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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Central Bank Independence and stock market outcomes: An event study on Borsa Istanbul

Ahmad Bash^{1*} and Abdullah M. Al-Awadhi¹

Abstract: This study explores the importance of central bank independence on stock market outcomes. Specifically, we examine the effects of President Recep Tayyip Erdogan's decree, which removes the top officials of the Central Bank of Turkey, on Borsa Istanbul returns. We use a well-established event study methodology for five events from 20 July 2018, to 11 November 2021. The results show that the market is sensitive to the dismissal decrees in that they have positive effects on cumulative abnormal returns in the first two events, while the three events that follow have negative effects on cumulative abnormal returns. Our results support the importance of central bank independence, revealing that political intervention in central banks has a robust, positive, negative, and significant impact on stock market outcomes.

Subjects: Economics; Finance; Banking; Investment & Securities

Keywords: Central bank; event study methodology; stock market returns; Borsa Istanbul

JEL classification: G2; G4

1. Introduction

On 6 July 2019, President Recep Tayyip Erdogan issued the first decree dismissing Central Bank of Turkey (CBT) governor Murat Cetinkaya without specifying the reason behind such action. In a speech delivered by President Erdogan in 8 December 2021, he said the following:

We certainly don't believe in high interest rates. We will pull down inflation and exchange rates with low-rate policy ... High rates make the rich richer, the poor poorer. We won't let that happen.

President Recep Tayyip Erdogan¹

Media reports stated that the governor was fired because of his unwillingness to cut interest rates (Imbert, 2019). Since then, President Erdogan continued to interfere with central bank independence, removing several top CBT officials from their positions within a short period of time after disagreeing with their economic decisions.

Central bank independence is required to maintain economic stability and assist in rescues from financial crisis (Mishkin, 2004). It is usually measured through political and economic independence. Political independence refers to the central bank's discretion in designing and implementing policies for monetary stability; it shields the central bank from short-term political pressures. In contrast, economic independence relates to the central bank's freedom to choose a set of instruments consistent with monetary policy (Masciandaro & Romelli, 2015). This study investigates the relationship between central bank independence and stock market outcomes.²

The theoretical work of Ueda and Valencia (2014) suggests that central bank independence is an important factor for economic stability. In the past few years, many countries have given monetary authorities more autonomy (Klomp & De Haan, 2010). According to Garcia and Costa (2019), some features of the central bank, such as central bank independence and transparency in monetary policy-making, may influence stock market returns. A high degree of central bank's independence may signal good governance to investors (Maxfield, 1997), an independent central bank's monetary policy may limit budget deficits and, in turn, future expected taxes (Sargent & Wallace, 1981), and an independent central bank may promote stock market returns by limiting inflation (Fama & Schwert, 1977).

Empirical work shows that central bank independence affects exchange rates and sovereign bond yields (Kuttner & Posen, 2010; Moser & Dreher, 2010), inflation (Alesina and Summers, 1993; Anwar, 2022; Berger et al., 2001; Garriga & Rodriguez, 2020; Gyeke-Dako et al., 2022; Strong, 2021), and fiscal deficits (Agoba et al., 2019; Bodea & Hicks, 2015; Strong & Yayi, 2021). In terms of the impact of central bank independence on stock market returns, a limited number of papers have discussed this topic. For example, Förch and Sunde (2012) study the emerging economies, where they find a positive impact of central bank independence on stock market returns. Kurihara et al. (2012) also find a positive relationship between central bank independence and stock market returns. Garcia and Costa (2019), in a study on the central bank independence in developed countries for a period of greater than 20 years, find that central bank independence positively affects stock market returns.

Using an event study methodology, this study explores the effects of the sacking of CBT top officials on Borsa Istanbul returns. What motivated us to conduct this study is the fact that we have a unique case of five changes of the officials of the central bank within a very short period of time. We believe such political interference will have a great influence on central bank independence and, in consequence, on stock market returns.³

Political intervention in central banks has in general, has a robust, negative, and significant impact on stock market outcomes. Such results support the importance of central bank independence. Thus, the implications of our study are important for politicians and investors to understand the effect of central bank independence on stock market outcomes.

The remainder of this paper is organized as follows: Section 2 provides the background of the events. Section 3 presents the data and methodology. Section 4 presents the descriptive statistics. Section 5 includes the results and discussion. Section 6 concludes the study.

2. Events background

The Turkish economy has suffered from an economic slowdown and rising inflation (Sonmez, 2022). Since 2019 up-to-date, the inflation rate has continued to increase in double digits. For example, it was 16.5% in 14 July 2019.0% in 16 November 2020.20% in 16 March 2021.60% in 19 May 2021.90% in October 2021 and 84.40% in November 2022.⁴ To protect the currency from further depreciation and to combat inflation, the central bank increased the one-week repo rate from 17.5% to 24% in September 2018, which was considered high and would impede economic expansion (BBC, 2019). From 6 July 2019, to 14 October 2021, President Erdogan issued multiple decrees dismissing and hiring several CBT officials, which provided an opportunity to test the following five events:

- **Event 1:** On 6 July 2019, President Erdogan issued a decree dismissing CBT governor Murat Cetinkaya. According to Coskun (2019), Mr. Cetinkaya refused to cut the interest rate by 300 basis points in June 2019. Following this decree, the Turkish lira dropped by 1.5% against the US dollar (Imbert, 2019).

- **Event 2:** On 7 November 2020, Murat Uysal was dismissed from his position as CBT governor. He was sacked by President Erdogan without any reason being specified (Coskun et al., 2020). He had previously been Cetinkaya's deputy and became CBT governor on 6 July 2019 (TRTWORLD, 2019).
- **Event 3:** On 20 March 2021, Naci Agbal was dismissed from his position. He had previously been a finance minister and became the CBT governor on 7 November 2020 (Coskun et al., 2020). He was sacked by President Erdogan, who rejected the idea of increasing interest rates (Soylu, 2021). Naci Agbal was fired two days after deciding to increase the interest rate (ALJAZEERA, 2021).
- **Event 4:** On 25 May 2021, Oguzhan Ozbas was removed as deputy governor of the CBT. He was one of seven members of the rate-setting committee and had served as deputy governor since 30 August 2019 (Butler & Spicer, 2021).
- **Event 5:** On 14 October 2021, President Erdogan dismissed Semih Tumen, Ugur Namik Kucuk, and Abdullah Yavas. Semih Tumen was an economic adviser to Erdogan (Ahval, 2021) and became the deputy governor on 25 May 2021. Semih Tumen, who worked previously as an economic adviser to Erdogan, filled Oguzhan Ozbas' position (Ahval, 2021). Ugur Namik Kuck, a monetary policy committee member, was appointed as deputy governor on 14 August 2018. Abdullah Yavas, a monetary policy committee member, was appointed on 11 March 2008 (ALJAZEERA, 2021).

President Erdogan's interference in the central bank's decision concerning Turkey's monetary policy provides a clue about the level of independence that the central bank enjoys because interference contradicts central bank Law No. 1211 in Turkey.⁵

3. Data and methodology

3.1. Data

Our sample represents daily data collected from Bloomberg from 20 July 2018, to 11 November 2021. When the removal decree is issued on a weekend, we consider the first trading day of the following week as the event day.⁶ The sample includes the adjusted closing prices of the Borsa Istanbul 100 Index (BIST100) and all stocks listed on Borsa Istanbul.

3.2. Methodology

We use a well-established event-study methodology. Event studies calculate the effect of a certain event on a firm's value using information from the financial markets. The advantage of such a method comes from the fact that, in a rational market, the impact of an event will be quickly reflected in security prices. As a result, security prices observed over a relatively short time period can be used to provide a clear picture of the event's economic impact (Mackinlay, 1997).

We calculate the daily return as follows:

$$DR_n = \ln\left(\frac{P_{nd}}{P_{nd-1}}\right) \quad (1)$$

where DR_n represents the daily rate of return for stock n , \ln is the natural logarithm, P_{nd} is the price of stock n at time d , and P_{nd-1} is the price of stock n at time $d - 1$.

The daily abnormal returns $AR_{n,d}$ and cumulative abnormal returns $CAR_{n,d}$ in the observation period, including the event day (Day 0), are calculated using the market model. As in Dodd and Warner (1983) and Brown and Warner (1985), abnormal returns using the market model are calculated as follows:

$$AR_{n,d} = DR_{n,d} - (\alpha_n + \beta_n DR_{m,d}) \quad (2)$$

where the dependent variable $AR_{n,d}$ represents the daily abnormal returns for stock n at time d ; $DR_{n,d}$ is the daily return for stock n at time d , as shown in Eq. 1; $DR_{m,d}$ is the daily return of the BIST100; $DR_{m,d}$ is simply the summation of daily AR s divided by the number of stocks N ; and α_n

and β_n indicate the regression coefficient estimates from the ordinary least squares method for the period $[-250, -11]$ days.⁷

The advantage of this method is that it has a good predictive power and is widely used in the literature (Brenner, 1997). According to Armitage (1995), the market model is the most reliable approach for calculating abnormal returns because as it consistently outperforms alternative estimation methods.

To determine the statistical significance of $CAR_{n,d}$, we use the Satterthwaite–Welch *t*-test as our parametric test and the Wilcoxon–Mann–Whitney signed-rank median as our non-parametric test. According to Bartholdy et al. (2011), Harris and Hardin (2013), and Maynes and Rumsey (1993), the median test is preferred when stocks are thinly traded and the sample size is small.

4. Descriptive statistics

Figure (B1–B5) show the patterns $AR_{n,d}$ and $CAR_{n,d}$. All figures suggest negative $AR_{n,d}$ and $CAR_{n,d}$ values surrounding the events.

The descriptive statistics in Table C1 and Table C2 show that events have a negative effect on our sample. Table C1 shows the mean and median for the $AR_{n,d}$ of the five events included in our study. For all five events, both the mean and the median $AR_{n,d}$ are negative on the event day (Day 0), except for Event 2.

Table C2 shows the mean and median for the $CAR_{n,d}$ for the five events. For all five events, both the mean and the median $CAR_{n,d}$ are negative on the event day (Day 0).

5. Results and discussion

The market model results show that dismissal decisions have a significant impact on stock market returns. The mean and median equality tests results in Table (C3–C7) show the effects of dismissal decisions on $CAR_{n,d}$.

Table C3 presents the results of the mean and median equality tests for Event 1. The mean equality tests in Panel A of Table C3 suggest a significant negative market reaction for the first dismissal decision in the event window $[-5, 5]$. However, the event window $[-10, 20]$ shows a significant positive market reaction. The median equality tests in Panel B of Table C3 suggest a significant negative market reaction for the first dismissal decision in the event window $[-5, 5]$. However, the event windows $[-10, 15]$ and $[-10, 20]$ show a significant positive market reaction.⁸

Table C4 presents the results of the mean and median equality tests for Event 2. The mean and median equality tests in Panels A and B of Table C4 suggest insignificant reactions for early event window days. However, the event window $[-10, 20]$ shows a significant positive market reaction for both the mean and the median equality tests.

The results of the mean and median equality tests for Event 3 in Table C5 suggest a significant negative market reaction for both mean and median equality tests for event windows $[-10, 10]$, $[-10, 15]$, and $[-10, 20]$.

The results of the mean and median equality tests for Events 4 and 5 in Table (C6 and C7), respectively, suggest a significant negative market reaction for both mean and median equality tests for all event windows.

In general, we find mixed results for the first two events and a clear negative significant effect for the last three events. One possible explanation for the mixed results of the first two events is that in a Muslim-majority country such as Turkey, speeches by President Erdogan to fight interest

rate hikes may have sent a positive signal to some Islamic investors. However, his continuous intervention in the CBT has sent a clear message to investors about the lack of economic stability. In the later events (Events 3, 4, and 5), it is clear that the political intervention of removing central bank leaders has a robust, negative, and significant impact on stock market returns.

The findings mainly support recent contributions to the literature on the effects of central bank independence on market outcomes, which have found that market performance seems to be improved by central bank independence. There is quantitative significance to the impacts. A high degree of central bank independence may signal good governance to investors (Maxfield, 1997), and an independent central bank may promote stock market returns by limiting inflation (Fama & Schwert, 1977). To determine the mechanisms by which central banks influence stock market returns, more research is required.

6. Conclusion

This study investigates the importance of central bank independence on stock market stability. We examine how President Erdogan's dismissal decisions to remove top CBT officials affected Borsa Istanbul returns, using daily data from Borsa Istanbul from 20 July 2018, to 11 November 2021.

Employing event study methodology, we find that these decisions have positive and negative effects on stock market returns. Specifically, we find that the first two dismissal decrees have positive outcomes on cumulative abnormal returns; however, the last three events have negative effects on cumulative abnormal returns.

Our results support the importance of central bank independence, revealing that political intervention in central banks has a robust, positive, negative, and significant impact on stock market outcomes.

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Notes

1. As quoted by Firat Kozok (8 December 2021). <https://www.bloomberg.com/news/articles/2021-12-08/erdogan-urges-central-bank-to-keep-going-on-interest-rate-cuts>
2. Other studies have investigated the determinants of the stock market returns. For example, Demier (2019) studies the effect of some macroeconomic variables on the Borsa Istanbul 100 index. He finds that economic growth, the relative value of the domestic currency, portfolio investments and foreign direct investments positively affect the BIST100 whereas interest rates and crude oil prices negatively affect the index. In addition, Acikalin et al. (2008) find that GDP, exchange rate, and current account balance negatively affect the BIST100. These studies differ from our paper, in that our focus here is on the relationship between

central bank independence and stock market returns. Researchers interested in such topics—the determinants of stock market returns—can investigate it in more detail in a future research by employing different economic variables in their econometric model.

3. The figure in Appendix 1 shows the significant impact of the events on the Borsa Istanbul 100 Index Returns (BIST100).
4. Inflation rates kept accelerating until very recently. The mentioned dates are associated with the dismissal dates of the officials. These rates are year-over-year inflation rates (compared with the same month in the previous year). Data obtained from https://ycharts.com/indicators/turkey_inflation_rate#:~:text=Turkey%20Inflation%20Rate%20is%20at, long%20term%20average%20of%2025.67%25.
5. Article 4 states “the bank shall enjoy absolute autonomy in exercising the powers and carrying out the duties granted by this Law under its own responsibility”.
6. For example, Murat Cetinkaya was removed on Saturday 6 July 2019, and the stock market was closed on that day. Thus, we consider the first trading day of the week, that is, Monday 8 July 2019, as the event day. The same treatment is applied for events 2 and 3.
7. The −250 is selected to roughly match the number of trading days in a calendar year. It represents a period before the event day that is lengthy enough to allow accurate estimation of the parameters of the selected return-generating mechanism.
8. We follow Kolaric and Schiereck (2016) and Bash and Alsaifi (2019) in choosing the event windows [−1, 1], [−3, 3], [−5, 5], [−10, 10], [−10, 15], [−10, 20]. They are arbitrarily chosen and widely employed in the event-studies.

Disclosure statement

No potential conflict of interest was reported by the author(s).

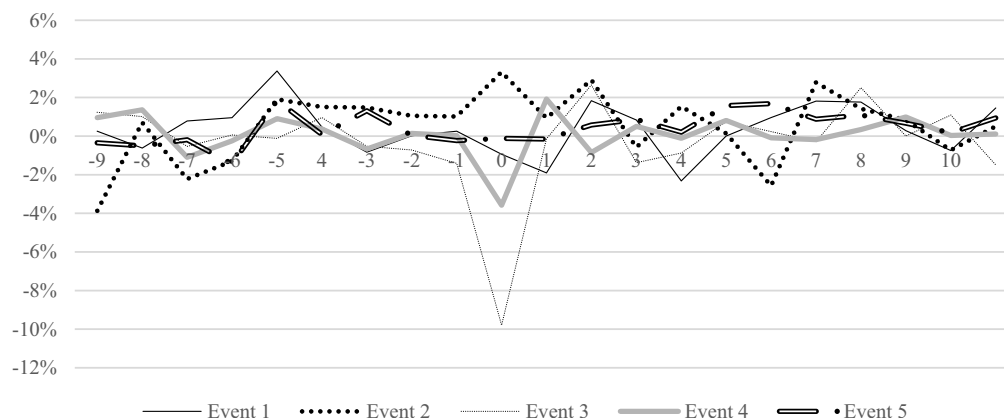
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Appendix A

Figure A1. Borsa Istanbul 100 Index Returns (BIST100) around the days of events.



Appendix B

Figure B1. $AR_{n,d}$ and $CAR_{n,d}$ for all stocks following Event 1—market model.

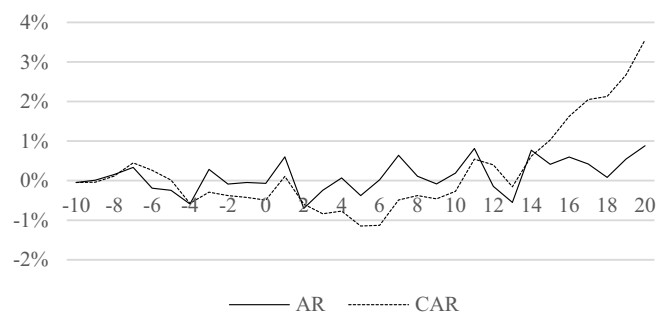


Figure B2. $AR_{n,d}$ and $CAR_{n,d}$ for all stocks following Event 2—market model.

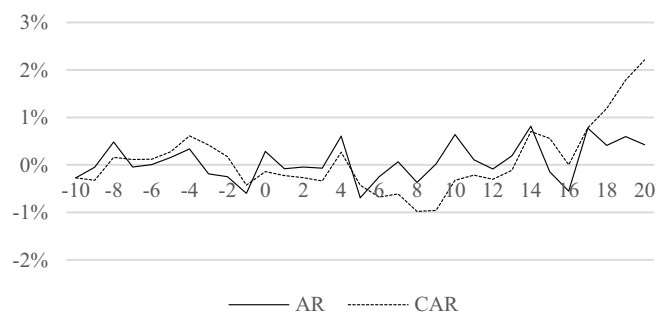


Figure B3. $AR_{n,d}$ and $CAR_{n,d}$ for all stocks following Event 3—market model.

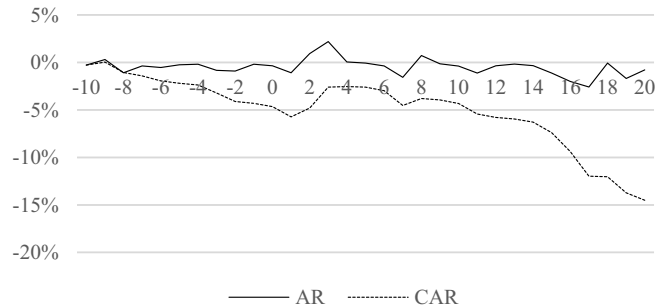


Figure B4. $AR_{n,d}$ and $CAR_{n,d}$ for all stocks following Event 4—market model.

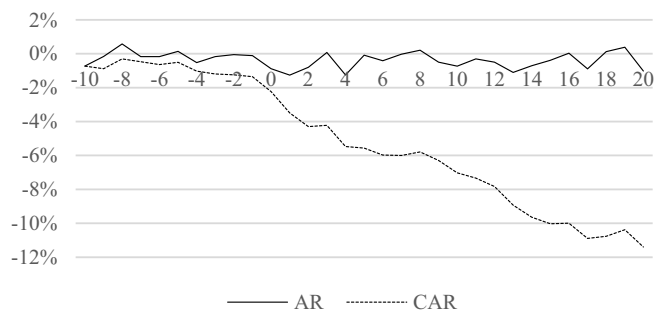
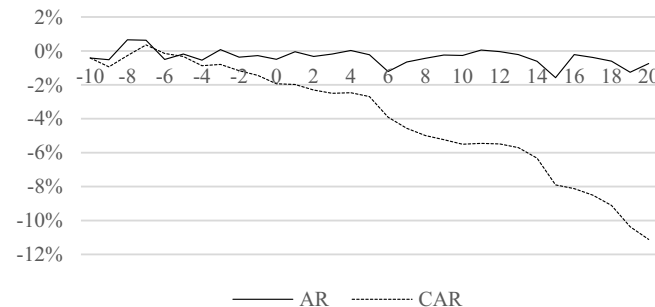


Figure B5. $AR_{n,d}$ and $CAR_{n,d}$ for all stocks following Event 5—market model.



Appendix C

Table C1. Descriptive Statistics for Abnormal Returns ($AR_{n,d}$) for the Five Events

	Mean					Median				
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 1	Event 2	Event 3	Event 4	Event 5
-10	-0.0005	-0.0027	-0.0027	-0.0073	-0.0042	-0.0006	-0.0046	-0.0057	-0.0080	-0.0030
-9	0.0001	-0.0005	0.0031	-0.0016	-0.0052	-0.0021	-0.0038	-0.0005	-0.0022	-0.0054
-8	0.0016	0.0048	-0.0109	0.0058	0.0066	-0.0006	0.0021	-0.0121	0.0027	0.0045
-7	0.0033	-0.0005	-0.0036	-0.0017	0.0063	0.0018	-0.0005	-0.0077	-0.0013	0.0035
-6	-0.0019	0.0001	-0.0053	-0.0017	-0.0050	-0.0024	-0.0022	-0.0087	-0.0013	-0.0062
-5	-0.0025	0.0016	-0.0024	0.0014	-0.0018	-0.0044	-0.0005	-0.0039	-0.0009	-0.0047
-4	-0.0059	0.0034	-0.0019	-0.0052	-0.0054	-0.0067	0.0018	-0.0051	-0.0056	-0.0064
-3	0.0028	-0.0019	-0.0083	-0.0017	0.0008	0.0000	-0.0023	-0.0096	-0.0013	-0.0003
-2	-0.0009	-0.0025	-0.0091	-0.0005	-0.0037	-0.0016	-0.0048	-0.0136	-0.0013	-0.0045
-1	-0.0005	-0.0060	-0.0019	-0.0011	-0.0028	-0.0009	-0.0065	-0.0044	-0.0042	-0.0031
0	-0.0007	0.0028	-0.0034	-0.0088	-0.0049	-0.0024	0.0000	-0.0074	-0.0102	-0.0053
+1	0.0060	-0.0008	-0.0108	-0.0126	-0.0005	0.0018	-0.0016	-0.0054	-0.0118	-0.0015
+2	-0.0070	-0.0005	0.0094	-0.0080	-0.0033	-0.0064	-0.0010	0.0051	-0.0083	-0.0041
+3	-0.0025	-0.0007	0.0220	0.0007	-0.0019	-0.0033	-0.0023	0.0214	-0.0016	-0.0035
+4	0.0007	0.0060	0.0006	-0.0125	0.0003	-0.0012	0.0017	-0.0035	-0.0119	-0.0007
+5	-0.0038	-0.0069	-0.0007	-0.0009	-0.0022	-0.0034	-0.0063	-0.0040	-0.0020	-0.0037
+6	0.0002	-0.0025	-0.0037	-0.0041	-0.0122	0.0002	-0.0033	-0.0070	-0.0059	-0.0130
+7	0.0064	0.0007	-0.0156	-0.0002	-0.0065	0.0019	-0.0012	-0.0183	-0.0020	-0.0081
+8	0.0011	-0.0037	0.0074	0.0021	-0.0043	-0.0009	-0.0034	0.0017	-0.0007	-0.0063
+9	-0.0008	0.0002	-0.0014	-0.0050	-0.0024	-0.0022	0.0002	-0.0055	-0.0053	-0.0042
+10	0.0019	0.0064	-0.0038	-0.0073	-0.0027	-0.0008	0.0019	-0.0070	-0.0074	-0.0037
+11	0.0081	0.0011	-0.0111	-0.0031	0.0005	0.0037	-0.0011	-0.0090	-0.0033	-0.0013
+12	-0.0014	-0.0009	-0.0036	-0.0050	-0.0004	-0.0032	-0.0023	-0.0059	-0.0054	0.0002
+13	-0.0055	0.0019	-0.0016	-0.0110	-0.0022	-0.0071	-0.0007	-0.0041	-0.0126	-0.0027
+14	0.0077	0.0082	-0.0033	-0.0071	-0.0061	0.0055	0.0036	-0.0066	-0.0071	-0.0053
+15	0.0041	-0.0015	-0.0112	-0.0039	-0.0158	0.0001	-0.0033	-0.0118	-0.0054	-0.0168
+16	0.0060	-0.0055	-0.0199	0.0003	-0.0022	0.0020	-0.0071	-0.0237	-0.0008	-0.0022
+17	0.0042	0.0078	-0.0259	-0.0089	-0.0039	0.0021	0.0055	-0.0247	-0.0075	-0.0036
+18	0.0008	0.0041	-0.0006	0.0012	-0.0061	0.0000	0.0000	0.0012	-0.0012	-0.0076
+19	0.0055	0.0060	-0.0169	0.0039	-0.0126	0.0014	0.0020	-0.0196	0.0017	-0.0121
+20	0.0088	0.0042	-0.0078	-0.0101	-0.0075	0.0069	0.0022	-0.0072	-0.0116	-0.0104

Table C2. Descriptive Statistics for Cumulative Abnormal Returns ($CAR_{n,d}$) for the Five Events

	Mean					Median				
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 1	Event 2	Event 3	Event 4	Event 5
-10	-0.0005	-0.0027	-0.0027	-0.0073	-0.0042	-0.0006	-0.0046	-0.0057	-0.0082	-0.0031
-9	-0.0004	-0.0032	0.0004	-0.0089	-0.0094	-0.0025	-0.0084	-0.0051	-0.0100	-0.0075
-8	0.0012	0.0016	-0.0105	-0.0031	-0.0028	-0.0001	-0.0035	-0.0154	-0.0040	-0.0013
-7	0.0045	0.0011	-0.0141	-0.0047	0.0035	0.0024	-0.0031	-0.0187	-0.0051	0.0039
-6	0.0026	0.0012	-0.0194	-0.0064	-0.0015	0.0007	-0.0039	-0.0210	-0.0062	0.0006
-5	0.0001	0.0027	-0.0219	-0.0051	-0.0033	-0.0006	-0.0024	-0.0244	-0.0041	-0.0020
-4	-0.0058	0.0061	-0.0237	-0.0103	-0.0087	-0.0068	0.0006	-0.0279	-0.0090	-0.0078
-3	-0.0029	0.0042	-0.0320	-0.0120	-0.0080	-0.0033	0.0013	-0.0367	-0.0108	-0.0030
-2	-0.0038	0.0017	-0.0411	-0.0124	-0.0116	-0.0023	-0.0008	-0.0430	-0.0079	-0.0036
-1	-0.0042	-0.0043	-0.0431	-0.0135	-0.0144	-0.0008	-0.0071	-0.0479	-0.0094	-0.0070
0	-0.0049	-0.0014	-0.0465	-0.0223	-0.0193	-0.0060	-0.0040	-0.0552	-0.0190	-0.0088
+1	0.0011	-0.0022	-0.0573	-0.0349	-0.0198	-0.0011	-0.0022	-0.0532	-0.0299	-0.0089
+2	-0.0059	-0.0027	-0.0479	-0.0429	-0.0231	-0.0030	-0.0036	-0.0505	-0.0401	-0.0125
+3	-0.0084	-0.0034	-0.0259	-0.0422	-0.0250	-0.0072	-0.0041	-0.0323	-0.0405	-0.0165
+4	-0.0077	0.0027	-0.0253	-0.0547	-0.0247	-0.0079	-0.0027	-0.0362	-0.0510	-0.0106
+5	-0.0115	-0.0043	-0.0260	-0.0556	-0.0269	-0.0095	-0.0056	-0.0325	-0.0498	-0.0141
+6	-0.0113	-0.0068	-0.0297	-0.0597	-0.0391	-0.0093	-0.0045	-0.0390	-0.0575	-0.0212
+7	-0.0049	-0.0061	-0.0453	-0.0600	-0.0456	-0.0074	-0.0041	-0.0537	-0.0502	-0.0290
+8	-0.0038	-0.0098	-0.0379	-0.0579	-0.0499	-0.0067	-0.0094	-0.0455	-0.0491	-0.0336
+9	-0.0046	-0.0096	-0.0394	-0.0629	-0.0523	-0.0078	-0.0085	-0.0556	-0.0572	-0.0361
+10	-0.0027	-0.0032	-0.0431	-0.0702	-0.0550	-0.0029	-0.0041	-0.0518	-0.0623	-0.0385
+11	0.0054	-0.0022	-0.0543	-0.0733	-0.0545	0.0038	-0.0046	-0.0547	-0.0651	-0.0410
+12	0.0040	-0.0030	-0.0578	-0.0783	-0.0549	0.0022	-0.0067	-0.0612	-0.0693	-0.0393
+13	-0.0015	-0.0011	-0.0595	-0.0893	-0.0571	-0.0010	-0.0015	-0.0628	-0.0808	-0.0409
+14	0.0062	0.0070	-0.0628	-0.0964	-0.0632	0.0073	0.0039	-0.0651	-0.0866	-0.0421
+15	0.0103	0.0056	-0.0740	-0.1002	-0.0790	0.0059	-0.0003	-0.0791	-0.0889	-0.0590
+16	0.0163	0.0000	-0.0939	-0.1000	-0.0812	0.0125	-0.0051	-0.0936	-0.0884	-0.0585
+17	0.0205	0.0078	-0.1197	-0.1089	-0.0850	0.0191	0.0026	-0.1165	-0.0936	-0.0626
+18	0.0213	0.0119	-0.1203	-0.1076	-0.0911	0.0211	0.0037	-0.1135	-0.0945	-0.0680
+19	0.0268	0.0179	-0.1372	-0.1038	-0.1037	0.0253	0.0118	-0.1295	-0.0884	-0.0700
+20	0.0355	0.0221	-0.1450	-0.1139	-0.1111	0.0323	0.0146	-0.1333	-0.1024	-0.0822

Table C3. Event 1 Mean and Median Equality Tests for Cumulative Abnormal Returns ($CAR_{n,d}$): Market Model Following Event 1

Panel A: Mean Equality Test

Event window	Before	After	After—Before	t-test
[-1, 1]	-0.0042	0.0011	0.0053	0.7876
[-3, 3]	-0.0029	-0.0084	-0.0055	-0.7952
[-5, 5]	0.0001	-0.0115	-0.0116	-1.7239*
[-10, 10]	-0.0005	-0.0027	-0.0022	-0.3395
[-10, 15]	-0.0005	0.0103	0.0108	1.4094
[-10, 20]	-0.0005	0.0355	0.0360	4.0738***

Panel B: Median Equality Test

Event window	Before	After	After—Before	W/M
[-1, 1]	-0.0008	-0.0011	-0.0003	-0.7241
[-3, 3]	-0.0033	-0.0072	-0.0039	-0.8334
[-5, 5]	-0.0006	-0.0095	-0.0089	-2.3311**
[-10, 10]	-0.0006	-0.0029	-0.0023	-0.7386
[-10, 15]	-0.0006	0.0059	0.0065	2.2739**
[-10, 20]	-0.0006	0.0323	0.0328	5.6571***

Note. The t-test denotes the equality test of two groups using the Satterthwaite-Welch t-test. W/M represents the Wilcoxon-Mann-Whitney signed-rank median test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C4. Event 2 Mean and Median Equality Tests for Cumulative Abnormal Returns ($CAR_{n,d}$): Market Model Following Event 2

Panel A: Mean Equality Test

Event window	Before	After	After—Before	t-test
[-1, 1]	-0.0043	-0.0022	0.0020	0.3067
[-3, 3]	0.0042	-0.0034	-0.0076	-1.1401
[-5, 5]	0.0027	-0.0043	-0.0070	-1.0214
[-10, 10]	-0.0027	-0.0041	-0.0014	-0.0737
[-10, 15]	-0.0027	-0.0003	0.0024	1.1045
[-10, 20]	-0.0027	0.0146	0.0173	2.8816***

Panel B: Median Equality Test

Event window	Before	After	After—Before	W/M
[-1, 1]	-0.0071	-0.0022	0.0049	0.7193
[-3, 3]	0.0013	-0.0041	-0.0054	-1.6225
[-5, 5]	-0.0024	-0.0056	-0.0032	-1.0064
[-10, 10]	-0.0046	-0.0041	0.0004	0.3981
[-10, 15]	-0.0046	-0.0003	0.0042	1.0386
[-10, 20]	-0.0046	0.0146	0.0192	4.1054***

Note. The t-test denotes the equality test of two groups using the Satterthwaite-Welch t-test. W/M represents the Wilcoxon-Mann-Whitney signed-rank median test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C5. Event 3 Mean and Median Equality Tests for Cumulative Abnormal Returns ($CAR_{n,d}$): Market Model Following Event 3

Panel A: Mean Equality Test

Event window	Before	After	After—Before	t-test
[-1, 1]	-0.0431	-0.0573	-0.0143	-1.6075
[-3, 3]	-0.0320	-0.0259	0.0061	0.7227
[-5, 5]	-0.0219	-0.0260	-0.0041	-0.4887
[-10, 10]	-0.0027	-0.0431	-0.0404	-4.7172***
[-10, 15]	-0.0027	-0.0740	-0.0713	-7.0475***
[-10, 20]	-0.0027	-0.1450	-0.1423	-12.6842***

Panel B: Median Equality Test

Event window	Before	After	After—Before	W/M
[-1, 1]	-0.0479	-0.0532	-0.0053	-1.4984
[-3, 3]	-0.0367	-0.0323	0.0044	0.2773
[-5, 5]	-0.0244	-0.0325	-0.0081	-1.5283
[-10, 10]	-0.0057	-0.0518	-0.0461	-7.9624***
[-10, 15]	-0.0057	-0.0791	-0.0734	-9.1832***
[-10, 20]	-0.0057	-0.1333	-0.1276	-13.1123***

Note. The t-test denotes the equality test of two groups using the Satterthwaite–Welch t-test. W/M represents the Wilcoxon–Mann–Whitney signed-rank median test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C6. Event 4 Mean and Median Equality Tests for Cumulative Abnormal Returns ($CAR_{n,d}$): Market Model Following Event 4

Panel A: Mean Equality Test

Event window	Before	After	After—Before	t-test
[-1, 1]	-0.0135	-0.0349	-0.0214	-3.4440***
[-3, 3]	-0.0120	-0.0422	-0.0303	-4.8382***
[-5, 5]	-0.0051	-0.0556	-0.0506	-7.3594***
[-10, 10]	-0.0073	-0.0702	-0.0629	-8.8003***
[-10, 15]	-0.0073	-0.1002	-0.0930	-10.8482***
[-10, 20]	-0.0073	-0.1139	-0.1066	-10.1031***

Panel B: Median Equality Test

Event window	Before	After	After—Before	W/M
[-1, 1]	-0.0094	-0.0299	-0.0205	-3.7507***
[-3, 3]	-0.0108	-0.0405	-0.0297	-5.4909***
[-5, 5]	-0.0041	-0.0498	-0.0457	-7.8904***
[-10, 10]	-0.0082	-0.0623	-0.0541	-9.1602***
[-10, 15]	-0.0082	-0.0889	-0.0807	-12.0179***
[-10, 20]	-0.0082	-0.1024	-0.0942	-10.8607***

Note. The t-test denotes the equality test of two groups using the Satterthwaite–Welch t-test. W/M represents the Wilcoxon–Mann–Whitney signed-rank median test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C7. Event 5 Mean and Median Equality Tests for Cumulative Abnormal Returns ($CAR_{n,d}$): Market Model Following Event 5

Panel A: Mean Equality Test

Event window	Before	After	After—Before	t-test
[-1, 1]	-0.0144	-0.0198	-0.0054	-0.6862
[-3, 3]	-0.0080	-0.0250	-0.0170	-2.1428**
[-5, 5]	-0.0033	-0.0269	-0.0236	-2.9587***
[-10, 10]	-0.0042	-0.0550	-0.0508	-6.0186***
[-10, 15]	-0.0042	-0.0790	-0.0748	-7.4565***
[-10, 20]	-0.0042	-0.1111	-0.1069	-9.0963***

Panel B: Median Equality Test

Event window	Before	After	After—Before	W/M
[-1, 1]	-0.0070	-0.0089	-0.0019	-0.7323
[-3, 3]	-0.0030	-0.0165	-0.0134	-2.6020***
[-5, 5]	-0.0020	-0.0141	-0.0121	-2.9934***
[-10, 10]	-0.0031	-0.0385	-0.0354	-7.4732***
[-10, 15]	-0.0031	-0.0590	-0.0559	-9.7386***
[-10, 20]	-0.0031	-0.0822	-0.0791	-12.6179***

Note. The t-test denotes the equality test of two groups using the Satterthwaite-Welch t-test. W/M represents the Wilcoxon-Mann-Whitney signed-rank median test. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.



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