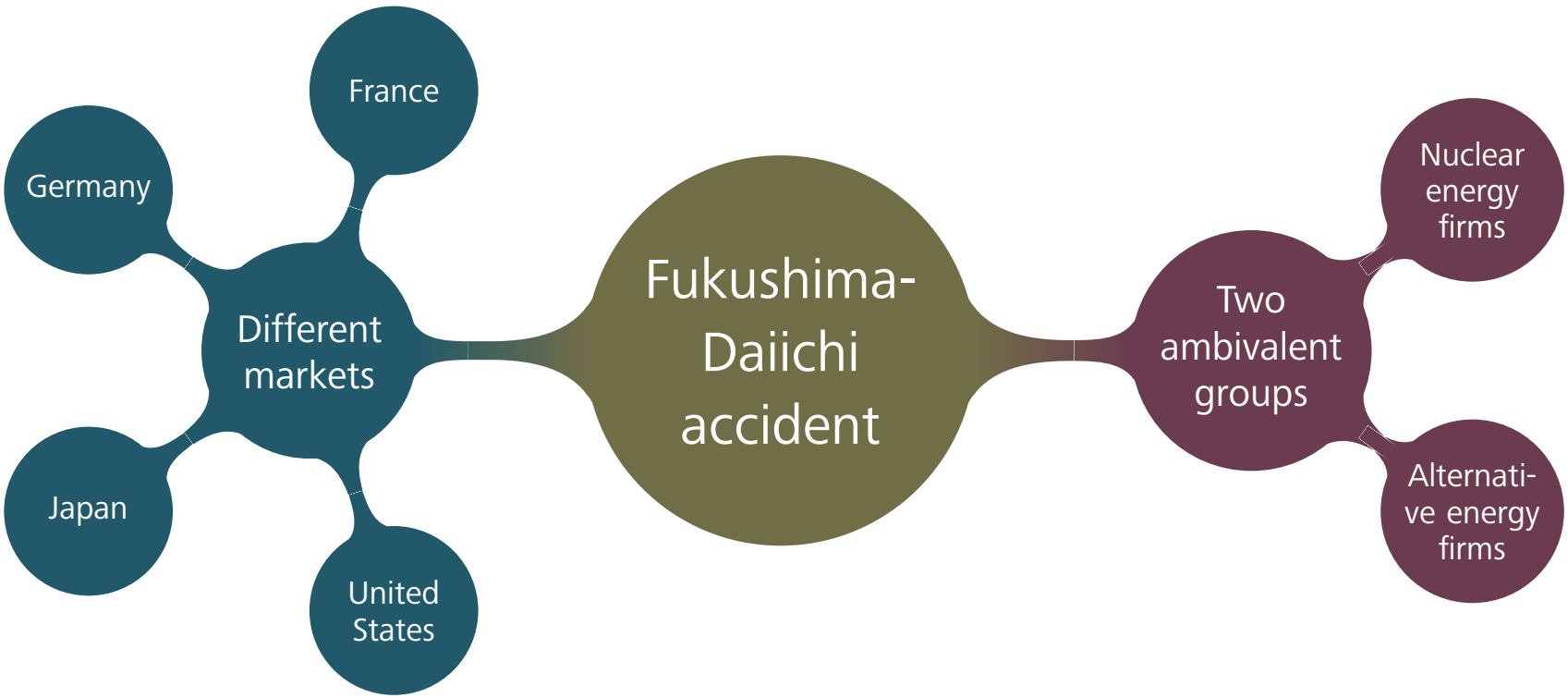
Contribution



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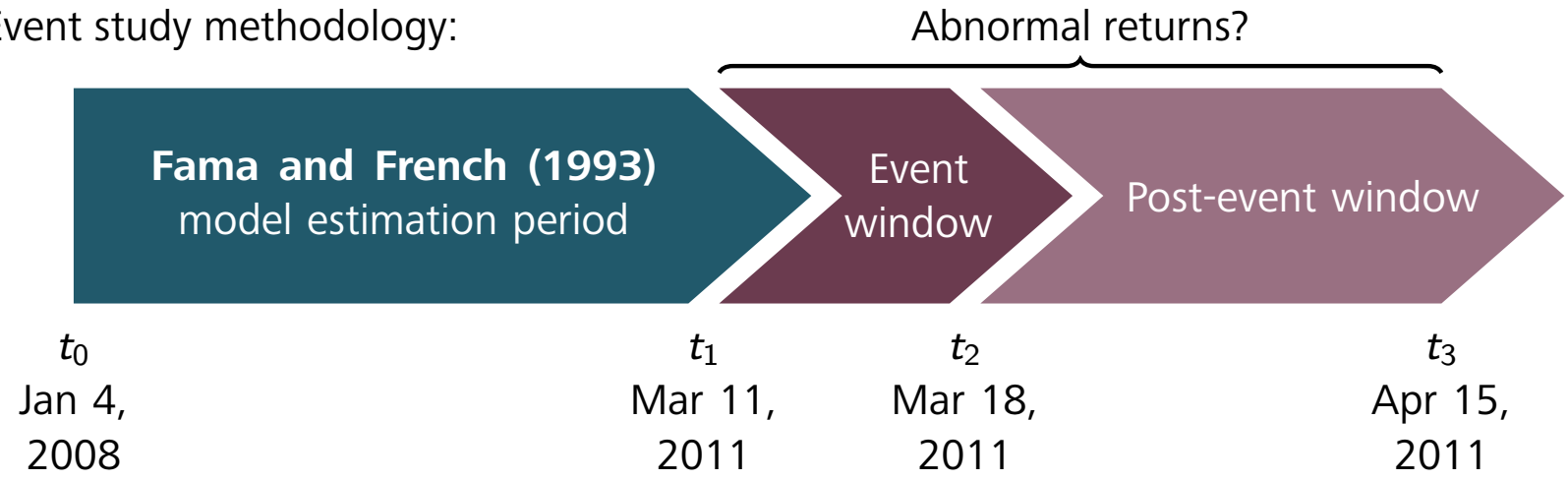
Methodology

- Event study methodology:



- For a single asset, let

$$R_t = \beta_0 + \beta_M M_t + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \varepsilon_t, \qquad t = t_0, \ldots, t_3.$$

- In matrix form:

$$\boldsymbol{R} = \boldsymbol{X}\beta + \varepsilon, \qquad \boldsymbol{X} = [\mathbf{1} \mid \boldsymbol{M} \mid \boldsymbol{SMB} \mid \boldsymbol{HML}] \in \mathbb{R}^{(t_3 - t_0 + 1) \times 4}.$$

- Including dummy variables $\boldsymbol{D}_{t_i}$, $t_i = t_1, \ldots, t_3$ for the (post-)event window:

$$\boldsymbol{R} = \boldsymbol{X}\beta + \boldsymbol{D}\gamma + \varepsilon, \qquad \boldsymbol{D} = [\boldsymbol{D}_{t_1} \mid \cdots \mid \boldsymbol{D}_{t_3}] \in \mathbb{R}^{(t_3 - t_0 + 1) \times (t_3 - t_1 + 1)}.$$

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Methodology

- For g different assets, let

$$\boldsymbol{R}_i = \boldsymbol{X}\beta_i + \boldsymbol{D}\gamma_i + \varepsilon_i, \qquad i = 1, \ldots, g.$$

- Stacked multivariate regression model (MVRM):

$$\begin{bmatrix} \boldsymbol{R}_1 \\ \boldsymbol{R}_2 \\ \vdots \\ \boldsymbol{R}_g \end{bmatrix} = \underbrace{\begin{bmatrix} \boldsymbol{X} & \boldsymbol{D} & 0 & 0 & \cdots & 0 & 0 \\ 0 & 0 & \boldsymbol{X} & \boldsymbol{D} & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \cdots & \boldsymbol{X} & \boldsymbol{D} \end{bmatrix}}_{=:\Xi} \underbrace{\begin{bmatrix} \beta_1 \\ \gamma_1 \\ \vdots \\ \beta_g \\ \gamma_g \end{bmatrix}}_{=:\delta} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_g \end{bmatrix}.$$

- **Hein and Westfall (2004)** bootstrap test statistic of the linear hypothesis matrix $\boldsymbol{A}$:

$$S = (\boldsymbol{A}\hat{\delta})'(\boldsymbol{A}(\Xi'(\hat{\Sigma} \otimes \boldsymbol{I}_{t_2 - t_0 + 1})^{-1}\Xi)^{-1}\boldsymbol{A}')^{-1}(\boldsymbol{A}\hat{\delta}).$$

  - Robust to non-normal i.i.d. residuals
  - Adjusts for cross-sectional correlations

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Hypotheses

H_1: The event does not affect the **abnormal returns** of the **nuclear** energy stocks in the (post-)event window.

H_2: The event does not affect the **abnormal returns** of the **alternative** energy stocks in the (post-)event window.

H_3: The event does not affect the **cumulative abnormal** returns of the **nuclear** energy stocks in the (post-)event window.

H_4: The event does not affect the **cumulative abnormal** returns of the **alternative** energy stocks in the (post-)event window.

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Data—Fama-French model estimation

- Thomson Reuters Datastream:
  - **Price Adjusted** (P) as stock price
  - **Market Value** (MV) as market value
  - **Common/Shareholder Equity** (WC03501) as book value
- Calculate market portfolio, SMB portfolio, HML portfolio similar to **Fama and French (1993)**, but use median of the market capitalization of **all stocks** in the respective market as of June 30 as the threshold for the SMB portfolio

- **France**: NYSE Euronext (295 stocks, €1.242 trillion)
- **Germany**: Börse Frankfurt (230 stocks, €907 billion)
- **Japan**: Tokyo Stock Exchange (2,264 stocks, ¥309.522 trillion)
- **United States**: NYSE, AMEX, NASDAQ (3,876 stocks, $14.022 trillion)

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Data—Sample selection

Nuclear firms

- min. 1,000 MW nuclear power capacity
- Domestic

1 (FR) / 2 (DE) / 9 (JP) / 19 (US) stocks remaining

Alternative energy firms

- Datastream classification **Alternative Energy**
- Liquidity requirements:
  - max. 90 days w/o trades during the estimation period
  - max. 5 days w/o trades during the (post-)event window
  - min. FF-model R^2: 15%

1 (FR) / 8 (DE) / 1 (JP) / 7 (US) stocks remaining

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Results—Fama-French model fit

	Nuclear Stocks			
Factor	**France**	**Germany**	**Japan**	**USA**
β_M	0.91 (0.00)	0.81 (0.13)	0.40 (0.04)	0.72 (0.15)
β_{SMB}	−0.01 (0.00)	−0.14 (0.05)	−0.07 (0.05)	−0.35 (0.14)
β_{HML}	−1.00 (0.00)	−1.01 (0.17)	0.69 (0.10)	−0.36 (0.16)
R^2	0.54 (0.00)	0.59 (0.03)	0.43 (0.16)	0.48 (0.08)
	Alternative Energy Stocks			
Factor	**France**	**Germany**	**Japan**	**USA**
β_M	1.13 (0.00)	1.87 (0.51)	1.17 (0.00)	1.47 (0.39)
β_{SMB}	1.14 (0.00)	0.99 (0.54)	1.18 (0.00)	0.62 (0.43)
β_{HML}	−0.00 (0.00)	−0.84 (0.29)	0.50 (0.00)	−0.36 (0.44)
R^2	0.15 (0.00)	0.28 (0.10)	0.39 (0.00)	0.26 (0.09)

Table 1. Fama-French model fit (mean factors). Standard deviations are in parentheses.

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Results

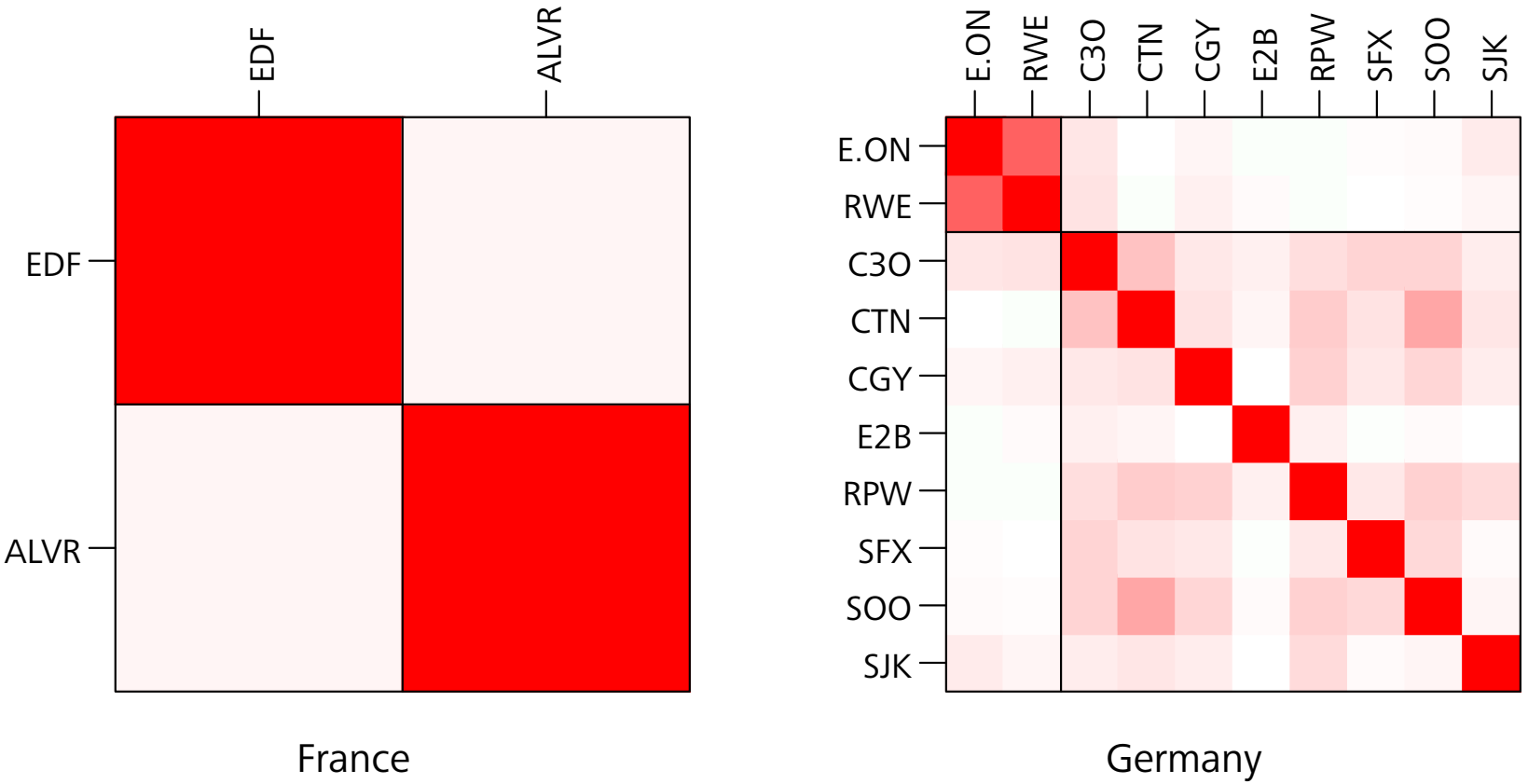

Figure 2. Correlation matrices of all nuclear and alternative energy stock residual returns in each country estimated by the MVRM. Red color equals 1, white color equals 0, and green color equals −1.

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Results

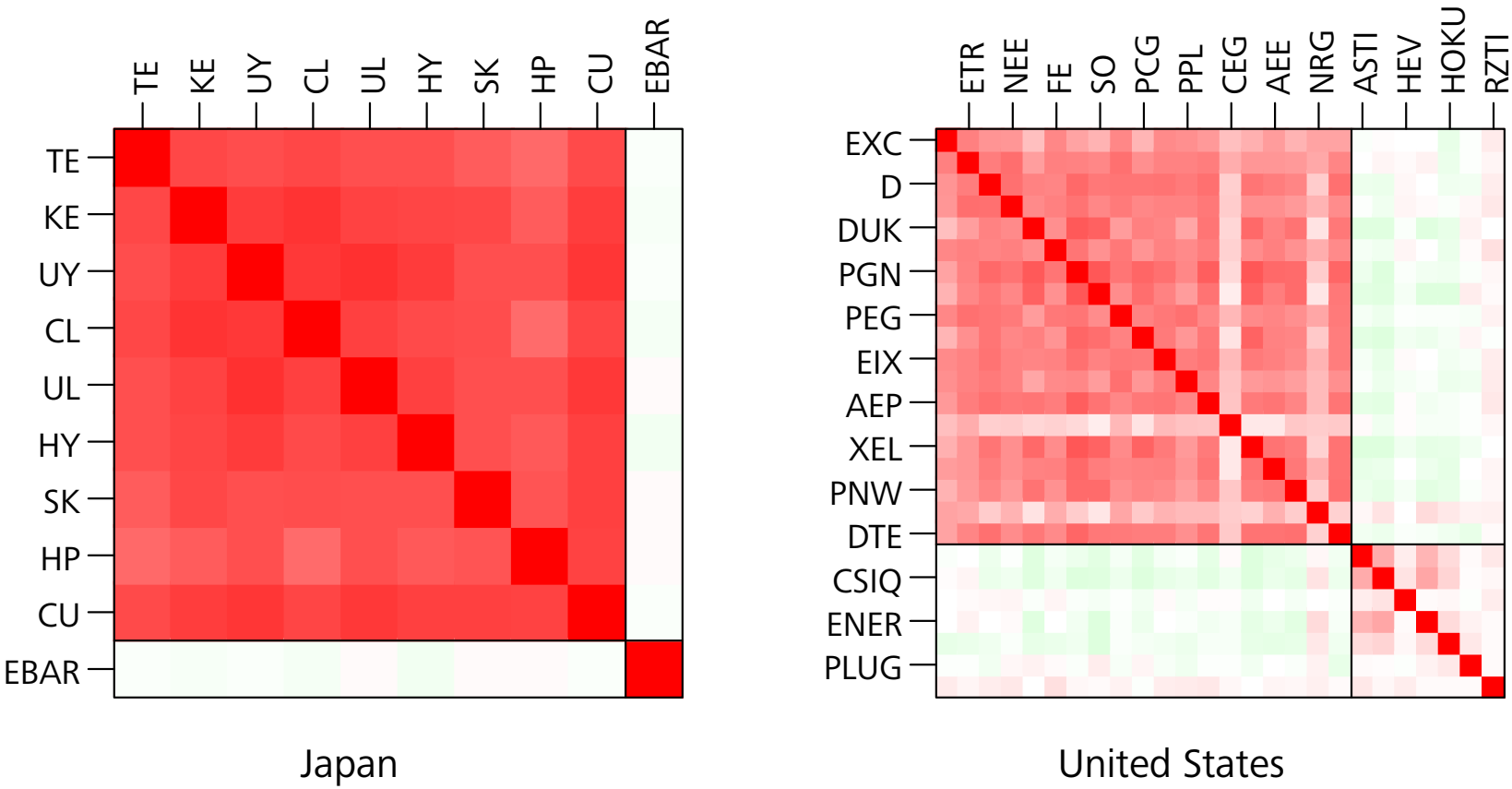

Figure 2. Correlation matrices of all nuclear and alternative energy stock residual returns in each country estimated by the MVRM. Red color equals 1, white color equals 0, and green color equals -1.

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Results

		Nuclear Stocks								Alternative Energy Stocks							
	Date	France		Germany		Japan		USA		France		Germany		Japan		USA	
	March 11	−0.0		1.9		−0.3		0.0		−0.6		1.0		0.9		−0.2	
Event Window	March 14	−3.1*	*−3.1**	−4.7**	*−4.7***	−6.4***	*−6.4****	−1.0	*−1.0*	5.0**	*5.0**	19.3***	*19.3****	2.6	*2.6*	−1.4	*−1.4*
	March 15	1.3	*−1.8*	−1.0	*−5.7***	−9.8***	*−16.2****	−1.3	*−2.3*	11.4***	*16.4****	37.1***	*56.4****	5.0**	*7.6***	3.8	*2.3*
	March 16	−1.2	*−2.9*	0.5	*−5.2***	1.4***	*−14.9****	−0.0	*−2.3*	−1.0	*15.4****	−14.5***	*42.0****	−2.2	*5.4*	1.4	*3.7*
	March 17	−1.5	*−4.4*	−0.2	*−5.3**	3.4***	*−11.5****	−1.0	*−3.3*	−1.4	*14.0***	0.7	*42.7****	2.4	*7.7**	−3.9	*−0.2*
	March 18	−1.9	*−6.3**	−1.0	*−6.4**	1.7***	*−9.9****	0.2	*−3.1*	−0.6	*13.4***	−3.0	*39.6****	−4.5**	*3.2*	−0.3	*−0.5*
Post-Event Window	March 21	3.1*	*3.1**	−0.6	*−0.6*	†	†	−0.0	*−0.0*	−1.5	*−1.5*	−8.7**	*−8.7***	†	†	−0.3	*−0.3*
	March 22	−1.2	*1.9*	1.2	*0.6*	1.9***	*1.9****	0.4	*0.4*	−1.1	*−2.6*	−0.8*	*−9.4***	−2.2	*−2.2*	1.3	*1.0*
	March 23	1.1	*3.0*	0.4	*1.0*	−1.1**	*0.8****	−0.1	*0.3*	0.8	*−1.7*	8.0*	*−1.4*	0.3	*−2.0*	−1.4	*−0.4*
	March 24	0.2	*3.2*	−0.9	*0.2*	−3.8***	*−3.1*	−0.5	*−0.2*	−0.2	*−1.9*	−5.3	*−6.7*	1.0	*−1.0*	−0.3	*−0.7*
	March 25	−0.3	*3.0*	0.2	*0.4*	−1.1**	*−4.1***	−0.1	*−0.3*	−1.9	*−3.8*	1.6	*−5.1*	3.0*	*2.0*	−0.9	*−1.6*
	March 28	−0.1	*2.8*	−0.8	*−0.4*	−2.8***	*−7.0****	−0.3	*−0.6*	2.1	*−1.7*	2.0	*−4.3*	0.6	*2.6*	2.1	*0.6*
	March 29	0.6	*3.5*	−0.9	*−1.3*	−3.5***	*−10.5****	0.3	*−0.3*	−0.5	*−2.2*	−1.1	*−4.7*	1.7	*4.3*	0.8	*1.3*
	March 30	1.4	*4.9*	0.4	*−0.9*	−3.3***	*−13.7****	0.8	*0.5*	0.3	*−2.0*	−2.2	*−5.6*	−0.7	*3.6*	−0.8	*0.5*
	March 31	−1.0	*3.9*	−0.4	*−1.3*	−2.1	*−15.9****	−0.1	*0.4*	−1.5	*−3.5*	−0.6	*−6.1*	−1.2	*2.4*	−2.1	*−1.6*
	April 1	−0.8	*3.1*	−0.6	*−1.9*	−3.0**	*−18.8****	0.3	*0.7*	0.0	*−3.5*	−3.2	*−8.5*	1.9	*4.3*	−0.7	*−2.1*
	April 4	0.3	*3.4*	1.0	*−0.9*	−0.6	*−19.4****	−0.1	*0.6*	−0.1	*−3.6*	0.5	*−8.2*	0.6	*5.0*	−3.9	*−5.4*
	April 5	↯	↯	0.8	*−0.1*	−2.8***	*−22.2****	−0.3	*0.3*	−0.2	*−3.8*	−2.8	*−10.6*	2.2	*7.1*	−0.2	*−5.6*
	April 6	↯	↯	0.3	*0.2*	−1.8**	*−24.0****	0.9	*1.2*	0.3	*−3.5*	−0.6	*−11.2*	−0.3	*6.8*	−0.0	*−5.6*
	April 7	0.2	*3.6*	0.9	*1.2*	3.7**	*−20.4****	−0.1	*1.1*	1.1	*−2.5*	−0.5	*−11.7*	1.6	*8.3*	0.4	*−5.3*
	April 8	†	†	0.5	*1.7*	3.4***	*−17.0****	−0.1	*1.0*	†	†	−1.1	*−12.8*	−0.4	*8.0*	−0.2	*−5.4*
	April 11	2.5	*6.1*	0.7	*2.3*	4.4***	*−12.5****	−1.2	*−0.2*	1.2	*−1.3*	−0.7	*−13.6*	−1.3	*6.6*	0.1	*−5.3*
	April 12	0.2	*6.4*	0.5	*2.8*	−1.9***	*−14.4****	−0.0	*−0.2*	−0.1	*−1.4*	1.3	*−12.3*	1.4	*8.1*	−1.5	*−6.8*
	April 13	−0.7	*5.7*	−0.1	*2.7*	†	†	0.1	*−0.1*	−3.2	*−4.6*	−1.3	*−13.6*	0.0	*8.1*	1.9	*−5.0*
	April 14	−1.4	*4.3*	−0.4	*2.3*	−0.5	*−14.9****	0.5	*0.5*	0.2	*−4.4*	−0.7	*−14.3*	−1.8	*6.3*	−1.6	*−6.6*
	April 15	−0.6	*3.7*	−1.2	*1.2*	−0.4***	*−15.3****	1.0	*1.5*	0.5	*−3.9*	−2.0	*−16.2*	−0.1	*6.2*	−3.2	*−9.8*

Table 2. Mean daily abnormal returns (in upright letters) and mean daily cumulative abnormal returns (in italic letters). ∗, ∗∗, ∗∗∗ denote joint significant (cumulative) abnormal returns at a 10%, 5%, and 1% level, respectively.

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Results

		Nuclear Stocks		Alternative Energy Stocks							
	Date	**E.ON**	**RWE**	**C3O**	**CTN**	**CGY**	**E2B**	**RPW**	**SFX**	**SOO**	**SJK**
	March 11	2.2	1.5	−6.0*	3.1	6.5	12.0**	0.5	−3.8	−2.2	−2.1
Event Window	March 14	−5.0***	−4.5**	14.7***	12.9**	48.5***	−9.0*	9.0**	16.7***	51.0***	10.6*
	March 15	−0.4	−1.6	7.1*	6.7*	109.2***	6.7	1.1	13.0***	57.0***	96.4***
	March 16	1.5	−0.5	−9.0**	3.2	−39.2***	−1.0	−0.6	−7.4*	−32.0***	−29.7***
	March 17	−0.8	0.5	−3.2	1.9	1.7	−2.8	0.4	0.5	3.7	3.2
	March 18	−1.5	−0.6	3.8	−2.9	−13.8**	−2.3	0.1	−1.4	6.1	−14.0**
Post-Event Window	March 21	−0.8	−0.4	−0.1	1.1	−21.0**	−16.6**	−0.3	−2.7	−13.4**	−16.3**
	March 22	1.5	0.9	−1.4	−3.0	−15.2**	2.9	1.1	0.1	−11.1**	20.4**
	March 23	0.5	0.4	1.0	9.5**	17.7**	11.7**	5.4*	0.1	13.3**	5.5
	March 24	−1.2	−0.6	−0.2	−2.6	−10.3*	−1.7	−3.5	−2.2	−5.5	−16.1**
	March 25	−0.2	0.6	−2.6	1.2	10.0*	−12.3**	−0.5	8.1*	−0.7	9.5*
	March 28	−1.2	−0.4	1.4	↯8.7**	↯8.5*	3.1	1.6	↯11.1**	↯14.0**	↯17.2**
	March 29	−1.0	−0.8	4.6	↯−3.5	↯−8.7*	−7.5	−0.3	↯2.0	↯−5.8	↯−8.3
	March 30	0.4	0.4	−4.4	↯−8.0**	↯−3.8	−2.8	0.6	↯−2.4	↯−1.1	↯−3.4
	March 31	−0.2	−0.6	1.2	4.6	−0.6	↯53.2***	1.6	−10.9**	−0.0	0.1
	April 1	−1.2	0.0	−1.3	−4.7	−2.5	↯−21.8***	−1.7	−3.6	−5.5	↯−11.7*
	April 4	0.5	1.5	0.9	−0.1	−2.0	↯−12.3**	↯8.9**	2.6	1.0	↯18.9**
	April 5	1.2	0.4	−1.9	1.5	−5.5	−3.6	−4.9	−2.4	−2.8	↯−9.7*
	April 6	0.3	0.3	0.5	−2.5	−0.4	3.8	−0.4	0.1	−2.1	−3.8
	April 7	1.1	0.8	−4.3	−1.6	4.5	−1.5	−0.8	−0.7	−2.9	3.2
	April 8	0.5	0.4	−2.0	−2.5	−1.8	3.4	−1.1	−1.0	3.2	−7.0
	April 11	0.8	0.6	−0.6	−1.0	0.9	−8.2	−0.2	0.7	−1.9	4.6
	April 12	0.7	0.3	4.1	1.9	6.4	−2.6	1.0	−0.1	1.2	−2.0
	April 13	−0.3	0.1	−4.2	0.3	−4.1	−7.3	0.4	−3.2	6.5	1.2
	April 14	0.0	−0.8	−0.4	0.9	1.5	−7.2	−1.2	1.6	1.4	−2.1
	April 15	−1.0	−1.3	−0.4	1.2	−1.9	2.1	−1.9	−3.5	−6.2	−5.1

Table A.3. Daily abnormal returns of nuclear and alternative energy companies in Germany.

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Results

		Nuclear Stocks									Alt. Energy Stocks
	Date	**TE**	**KE**	**UY**	**CL**	**UL**	**HY**	**SK**	**HP**	**CU**	**EBAR**
	March 11	−0.9	−0.2	0.3	−0.8	−0.2	−0.1	−0.2	−0.3	−0.3	0.9
Event Window	March 14	−22.1***	−2.9*	−4.7***	−2.6*	−21.0***	−2.4*	0.2	−0.7	−1.4	2.6
	March 15	−21.0***	−8.5***	−9.4***	−6.8***	−16.9***	−6.2***	−7.9***	−6.5***	−5.6***	5.0**
	March 16	−26.9***	5.3***	4.6***	1.4	15.2***	3.6**	3.3**	3.9***	2.0*	−2.2
	March 17	−13.0***	3.3**	3.3**	6.5***	8.4***	5.0***	6.2***	4.3***	6.2***	2.4
	March 18	18.3***	0.3	2.4*	−1.5	−0.6	−0.9	−0.7	−0.8	−1.5	−4.5**
Post-Event Window	March 21	†	†	†	†	†	†	†	†	†	†
	March 22	13.5***	−2.4*	−0.8	0.2	6.8***	−0.6	−1.2	0.6	0.4	−2.2
	March 23	−4.4**	0.4	1.2	−1.6	−2.3*	0.3	−1.0	−1.4	−1.1	0.3
	March 24	−14.1***	−1.7	−2.6*	−1.9	−5.4***	−1.9	−1.8	−3.0**	−1.9*	1.0
	March 25	−6.3***	−0.5	0.0	−0.6	−0.5	−0.7	0.1	−0.6	−0.5	3.0*
	March 28	−18.0***	−1.6	−0.4	−0.5	−1.1	−0.4	−1.2	−0.2	−2.0*	0.6
	March 29	−18.1***	−3.4**	−2.3*	−1.6	−1.4	−1.5	−1.7	−0.7	−0.8	1.7
	March 30	−18.2***	−1.0	−1.5	−2.4*	−2.3*	−0.8	−0.6	−0.0	−2.8**	−0.7
	March 31	−0.1	−2.6*	−3.4**	−1.7	−2.2*	−1.5	−3.2**	−2.7**	−1.9*	−1.2
	April 1	−3.4**	−1.3	−2.8**	−2.7*	−3.6**	−4.3**	−2.4*	−5.0***	−1.1	1.9
	April 4	−1.2	−0.5	−0.4	−1.1	−1.1	−0.2	−0.2	0.4	−0.9	0.6
	April 5	−17.6***	−1.3	−0.7	0.0	−0.3	−1.7	−0.6	−2.2*	−0.9	2.2
	April 6	−6.3***	−0.8	−1.1	−0.7	−0.9	−2.1*	−1.3	−1.7	−1.5	−0.3
	April 7	0.9	5.3***	5.7***	6.0***	2.6*	2.9**	3.4**	2.9**	3.2**	1.6
	April 8	23.0***	0.2	0.7	1.3	0.3	1.5	0.6	0.8	2.0*	−0.4
	April 11	19.2***	2.5*	2.5*	3.2**	5.4***	2.4*	1.3	1.4	2.0*	−1.3
	April 12	−9.4***	0.4	−0.9	0.6	−3.2**	−0.9	−1.0	−1.2	−1.2	1.4
	April 13	↯11.4***	↯−4.2**	↯−3.7**	↯−3.3**	↯−2.5*	↯−2.1*	↯−3.7**	↯−2.2*	↯−2.1*	0.0
	April 14	−0.6	−1.0	−0.5	0.3	−0.6	−1.0	0.5	−0.2	−1.0	−1.8
	April 15	−5.8***	0.3	0.2	1.6	0.4	−0.0	−0.0	−0.5	−0.1	−0.1

Table A.4. Daily abnormal returns of nuclear and alternative energy companies in Japan.

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Results

		Nuclear Stocks																			Alternative Energy Stocks						
	Date	EXC	ETR	D	NEE	DUK	FE	PGN	SO	PEG	PCG	EIX	PPL	AEP	CEG	XEL	AEE	PNW	NRG	DTE	ASTI	CSIQ	HEV	ENER	HOKU	PLUG	RZTI
	Mr 11	−0.3	−0.5	−0.9	−0.1	0.1	−0.3	−0.4	−0.8	0.3	−1.1	0.3	−1.3	−0.4	3.5*	−0.0	−0.4	0.5	1.7	0.3	−3.4	−2.7	6.9	↓−22.5***	−0.5	−4.2	2.9
Event Window	Mr 14	−0.3	−4.6***	−0.5	−0.8	−1.1	−0.0	−0.6	−1.5	−2.4*	−2.8**	−2.2*	0.3	−1.0	−0.4	−1.1	−1.2	0.2	2.4	−0.8	5.0	−1.8	−7.5*	0.8	5.3	−3.7	−8.1
	Mr 15	−2.7*	−1.6	−0.3	−1.6	−1.0	−2.0	−1.1	−1.3	−0.5	−2.6*	−1.8	−1.8	−0.5	−3.1*	−0.9	−0.5	−2.2*	1.0	0.1	11.9**	12.2**	−1.8	−1.9	5.7	−1.1	1.3
	Mr 16	−1.5	−1.1	−0.9	−0.6	−0.3	−0.0	−0.2	0.4	−0.7	−0.0	0.7	0.6	−0.5	−0.7	−0.0	1.2	−0.1	2.7	0.3	−6.4	−4.5	2.8	−2.6	2.7	1.2	16.4**
	Mr 17	−0.5	−2.7*	−1.1	−0.6	−1.0	−1.1	−2.0*	−0.5	−0.6	−0.3	−0.6	−0.6	−2.8*	−1.0	−0.0	−0.3	−1.4	0.1	−1.8	−5.5	−0.7	−2.3	−8.6*	−6.4	−0.1	−3.5
	Mr 18	−0.3	0.4	0.4	−0.2	0.1	0.0	0.4	0.4	−0.1	0.9	0.2	0.6	0.6	1.4	−0.5	0.5	−0.4	0.9	−0.6	−1.6	−2.6	−4.9	4.5	1.8	2.1	−1.5
Post-Event Window	Mr 21	−0.4	−0.9	0.6	0.7	−0.4	−0.4	0.1	0.4	−0.2	0.6	0.7	−0.8	−0.3	0.3	0.1	0.4	0.1	−1.1	0.3	1.0	−2.8	0.7	−4.0	2.4	0.9	↓−11.8*
	Mr 22	2.1	2.2	0.1	0.5	0.4	0.5	0.7	0.1	1.1	0.2	0.7	−0.5	0.6	−0.2	−0.8	−0.7	−0.8	1.6	−0.1	1.3	2.0	1.4	1.0	−0.7	2.8	1.1
	Mr 23	−0.6	−0.1	−1.0	−0.7	0.1	−0.5	0.1	0.1	0.2	−0.6	−0.2	−0.5	0.8	1.3	−0.5	0.4	0.3	−0.4	−0.4	−0.8	0.8	−2.6	−0.7	−1.9	−2.3	−2.6
	Mr 24	−0.8	−0.8	−0.1	−0.4	−0.4	−1.3	−0.2	−0.5	−1.0	−0.7	−0.3	−0.6	0.1	−1.0	−0.4	−0.1	0.1	−1.0	−0.4	−1.5	−2.6	−0.9	0.9	2.4	−1.0	0.8
	Mr 25	−1.1	−0.6	0.2	0.0	−0.4	−0.2	0.1	0.0	−0.4	0.4	−0.5	0.4	−0.4	−0.4	−0.0	−0.1	−0.0	0.7	−0.0	−2.5	−1.5	1.5	−1.8	2.7	−1.4	−3.0
	Mr 28	−0.8	0.1	−0.6	−0.6	0.3	−0.6	0.4	−0.0	−0.3	−0.0	−1.2	−0.1	0.1	−0.6	−0.4	0.0	−0.2	−0.0	−0.5	1.6	2.5	0.9	2.5	3.1	−0.7	5.1
	Mr 29	0.8	0.6	0.2	1.0	0.6	−0.0	0.5	−0.0	0.4	−1.2	0.1	0.6	0.7	−0.1	0.4	0.6	−0.1	0.6	0.6	11.1**	−0.8	4.6	−0.6	−4.6	↓12.4**	−5.1
	Mr 30	1.2	0.7	1.0	0.1	0.3	1.5	0.5	0.8	0.8	0.7	0.1	1.0	0.8	1.5	0.9	1.1	1.0	0.4	1.4	−3.7	−0.4	−4.0	4.2	0.0	0.5	−2.0
	Mr 31	−0.2	−0.8	−0.8	0.5	0.1	0.3	−0.3	0.1	−0.2	0.7	0.2	0.9	−0.8	−0.7	−0.1	−0.3	0.1	−1.0	0.1	−2.4	−2.8	−3.8	−6.2	−2.5	1.3	1.9
	Ap 1	−0.7	0.2	−0.4	1.0	1.1	−0.0	0.9	0.2	−0.6	0.3	0.8	1.2	0.7	0.4	0.4	−0.1	0.8	−0.1	0.4	↓−26.1***	−2.9	−0.6	2.7	−0.4	−1.0	−1.7
	Ap 4	−0.2	−0.3	0.5	0.5	−0.2	−0.3	0.2	0.0	−1.9	−0.0	−0.4	0.5	−0.1	−0.5	0.3	0.8	−0.2	−1.2	0.0	↓−23.1***	−1.3	−1.4	−5.8	−1.2	−12.0**	−1.7
	Ap 5	−0.7	−0.8	−0.3	0.2	0.1	−0.8	−0.0	−0.1	−0.3	−0.1	0.1	−1.0	−0.4	0.6	−0.5	0.1	−0.8	−1.2	0.2	6.5	−0.9	−0.3	−6.1	0.8	−1.3	↓−14.6**
	Ap 6	0.5	0.8	0.6	0.5	0.8	1.4	0.9	1.1	2.5*	1.3	0.4	0.1	0.7	1.2	0.5	1.3	0.7	0.9	0.2	−3.1	−0.1	1.0	0.3	−1.1	2.9	↓−31.7***
	Ap 7	−0.5	−0.8	−0.1	−0.8	−0.9	−0.2	−2.1*	0.1	−0.5	−0.5	−0.3	0.6	−0.2	3.3*	−0.7	0.1	−0.3	2.5	−0.2	0.1	−0.4	−0.8	5.0	0.5	−1.8	↓21.7**
	Ap 8	−0.4	−0.5	−0.2	−0.0	0.3	0.0	−0.0	−0.8	−0.4	−0.2	1.1	0.9	−0.3	1.9	−0.4	−0.8	0.1	−1.0	−0.5	−3.5	−1.7	−1.2	−1.6	1.9	2.4	2.5
	Ap 11	−1.4	−1.4	−1.9*	−1.5	−1.3	−1.0	−1.4	−1.7	−2.1	−1.6	−1.2	−0.6	−1.5	0.6	−1.5	−1.1	−1.2	−0.1	−0.9	0.6	−1.1	2.0	−0.7	0.4	−1.9	1.6
	Ap 12	0.2	0.1	−0.6	0.3	−0.6	1.0	−0.4	−0.6	0.5	−0.5	↓3.6**	↓5.1***	−0.2	−0.1	0.1	0.8	−0.5	0.1	−0.4	3.0	1.1	−5.9	−0.1	0.7	−3.5	−6.0
	Ap 13	0.0	0.0	−0.4	−0.6	0.3	1.7	0.5	0.1	0.9	−0.0	0.4	−0.6	0.8	0.4	0.2	−0.5	−0.2	−0.5	0.0	4.2	0.7	5.8	5.7	0.9	−4.2	−0.1
	Ap 14	0.9	0.5	1.1	0.3	0.7	1.2	0.9	0.7	−0.2	0.5	0.1	−0.1	0.8	0.4	0.6	0.6	1.0	0.2	−0.2	−2.1	−2.4	−1.6	−4.3	0.7	2.0	−3.5
	Ap 15	0.9	1.0	0.8	−0.3	0.7	0.6	0.7	1.2	0.9	1.7	1.1	0.8	0.6	1.1	1.4	1.9	0.8	1.2	1.8	−3.2	−2.4	−1.8	0.3	−0.9	−4.8	−9.9*

Table A.5. Daily abnormal returns of nuclear and alternative energy companies in the USA.

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Outline

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Conclusion

- Effects of the event are incorporated into stock prices within a few days

  Semi-strong market efficiency

- High volatility for Japanese stocks
- Policy change towards alternative energies expected in France and Germany
- No forthcoming policy departure expected in the United States

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