Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Global financial crisis and COVID-19: Industrial reactions

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ABSTRACT

We study industrial reactions to both the global financial crisis of 2008 and the COVID-19 pandemic. Although most industries in the U.S. suffered from the two events, the stock performance of most industries started to recover following the announcements of quantitative easing. Our results indicate that quantitative easing is effective in boosting investor confidence. We also find that the effect of quantitative easing in 2020 on stock performance is more significant for the industries that are more affected by the pandemic.

1. Introduction

On March 11, 2020, the World Health Organization (WHO) characterized the spread of a novel coronavirus (COVID-19) as a global pandemic as many countries reported surging numbers of confirmed cases. The quick spread of COVID-19 saw enormous impacts on economies and financial markets around the world. For instance, mandatory closures of non-essential businesses, lockdowns (limiting the movement of people), and travel bans (restricting travel and closing borders) are implemented to control the spread of COVID-19 and simultaneously restrict economic activities (Baig et al., 2020; Narayan et al., 2020). Also, in March 2020, the S&P 500 index dropped by more than 7% in each of three single trading days.[2] In response to adverse effects triggered by COVID-19 on the economy and financial markets, the Federal Reserve (Fed) announced a quantitative easing plan to purchase $500 billion in Treasury securities and $200 billion in mortgage-backed securities on March 15, 2020 (Timiraos, 2020). Furthermore, the Coronavirus Aid, Relief, and Economic Security (CARES) Act, an economic relief package of over $2 trillion, was passed by Congress with overwhelming support and immediately signed into law by President Trump on March 27, 2020.[3]

Given the worldwide impact of the current pandemic on stock market performance, recent studies have begun to investigate the effects of COVID-19 and present the results using event studies. For example, Goodell and Huynh (2020) examine whether legislator trades were ahead of the market. Using the criteria set by a key announcement date (February 26, 2020) and 15 industries identified as

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[2] Those single-day index returns were -7.6% (3/09/2020), -9.5% (3/12/2020), and -12.0% (3/16/2020), respectively.

[3] https://www.congress.gov/bill/116th-congress/house-bill/748/all-actions?overview=closed#tabs.

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having abnormal returns, they find that many of legislator trades can be categorized as "trading ahead of the market."[4] Heyden and Heyden (2020) document that stocks react significantly negatively to the announcement of the first death in the U.S. and in European countries. Using the universe of S&P1500 firms, Mazur et al. (2020) investigate the effect of COVID-19 on stock performance during the market crash of March 2020 (i.e., March 9, 2000; March 12, 2000; March 16, 2000). Narayan et al. (2020) study the effect of government responses of G7 countries to the pandemic on stock market returns. They show that lockdowns, travel bans, and economic stimulus packages had a positive effect on the G7 stock markets, with lockdowns as the most effective response in cushioning the effects of COVID-19.

Our paper complements the event study literature on the impacts of COVID-19 on stock market performance by providing insights into both the pandemic impacts and the policy effects of monetary authority on industrial portfolio performance. We also compare the two recent worldwide events, namely, the financial crisis of 2008 and the COVID-19 pandemic of 2020. We find that some industries began to decline before the bankruptcy of Lehman Brothers. After September 15, 2008, the decline in industries including coal, precious metals, non-metallic and industrial metal mining, petroleum and natural gas, and fabricated products was persisting. Some industries that performed well before September 15, 2008 were also affected by the bankruptcy event and started to experience negative abnormal returns. Around October 3, 2008, a bailout plan was proposed and passed by the U.S. Congress, but the stock market did not recover immediately. After the first announcement of quantitative easing (QE) on November 25, 2008, most industries started to recover from negative abnormal returns.

The outburst of COVID-19 also exhibits severe effects on the stock market. Many companies are forced to halt production for controlling the spread of COVID-19. Before the WHO announced the spread of COVID-19 as a pandemic on March 11, 2020, most industries had already experienced negative abnormal returns. The Fed announced a QE plan on March 15, 2020 and the Congress passed the CARES Act quickly on March 27, 2020. As a result, the severe negative returns did not last for a long time. The regression results show that the daily excess returns of industrial portfolios are significantly reduced following both the financial crisis of 2008 and the announcement of WHO, but significantly increase after the QE announcements, suggesting that the QEs are effective in restoring investor confidence when major adverse events occurred. Moreover, the effect of QE is more significant for worst performing industries that are severely affected by the pandemic than for the other industries.

The remainder of this paper is organized as follows. Section 2 describes the data. Section 3 presents the empirical results, and Section 4 concludes.

2. Data

We obtain the daily market return data from the Center for Research in Security Prices (CRSP) database. To be included in the sample, we require the stocks to be listed on the NYSE, AMEX, or NASDAQ. Following the classification of Fama and French (1997), we form 49 industry portfolios based on the four-digit SIC code at the end of June of each year. The daily abnormal return is computed as the difference between the industry portfolio's daily return and the CRSP value-weighted market index return (as the proxy for the market return) on the same date. We estimate the market model over the estimation window $(-150, -31)$. The cumulative abnormal return (CAR) is then calculated by cumulating the abnormal returns over the window (t1, t2), where day 0 is the event date, or the first trading day following the event date if it is a nontrading day. We use the St. Louis Fed Financial Stress Index (STLFSI2) to measure the degree of financial stress in the markets. It is a weekly index constructed by the Federal Reserve Bank of St. Louis with higher index values representing above-average financial market stress.

3. Empirical results

3.1. The effect of COVID-19 on stock performance

On March 11, 2020, the WHO characterized the spread of COVID-19 as a pandemic as many countries reported surging numbers of cases. Fig. 1 presents the CARs around the announcement of the WHO. The market portfolio return (Benchmark) declines following the event date (March 11, 2020) and reaches a bottom around day +8 (March 23, 2020). After the Coronavirus Aid, Relief, and Economic Security Act passed by the U.S. Congress (day +12; March 27, 2020), the stock market begins to recover. Similarly, we sort the industry portfolios based on CAR(−30, 0) before the event. The five worst-performing industries, including precious metals, petroleum and natural gas, entertainment, aircraft, and restaurants, hotels, motels, have negative CARs before the event date, and their performances are worse than that of the market portfolio after the event date. However, the CAR of the petroleum and natural gas portfolio becomes positive after day +34 (April 29, 2020). We also find that the five best-performing industries, including coal, candy and soda, agriculture, pharmaceutical products, and computer software, have positive CARs before the event date, and they do not seem to be

[4] On February 26, 2020, the Centers for Disease Control and Prevention (CDC) confirmed a possible first community transmission of COVID-19 in the United States. See "CDC Confirms Possible Instance of Community Spread of COVID-19 in U.S." https://www.cdc.gov/media/releases/2020/s0226-Covid-19-spread.html

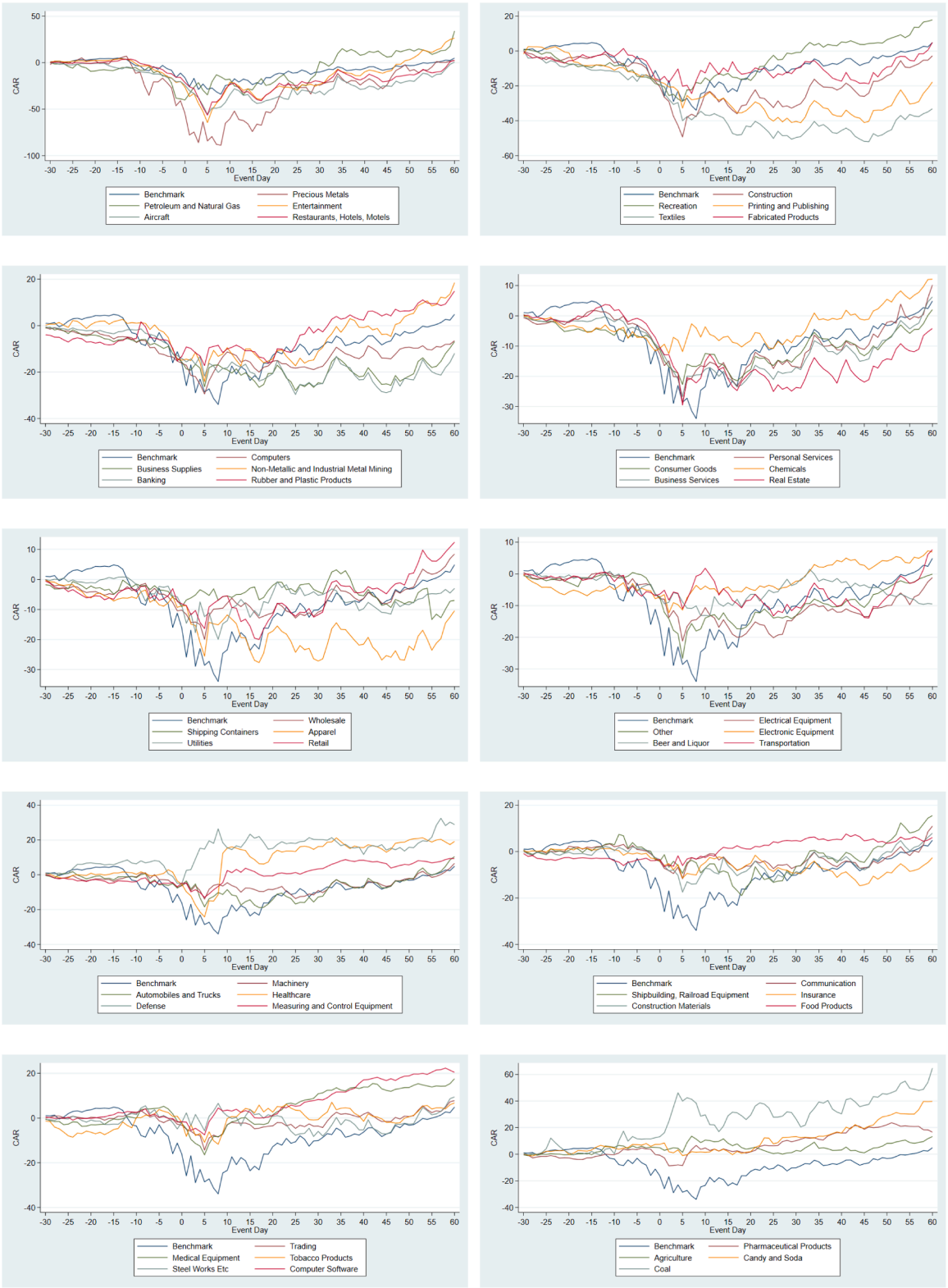

Fig. 1. Cumulative abnormal returns around the event that WHO characterized the spread of COVID-19 as a pandemic
This figure displays the cumulative abnormal returns (CARs) from 30 days before to 60 days after the event that the World Health Organization characterized the spread of COVID-19 as a pandemic (March 11, 2020). The daily abnormal return is the difference between the daily return of an industry portfolio and the CRSP value-weighted market index return (Benchmark) on the same day.

Table 1
Cumulative abnormal returns around the WHO's assessment that characterizes COVID-19 as a pandemic
This table presents the cumulative abnormal returns (CARs) for 49 industry portfolios following the classification of Fama and French (1997). The CRSP value-weighted market index return is used as the benchmark when calculating the abnormal returns. The event date is March 11, 2020, when the World Health Organization (WHO) characterized the spread of COVID-19 as a pandemic. The ranking is based on CAR(−30, 0), which is the cumulative abnormal return before the event date.

Industry	Industry Name	Rank	CAR(−30,0)	CAR(−30,+10)	CAR(−30,+30)	CAR(−30,+60)
27	Precious Metals	1	−54.56	−60.48	−24.40	2.47
30	Petroleum and Natural Gas	2	−40.15	−17.85	1.14	34.08
7	Entertainment	3	−26.26	−20.90	−23.13	26.42
24	Aircraft	4	−24.17	−34.48	−30.73	0.64
44	Restaurants, Hotels, Motels	5	−21.35	−23.45	−20.36	2.56
18	Construction	6	−20.46	−24.38	−31.41	−2.71
6	Recreation	7	−19.44	−15.34	−0.82	17.89
8	Printing and Publishing	8	−17.72	−25.51	−40.34	−17.69
16	Textiles	9	−17.38	−36.71	−49.63	−33.09
20	Fabricated Products	10	−16.76	−12.57	−9.98	5.00
35	Computers	11	−16.13	−11.34	−18.08	−6.49
39	Business Supplies	12	−15.62	−19.03	−24.60	−6.89
28	Non-Metallic and Industrial Metal Mining	13	−14.87	−9.47	−11.05	18.50
45	Banking	14	−14.11	−18.24	−25.17	−11.96
15	Rubber and Plastic Products	15	−13.20	−10.03	−1.39	14.91
33	Personal Services	16	−12.63	−16.83	−16.87	10.20
9	Consumer Goods	17	−11.24	−12.45	−13.60	2.06
14	Chemicals	18	−10.70	−3.62	−6.68	12.09
34	Business Services	19	−10.64	−17.66	−16.99	6.27
47	Real Estate	20	−10.36	−15.08	−23.69	−4.16
42	Wholesale	21	−10.22	−7.87	−10.87	8.46
40	Shipping Containers	22	−9.07	−5.47	−4.05	−6.96
10	Apparel	23	−8.79	−11.82	−27.15	−10.41
31	Utilities	24	−8.75	−13.73	−5.29	−2.97
43	Retail	25	−8.12	−5.44	−11.73	12.40
22	Electrical Equipment	26	−7.83	−10.65	−13.16	−1.16
49	Other	27	−7.51	−13.93	−13.15	−0.11
37	Electronic Equipment	28	−7.29	−3.84	−2.28	6.92
4	Beer and Liquor	29	−7.19	−13.13	−3.13	−9.51
41	Transportation	30	−6.39	1.78	−10.33	7.65
21	Machinery	31	−6.27	−4.57	−9.03	6.58
23	Automobiles and Trucks	32	−5.79	−8.53	−12.75	10.42
11	Healthcare	33	−5.44	15.34	16.22	19.17
26	Defense	34	−5.05	15.52	20.19	28.84
38	Measuring and Control Equipment	35	−4.74	2.47	3.38	9.33
32	Communication	36	−4.19	−1.94	−6.37	10.96
25	Shipbuilding, Railroad Equipment	37	−4.17	−7.15	−6.39	15.50
46	Insurance	38	−3.92	−4.71	−9.23	−2.65
17	Construction Materials	39	−3.44	−7.23	−8.65	7.91
2	Food Products	40	−3.38	−2.58	4.70	6.05
48	Trading	41	−3.20	−2.94	−3.63	7.80
12	Medical Equipment	42	−2.43	−3.03	10.84	17.56
5	Tobacco Products	43	−2.01	−0.19	−0.71	6.76
19	Steel Works Etc	44	−1.92	0.92	−5.98	9.44
36	Computer Software	45	−1.68	3.55	8.25	20.40
13	Pharmaceutical Products	46	−0.76	4.69	10.18	16.56
1	Agriculture	47	4.90	10.64	2.80	13.31
3	Candy and Soda	48	7.47	1.40	13.27	39.73
29	Coal	49	13.20	29.68	26.44	64.78

affected by this event.

Table 1 shows the CARs for the 49 industry portfolios. Most of the industry portfolios experience negative CARs at day +10 and day +30 following the announcement of the WHO, but have positive CARs at day +60, indicating that the CARES Act of 2020 is effective in restoring investors' confidence in the stock markets.[5]

Before the passage of the CARES Act of 2020, the Fed announced a quantitative easing plan to purchase $500 billion in Treasury securities and $200 billion in mortgage-backed securities on March 15, 2020 (Timiraos, 2020). Fig. 2 presents the CARs around the QE

[5] In addition to the WHO's announcement, we also use the date (February 26, 2020) when the Centers for Disease Control and Prevention (CDC) confirmed the possibility of community spread of the virus in the United States as an event date. We find weak industrial reactions before the CDC's announcement, but most of the industries started to exhibit negative CARs immediately following the announcement. The results are available upon request.

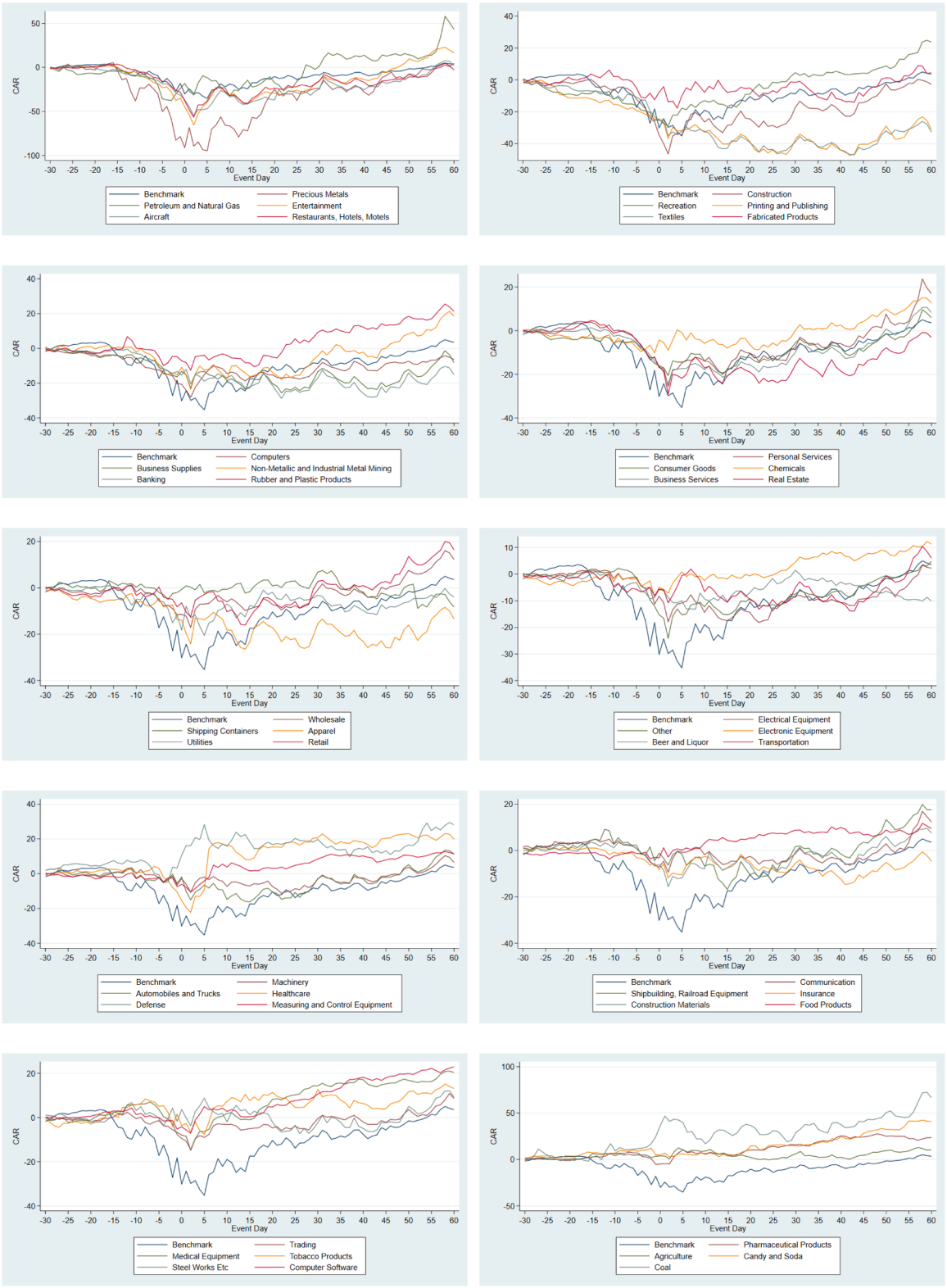

Fig. 2. Cumulative abnormal returns around the Quantitative Easing in 2020
This figure displays the cumulative abnormal returns (CARs) from 30 days before to 60 days after the first announcement of Quantitative Easing in 2020 (March 15, 2020). The daily abnormal return is the difference between the daily return of an industry portfolio and the CRSP value-weighted market index return (Benchmark) on the same day.

Table 2
Cumulative abnormal returns around the Quantitative Easing in 2020
This table presents the cumulative abnormal returns (CARs) for 49 industry portfolios following the classification of Fama and French (1997). The CRSP value-weighted market index return is used as the benchmark when calculating the abnormal returns. The event date is March 15, 2020, when the Fed announced the quantitative easing policy. The ranking of the industries follows Table 1.

Industry	Industry Name	Rank	CAR(−30,0)	CAR(−30,+10)	CAR(−30,+30)	CAR(−30,+60)
27	Precious Metals	1	−91.36	−66.46	−23.67	4.72
30	Petroleum and Natural Gas	2	−18.24	−32.22	1.47	43.28
7	Entertainment	3	−44.90	−31.91	−15.07	16.53
24	Aircraft	4	−36.94	−33.34	−24.77	2.04
44	Restaurants, Hotels, Motels	5	−38.06	−32.19	−15.39	−3.07
18	Construction	6	−34.59	−26.45	−17.26	−2.82
6	Recreation	7	−24.58	−12.94	4.58	23.66
8	Printing and Publishing	8	−24.54	−32.78	−37.38	−31.13
16	Textiles	9	−25.68	−32.34	−39.01	−32.83
20	Fabricated Products	10	−7.76	−7.81	−1.49	4.53
35	Computers	11	−20.68	−14.44	−10.87	−6.41
39	Business Supplies	12	−13.20	−18.60	−13.32	−8.15
28	Non-Metallic and Industrial Metal Mining	13	−10.93	−17.51	−4.26	18.53
45	Banking	14	−15.41	−16.84	−16.99	−15.22
15	Rubber and Plastic Products	15	−7.12	−3.98	9.26	21.25
33	Personal Services	16	−17.04	−13.91	−7.70	16.93
9	Consumer Goods	17	−16.06	−13.83	−5.56	5.89
14	Chemicals	18	−4.20	−5.82	0.05	12.70
34	Business Services	19	−16.32	−17.91	−10.01	8.20
47	Real Estate	20	−16.43	−17.10	−15.76	−3.11
42	Wholesale	21	−11.45	−6.00	−0.78	12.20
40	Shipping Containers	22	−0.67	−0.60	6.83	−8.31
10	Apparel	23	−13.98	−18.19	−15.38	−13.47
31	Utilities	24	−18.20	−6.93	−3.18	−3.92
43	Retail	25	−6.47	−10.32	2.75	16.33
22	Electrical Equipment	26	−8.30	−14.37	−8.21	2.24
49	Other	27	−15.27	−12.31	−7.55	4.87
37	Electronic Equipment	28	−4.88	−2.43	4.44	11.29
4	Beer and Liquor	29	−5.76	−9.29	1.47	−10.14
41	Transportation	30	−5.57	−6.56	−5.07	5.99
21	Machinery	31	−2.89	−7.30	−2.86	6.39
23	Automobiles and Trucks	32	−1.93	−14.80	−2.93	11.28
11	Healthcare	33	−15.41	16.25	20.65	19.81
26	Defense	34	10.61	15.81	19.66	28.07
38	Measuring and Control Equipment	35	−6.13	3.83	8.50	11.41
32	Communication	36	−7.15	−1.82	−1.39	12.27
25	Shipbuilding, Railroad Equipment	37	−1.14	−6.77	1.73	17.58
46	Insurance	38	−8.22	−2.58	−5.56	−4.70
17	Construction Materials	39	−6.04	−7.99	−0.60	7.47
2	Food Products	40	−3.17	3.15	8.73	9.41
48	Trading	41	−7.93	−3.22	−0.50	8.59
12	Medical Equipment	42	−9.50	1.87	14.37	20.30
5	Tobacco Products	43	−3.69	7.33	12.65	13.10
19	Steel Works Etc	44	3.63	−1.98	−2.29	9.18
36	Computer Software	45	−4.17	2.77	10.67	22.98
13	Pharmaceutical Products	46	−4.91	6.04	15.86	23.48
1	Agriculture	47	4.00	9.13	6.23	10.55
3	Candy and Soda	48	5.00	5.48	14.86	40.77
29	Coal	49	36.67	16.93	29.13	66.60

announcement in 2020. The results are similar to those in Fig. 1.

Table 2 presents the CARs for the 49 industry portfolios following the announcement of QE in 2020. Most of the industry portfolios have positive CARs at day +60 after the policy announcement, suggesting that QE is effective in boosting the confidence of investors though the effect is confounding with that of the CARES Act of 2020.[6]

3.2. Regression results

Using the method of Noth and Rehbein (2019), we conduct regression analyses to examine the effects of the two events on the

[6] We also conduct analyses using March 27, 2020 as the event date when the U.S. congress passed the CARES Act. The results are similar to those when we use the announcement of QE as the event date. These results are available upon request.

Table 3
Regressions of portfolio returns around the events
This table presents the results of the effects of the two events on the daily and weekly returns of industry portfolios. The sample period is from −255 to +60 days around the quantitative easing (QE) events. For columns (1) and (2), the sample period is from November 21, 2007 to February 24, 2009. For columns (3) to (6), the sample period is from March 12, 2019 to June 10, 2020. *ExcessReturn* is the difference between the industry portfolio return and the CRSP value-weighted market index return. We use daily returns in columns (1), (3), and (5), and weekly returns in columns (2), (4), and (6). *Financial Stress Index* is an index constructed by the Federal Reserve Bank of St. Louis, which measures the degree of financial stress in the markets. *Affected2008* is a dummy variable, which equals to one if the industry is one of the 10 worst-performing industries based on the CAR(−30, 0) before the bankruptcy of Lehman Brothers (refer to Table B1 in Appendix B), and zero otherwise. *Affected2020* is a dummy variable, which equals to one if the industry is one of the 10 worst-performing industries based on the CAR(−30, 0) before the announcement of the WHO (refer to Table 1), and zero otherwise. *Post2008* is a dummy variable, which equals to one after the bankruptcy of Lehman Brothers (September 15, 2008), and zero otherwise. *Post2008QE* is a dummy variable, which equals to one after the announcement of QE in 2008 (November 25, 2008), and zero otherwise. *Post2020* is a dummy variable, which equals to one after the announcement of the WHO (March 11, 2020), and zero otherwise. *Post2020QE* is a dummy variable, which equals to one after the announcement of QE in 2020 (March 15, 2020), and zero otherwise. *PostCARES* is a dummy variable, which equals to one after the U.S. Congress passes the CARES Act (March 27, 2020), and zero otherwise. *T*-statistics based on heteroscedasticity robust standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable	(1) *ExcessReturn*	(2) *ExcessReturn*	(3) *ExcessReturn*	(4) *ExcessReturn*	(5) *ExcessReturn*	(6) *ExcessReturn*
Financial Stress Index	0.051***	0.110	−0.118***	−0.507***	−0.169***	−0.636***
	(2.893)	(1.136)	(−4.415)	(−3.810)	(−6.579)	(−4.403)
Post2008	−0.505***	−1.875***				
	(−5.651)	(−3.646)				
Post2008 × *Affected2008*	−0.254	−1.642**				
	(−1.381)	(−2.084)				
Post2008QE	0.531***	2.355***				
	(8.323)	(7.081)				
Post2008QE × *Affected2008*	0.346	2.478**				
	(1.586)	(2.440)				
Post2020			−0.699***	−4.434***	−0.595***	−3.997***
			(−3.285)	(−5.068)	(−2.830)	(−4.458)
Post2020 × *Affected2020*			−1.475*	−7.010***	−1.477*	−6.946***
			(−1.850)	(−3.566)	(−1.854)	(−3.532)
Post2020QE			1.286***	7.122***	1.656***	8.769***
			(6.085)	(8.852)	(7.065)	(10.205)
Post2020QE × *Affected2020*			1.750**	8.533***	1.795**	5.622**
			(2.152)	(4.032)	(2.040)	(2.157)
PostCARES					−0.436***	−2.051***
					(−4.458)	(−4.035)
PostCARES × *Affected2020*					−0.053	3.203**
					(−0.161)	(2.009)
Number of observations	15,484	3,087	15,484	3,038	15,484	3,038
Adjusted R^2	0.008	0.048	0.020	0.150	0.023	0.157
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

industry portfolio returns around the event dates. Each sample period is from −255 to +60 days around the announcement date of the respective QE policy following each event. Therefore, for the event of financial crisis, the sample period is from November 21, 2007 to February 24, 2009; for the event of COVID-19, the sample period is from March 12, 2019 to June 10, 2020. Our regression model is specified as follows.

$$Excess\text{Return}_{it} = \beta_i + \beta_1 Financial\,Stress\,Index_t + \beta_2 PostYYYY_t + \beta_3 PostYYYY_t \times AffectedYYYY_i + \varepsilon_{it}, \quad (1)$$

where *ExcessReturn* is the daily difference between the industry portfolio return and the CRSP value−weighted market index return, and *YYYY* stands for either 2008 or 2020. *Financial Stress Index* is a weekly index constructed by the Federal Reserve Bank of St. Louis, which measures the degree of financial stress in the markets. Since the index is updated every Friday, we use the most recent available index value in the regression analyses. *Affected2008* is a dummy variable, which equals to one if the industry is one of the ten worst-performing industries based on the CAR(−30, 0) before the bankruptcy of Lehman Brothers (refer to Table B1), and zero otherwise. *Affected2020* is a dummy variable, which equals to one if the industry is one of the ten worst-performing industries based on the CAR (−30, 0) before the announcement of the WHO (refer to Table 1), and zero otherwise. *Post2008* is a dummy variable, which equals to one after the bankruptcy of Lehman Brothers (September 15, 2008), and zero otherwise. We also add *Post2008QE* in the regression model, which is a dummy variable equal to one following the announcement of QE in 2008 (November 25, 2008), and zero otherwise. Similarly, *Post2020* is a dummy variable, which equals to one after the announcement of the WHO (March 11, 2020), and zero otherwise.[7] We include *Post2020QE* in the regression model as well, which is a dummy variable equal to one after the announcement of

[7] We also do robustness check using the announcement date of the CDC (February 26, 2020). The results are qualitatively similar and are available upon request.

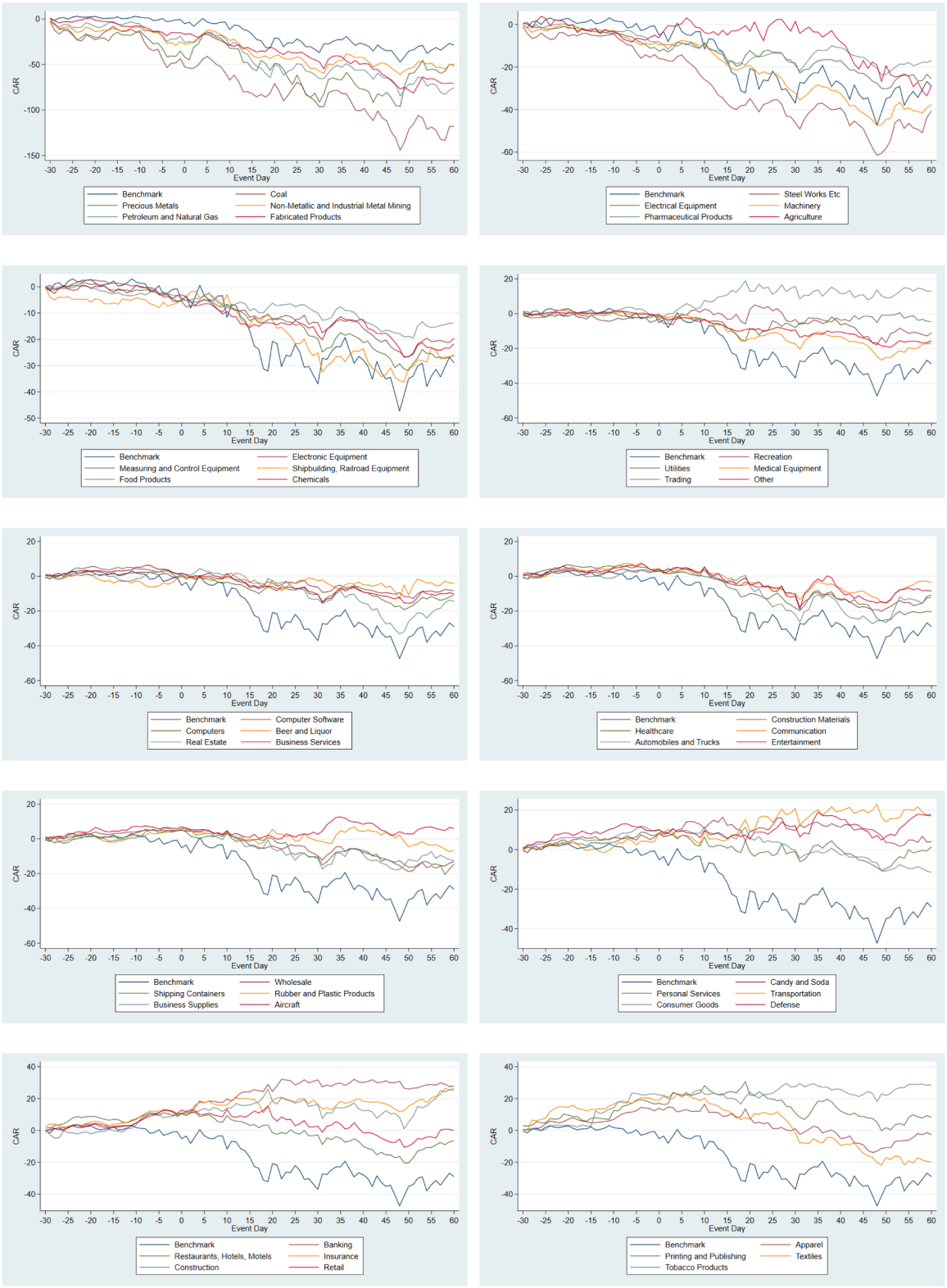

Fig. A1. Cumulative abnormal returns around the bankruptcy of Lehman Brothers
This figure displays the cumulative abnormal returns (CARs) from 30 days before to 60 days after the bankruptcy of Lehman Brothers (September 15, 2008). The daily abnormal return is the difference between the daily return of an industry portfolio and the CRSP value-weighted market index return (Benchmark) on the same day.

Table B1
Cumulative abnormal returns around the bankruptcy of Lehman Brothers
This table presents the cumulative abnormal returns (CARs) for 49 industry portfolios following the classification of Fama and French (1997). The CRSP value-weighted market index return is used as the benchmark when calculating the abnormal returns. The event date is September 15, 2008, when Lehman Brothers announced the bankruptcy. The ranking is based on CAR(−30, 0), which is the cumulative abnormal return before the event date.

Industry	Industry Name	Rank	CAR(−30,0)	CAR(−30,+10)	CAR(−30,+30)	CAR(−30,+60)
29	Coal	1	−52.67	−67.30	−96.58	−118.02
27	Precious Metals	2	−41.85	−32.20	−91.43	−51.30
28	Non-Metallic and Industrial Metal Mining	3	−27.88	−23.68	−57.44	−49.95
30	Petroleum and Natural Gas	4	−25.65	−28.68	−65.65	−75.68
20	Fabricated Products	5	−16.75	−29.00	−47.09	−71.06
19	Steel Works Etc	6	−16.11	−25.88	−46.05	−40.60
22	Electrical Equipment	7	−12.67	−9.02	−18.07	−25.67
21	Machinery	8	−9.54	−9.69	−32.19	−37.54
13	Pharmaceutical Products	9	−8.25	−8.40	−19.39	−16.95
1	Agriculture	10	−6.26	−3.81	1.45	−28.79
37	Electronic Equipment	11	−5.52	−7.54	−13.67	−19.61
38	Measuring and Control Equipment	12	−5.10	−6.56	−19.75	−25.85
25	Shipbuilding, Railroad Equipment	13	−4.65	−2.95	−25.14	−26.10
2	Food Products	14	−4.20	−7.08	−9.93	−13.75
14	Chemicals	15	−3.04	−9.42	−18.38	−21.66
6	Recreation	16	−3.04	2.59	−3.40	−10.96
31	Utilities	17	−2.34	−3.68	−8.02	−4.64
12	Medical Equipment	18	−1.74	−3.79	−17.39	−17.04
48	Trading	19	−0.97	7.71	15.67	13.02
49	Other	20	−0.44	−3.16	−9.37	−15.55
36	Computer Software	21	−0.20	0.00	−6.20	−8.28
35	Computers	22	0.82	−3.30	−10.40	−10.56
4	Beer and Liquor	23	0.92	−0.83	−2.57	−4.14
47	Real Estate	24	1.65	1.45	−13.03	−14.44
34	Business Services	25	1.82	1.28	−10.39	−10.06
17	Construction Materials	26	2.80	3.66	−10.61	−10.75
11	Healthcare	27	3.31	−0.17	−18.28	−20.43
32	Communication	28	3.98	5.39	−9.79	−3.61
23	Automobiles and Trucks	29	4.09	5.39	−22.11	−12.15
7	Entertainment	30	4.26	5.36	−11.45	−8.53
42	Wholesale	31	4.92	2.89	−9.77	−13.14
40	Shipping Containers	32	5.16	3.90	−10.41	−14.43
15	Rubber and Plastic Products	33	5.94	4.89	−1.23	−6.39
39	Business Supplies	34	5.95	3.16	−11.37	−12.61
24	Aircraft	35	7.05	4.57	2.61	5.96
3	Candy and Soda	36	7.99	10.61	9.62	4.09
33	Personal Services	37	8.43	6.36	−1.04	1.44
41	Transportation	38	8.52	9.50	20.74	16.91
9	Consumer Goods	39	9.87	11.27	−0.41	−11.48
26	Defense	40	10.06	9.73	11.94	17.56
45	Banking	41	10.32	19.81	31.75	27.92
44	Restaurants, Hotels, Motels	42	10.57	9.30	−2.85	−6.40
46	Insurance	43	10.81	15.95	16.21	25.08
18	Construction	44	10.93	13.95	16.46	26.32
43	Retail	45	12.80	13.22	2.66	−0.01
10	Apparel	46	13.98	16.52	1.19	−2.65
8	Printing and Publishing	47	17.05	28.20	10.94	8.28
16	Textiles	48	19.15	20.28	−1.38	−19.66
5	Tobacco Products	49	22.18	22.81	27.47	28.61

QE in 2020 (March 15, 2020), and zero otherwise. In the extended regression model, we have an additional variable, *PostCARES,* which is a dummy variable equal to one after the US Congress passed the CARES Act (March 27, 2020), and zero otherwise.

We present the regression results in Table 3. In column (1), we use daily excess returns as the dependent variable, and use the most recent available financial stress index value for each day as a control variable. The coefficient of *Post2008* is negative and significant, suggesting that industrial portfolio excess returns are reduced by 0.51% after the financial crisis; and the coefficient of *Post2008QE* is positive and significant, indicating that industrial excess returns increase by 0.53% after the QE announcement. However, the coefficients of both interaction terms are insignificant, suggesting that industrial excess returns over the respective post-event periods are not significantly different between the ten worst performing industries identified before the bankruptcy of Lehman Brothers and the other industries. In column (2), we compute excess returns on a weekly basis by aggregating the daily excess returns and conduct analysis using the weekly data. The coefficients of both *Post2008* and its interaction term with *Affected2008* are negative and significant. The result indicates that weekly excess returns are significantly different between two subperiods around the bankruptcy of

Lehman Brothers. Also, there is a significant difference in weekly excess return between the ten worst performing industries and the other industries during the post-event period. In addition, the coefficient of *Post2008QE* and its interaction term with *Affected2008* are positive and significant, suggesting that weekly excess returns increase following the QE announcement and the ten worst performing industries benefit more from this announcement than other industries.

Similarly, we use daily excess returns as the dependent variable in columns (3) and (5), and weekly excess returns in columns (4) and (6). In column (3), the coefficient of *Post2020* is negative and significant, indicating that industrial excess returns decrease by 0.70% after the announcement of WHO; and the coefficient of *Post2020QE* is positive and significant, suggesting that industrial excess returns increase by 1.29% following the QE announcement in 2020. In addition, the coefficients of both interaction terms are significant, which indicates that the effects of these announcements are more significant for the ten worst performing industries before the announcement of WHO than for the other industries. When we use the weekly data for robustness check in column (4), the results are similar to those in column (3). In column (5), we extend the model in column (3) by adding *PostCARES* and its interaction term with *Affected2020* to examine whether the passage of CARES Act has an additional effect on the excess return. The coefficient of *Post2020* is negative and significant, indicating that the daily excess returns decrease by 0.60% after the announcement of WHO; the coefficient of *Post2020QE* is positive and significant, suggesting that daily excess returns increase by 1.66% following the QE announcement in 2020; and the coefficient of *PostCARES* is negative and significant, suggesting that the daily excess returns decrease again by 0.44% after the CARES Act is passed. In column (6), we find that the coefficients of all interaction terms are significant, suggesting that the ten worst performing industries are most affected by the COVID-19, but they recover more than other industries after the QE announcement and the passage of CARES Act.

4. Conclusion

The financial crisis in 2008 and the outburst of COVID-19 in 2020 are two major events that negatively influence global financial markets. Most industries in the U.S. suffered from the two events, and the Fed announced several QE plans to support the economy and restore investor confidence. Our results show that the stock performance of most industries started to recover from the adverse impacts of both events following QE announcements, suggesting that QE is effective in boosting investor confidence. In addition, we find that the effect of the QE in 2020 on stock performance is more significant for the industries that are more affected by the pandemic.

CRediT authorship contribution statement

Hsuan-Chi Chen: Conceptualization, Methodology, Formal analysis, Investigation, Validation, Writing - original draft, Writing - review & editing. **Chia-Wei Yeh:** Methodology, Software, Data curation, Formal analysis, Investigation, Validation, Visualization, Writing - original draft.

Appendix: The effect of the financial crisis in 2008 on stock performance

On September 15, 2008, Lehman Brothers filed for bankruptcy protection, and a severe global financial crisis started and spread to the rest of the world (see Bartram and Bodnar, 2009; Grout and Zalewska, 2016; Kotkatvuori-Örnberg et al., 2013; Wang et al., 2017; among others). Fig. A1 presents the CARs around the bankruptcy of Lehman Brothers. The market portfolio return (Benchmark) started to decline following the event date (September 15, 2008), and it became worse even after the bailout plan was proposed and passed by the U.S. Congress (day +14; October 3, 2008). We sort the industry portfolios based on CAR(−30, 0) before the event. Fig. A1 shows the CARs of all 49 industries. The five worst-performing industries, including coal, precious metals, non-metallic and industrial metal mining, petroleum and natural gas, and fabricated products, have negative CARs before the event date, and their CARs decline more than market portfolio after the event date. We also find that the five best-performing industries, including tobacco products, textiles, printing and publishing, apparel, and retail, have positive CARs before the event date, but their CARs start to decline following the event date.[8]

Table B1 shows the CARs for the 49 industry portfolios. Most of the industry portfolios experience negative CARs even at day +60 following the bankruptcy of Lehman Brothers, indicating a long-lasting effect of this event on stock performance. In other words, it would take a long time for the Emergency Economic Stabilization Act of 2008 to be effective in restoring investors' confidence in the stock markets.

On November 25, 2008, the Fed announced the purchases of $100 billion in government-sponsored enterprise debt and $500 billion in mortgage-backed securities in response to the 2008 financial crisis (Krishnamurthy and Vissing-Jorgensen, 2011; Christensen and Rudebusch, 2012; Kiley, 2016; Kryzanowski et al., 2017; Gokmenoglu and Hadood, 2020). Fig. A2 presents the CARs around the announcement of quantitative easing in 2008. After the speech of Ben Bernanke, Chair of the Federal Reserve Board (day +4; December 1, 2008), the precious metals industry and the non-metallic and industrial metal mining industry started to recover from the negative CARs.

Table B2 shows the CARs for the 49 industry portfolios after the announcement of QE in 2008. Most of the industry portfolios start to recover from negative CARs at day +30 after the QE announcement, indicating that this announcement stimulates and restores

[8] Although we use identical data for the benchmark (market portfolio return), it looks different in various figures due to the scales of the axes.

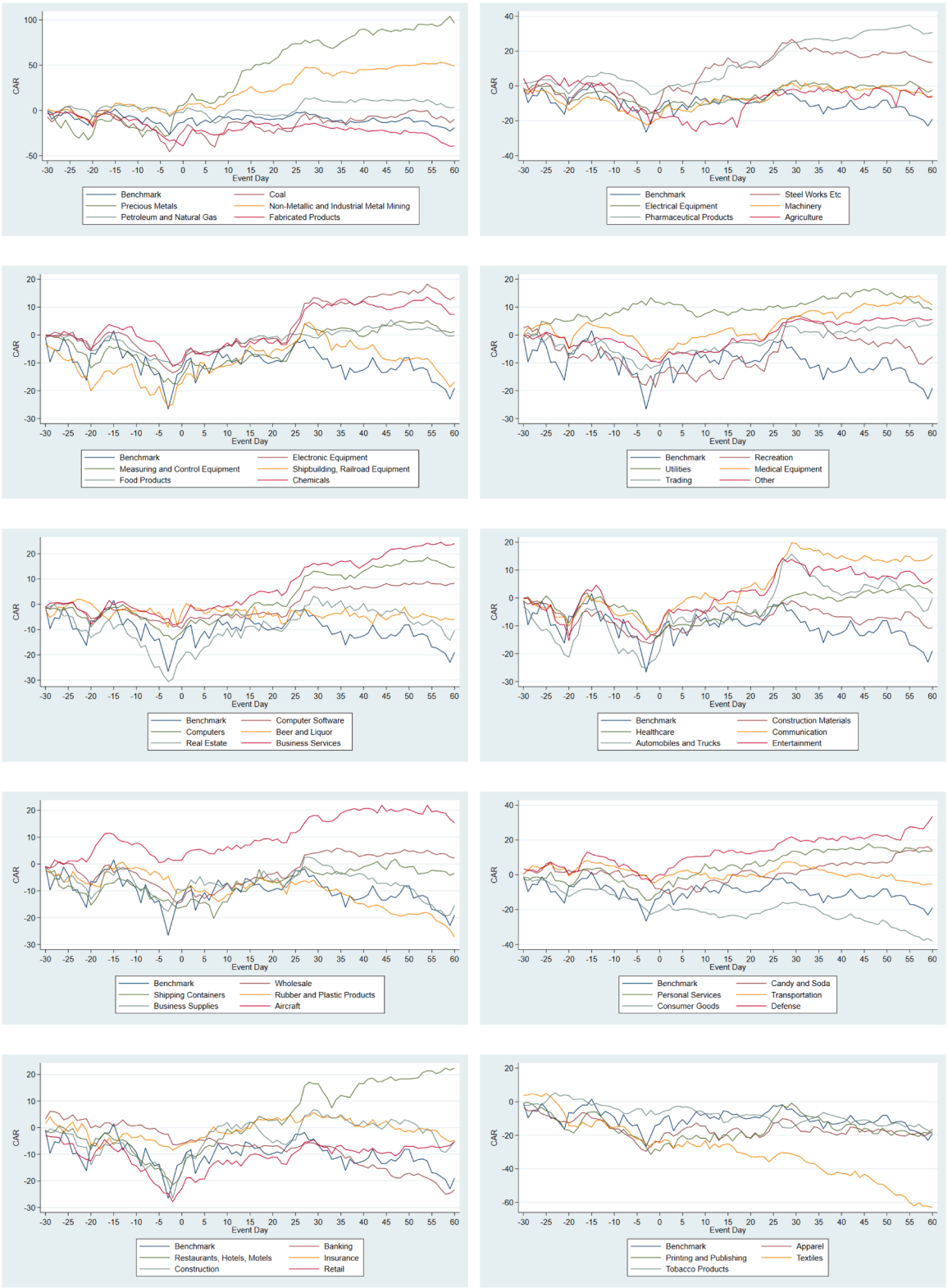

Fig. A2. Cumulative abnormal returns around the Quantitative Easing in 2008
This figure displays the cumulative abnormal returns (CARs) from 30 days before to 60 days after the first announcement of Quantitative Easing in 2008 (November 25, 2008). The daily abnormal return is the difference between the daily return of an industry portfolio and the CRSP value-weighted market index return (Benchmark) on the same day.

Table B2
Cumulative abnormal returns around the Quantitative Easing in 2008
This table presents the cumulative abnormal returns (CARs) for 49 industry portfolios following the classification of Fama and French (1997). The CRSP value-weighted market index return is used as the benchmark when calculating the abnormal returns. The event date is November 25, 2008, when the Fed announced the quantitative easing policy. The ranking of the industries follows Table B1.

Industry	Industry Name	Rank	CAR(−30,0)	CAR(−30,+10)	CAR(−30,+30)	CAR(−30,+60)
29	Coal	1	−23.09	−14.01	−7.61	−9.69
27	Precious Metals	2	5.74	19.81	77.85	96.17
28	Non-Metallic and Industrial Metal Mining	3	1.40	12.74	45.26	49.07
30	Petroleum and Natural Gas	4	−2.36	−2.01	12.00	3.15
20	Fabricated Products	5	−39.16	−20.94	−15.87	−39.38
19	Steel Works Etc	6	−9.74	10.62	24.95	13.42
22	Electrical Equipment	7	−15.16	−10.41	3.07	−2.40
21	Machinery	8	−18.67	−7.98	0.14	−5.65
13	Pharmaceutical Products	9	−3.12	2.42	24.99	30.76
1	Agriculture	10	−17.69	−19.97	−2.07	−6.27
37	Electronic Equipment	11	−11.31	−3.88	13.19	13.67
38	Measuring and Control Equipment	12	−14.79	−9.09	1.91	1.19
25	Shipbuilding, Railroad Equipment	13	−17.35	−10.92	−0.19	−16.86
2	Food Products	14	−11.16	−3.64	−1.07	−0.16
14	Chemicals	15	−9.46	−2.81	11.01	7.48
6	Recreation	16	−13.68	−13.84	6.73	−7.87
31	Utilities	17	11.62	7.66	10.30	8.93
12	Medical Equipment	18	−8.58	−0.61	6.66	10.75
48	Trading	19	−10.96	−5.08	2.78	4.40
49	Other	20	−9.94	−6.35	5.53	5.63
36	Computer Software	21	−9.54	−4.06	6.70	8.25
35	Computers	22	−11.06	−3.52	12.84	14.54
4	Beer and Liquor	23	−2.93	−0.76	−4.69	−6.09
47	Real Estate	24	−21.37	−9.54	2.32	−10.27
34	Business Services	25	−7.12	−0.71	15.56	24.02
17	Construction Materials	26	−13.27	−4.44	−1.67	−10.72
11	Healthcare	27	−13.67	−8.32	1.20	1.66
32	Communication	28	−10.24	1.92	19.59	15.57
23	Automobiles and Trucks	29	−18.96	−5.13	14.06	−0.09
7	Entertainment	30	−10.93	−5.54	12.79	7.11
42	Wholesale	31	−14.05	−7.28	4.23	2.17
40	Shipping Containers	32	−16.06	−14.13	−3.60	−3.46
15	Rubber and Plastic Products	33	−10.10	−11.37	−8.23	−27.17
39	Business Supplies	34	−9.81	−7.29	0.74	−15.36
24	Aircraft	35	1.43	6.46	17.99	15.36
3	Candy and Soda	36	−7.98	−4.79	0.10	13.99
33	Personal Services	37	−10.05	6.32	13.45	13.63
41	Transportation	38	−2.49	1.08	6.76	−5.44
9	Consumer Goods	39	−20.61	−21.53	−15.78	−38.01
26	Defense	40	0.21	10.68	20.47	33.55
45	Banking	41	−5.96	−6.16	−6.58	−23.43
44	Restaurants, Hotels, Motels	42	−16.54	−0.49	16.54	22.40
46	Insurance	43	−6.55	−2.33	4.61	−4.75
18	Construction	44	−16.96	1.92	6.33	−5.20
43	Retail	45	−22.98	−12.13	−6.24	−5.16
10	Apparel	46	−23.71	−14.44	−14.42	−17.86
8	Printing and Publishing	47	−29.38	−21.69	−2.93	−16.38
16	Textiles	48	−24.64	−23.15	−31.95	−62.97
5	Tobacco Products	49	−6.95	−7.05	−13.93	−19.23

investors' confidence in the stock markets.

References

Baig, A., Butt, H., Omair, H., Syed, R., 2020. Deaths, panic, lockdowns and US equity markets: The case of COVID-19 pandemic. Finance Res. Lett. forthcoming.
Bartram, S., Bodnar, G., 2009. No place to hide: The global crisis in equity markets in 2008/2009. J. Int. Money Finance 28, 1246–1292.
Christensen, J.H.E., Rudebusch, G.D., 2012. The response of interest rates to US and UK quantitative easing. Econ. J. 122, F385–F414.
Fama, E.F., French, K.R., 1997. Industry costs of equity. J. Financ. Econ. 43, 153–193.
Gokmenoglu, K., Hadood, A., 2020. Impact of US unconventional monetary policy on dynamic stock-bond correlations: Portfolio rebalancing and signalling channel effects. Finance Res. Lett. 33, 101185.
Goodell, J., Huynh, T., 2020. Did Congress trade ahead? Considering the reaction of US industries to COVID-19. Finance Res. Lett. 36, 101578.
Grout, P., Zalewska, A., 2016. Stock market risk in the financial crisis. Int. Rev. Financ. Anal. 46, 326–345.

Heyden, K., Heyden, T., 2020. Market reactions to the arrival and containment of COVID-19: An event study. Finance Res. Lett. forthcoming.
Kiley, M., 2016. Monetary policy statements, treasury yields, and private yields: Before and after the zero lower bound. Finance Res. Lett. 18, 285–290.
Kotkatvuori-Örnberg, J., Nikkinen, J., Äijö, J., 2013. Stock market correlations during the financial crisis of 2008–2009: Evidence from 50 equity markets. Int. Rev. Financ. Anal. 28, 70–78.
Krishnamurthy, A., Vissing-Jorgensen, A., 2011. The effects of quantitative easing on interest rates: channels and implications for policy. Brook. Papers Econ. Act. 215–287. Fall 2011.
Kryzanowski, L., Zhang, J., Zhong, R., 2017. Cross-financial-market correlations and quantitative easing. Finance Res. Lett. 20, 13–21.
Mazur, M., Dang, M., Vega, M., 2020. COVID-19 and the march 2020 stock market crash: evidence from S&P1500. Finance Res. Lett. forthcoming.
Narayan, P., Phan, D., Liu, G., 2020. COVID-19 lockdowns, stimulus packages, travel bans, and stock returns. Finance Res. Lett. forthcoming.
Noth, F., Rehbein, O., 2019. Badly hurt? Natural disasters and direct firm effects. Finance Res. Lett. 28, 254–258.
Timiraos, N., 2020. Fed cuts rates to near zero and will relaunch bond-buying program. Wall Street J. March 15, 2020.
Wang, G.-J., Xie, C., Lin, M., Stanley, E., 2017. Stock market contagion during the global financial crisis: A multiscale approach. Finance Res. Lett. 22, 163–168.