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Aerospace competition, investor attention, and stock return comovement[☆]

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ABSTRACT

Fierce aerospace competition among global superpowers has resulted in strong public attention on satellite launch events in the U.S. Given limited attentional resources, U.S. investors pay more attention to market-level shocks than to firm-specific shocks, making stock returns comove more with the market on satellite launch days than on other days. We find that the effect is significantly stronger for military-related satellite launches, launches before the dissolution of the former Soviet Union, and international satellite launches by other competitors, highlighting a greater concern for national security. A trading strategy that exploits the potential satellite-induced mispricing yields an annualized abnormal risk-adjusted return of up to 17% within the three-day window around launch date. Our results are robust to a battery of robustness analyses that consider the different characteristics of satellite launches, the exclusion of aerospace firms, and stock return comovement with industries.

1. Introduction

The Russia–Ukraine conflict has triggered a new East–West confrontation between the U.S. and Russia across various areas, particularly in the aerospace industry. On July 26, 2022, Russia stated that it would withdraw from the International Space Station (ISS) project in which it had collaborated with the U.S and built its own station after 2024.[1] This event harkens back to the intense competition between the two superpowers in the aerospace industry during the Cold War, with the rivalry constantly drawing public attention to each satellite launch event. In 1969, roughly one–fifth of the world's population (around 600 million people) watched the Apollo 11 mission live via television broadcast, making it a global media sensation. In the U.S., "94 percent of people watching

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[1] https://www.bbc.co.uk/news/world-europe-62308069

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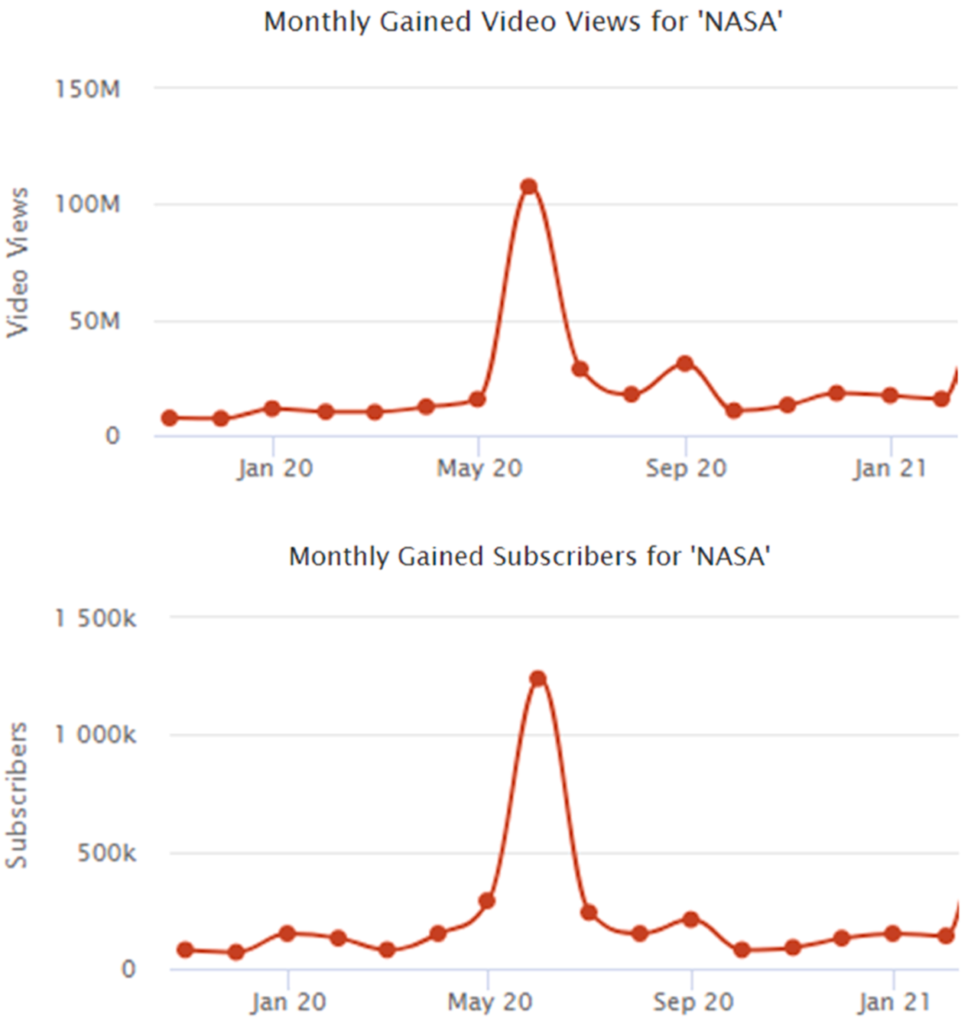

Fig. 1. Monthly gains in video view and subscribers for NASA. The spikes correspond to the launch of NASA-SpaceX Falcon 9 rocket (Demo-2 mission) in May 2020.

television were tuned into the event".[2] A survey conducted by the Pew Research Center in March 2018 revealed that 72% of the U.S. interviewees said, "It is essential that the U.S. continue to be a world leader in space exploration".[3] In the era of social media live streams, the launch of SpaceX's Falcon Heavy rocket on February 6, 2018, was the second largest live stream in YouTube's history with 2.3 million simultaneous views.[4] By April 2021, the YouTube channel of the National Aeronautics and Space Administration (NASA) had nearly 9 million subscribers, and its video view and subscriber numbers increased extraordinarily around the time of satellite launches. For example, as shown in Fig. 1, the launch of the NASA SpaceX Falcon 9 rocket (Demo-2 mission) in May 2020 was associated with an abrupt increase of nearly 108 million views and 1.3 million new subscribers compared to less than 10 million views and 100,000 new subscribers per month on average over the previous year.[5] This evidence clearly shows that satellite launches have garnered significant attention from the U.S. public. .

In our study, we argue that because of the long-term confrontation between the U.S and the Soviet Union (later, Russia) in the aerospace industry, the launch of a U.S. satellite can be an exogenous event that significantly attracts investor attention away from financial markets. Existing theoretical research (e.g., Peng and Xiong, 2006; Veldkamp, 2006; Veldkamp and Wolfers, 2007) forecasts that investor inattention drives stock return comovement: when investors are attracted away from financial markets by exogenous events, they pay less attention to firm-specific information than to market shocks, leading to higher stock return correlations with the market. However, testing the theory's implications is challenging due to an identification of a suitable exogenous shock to investors'

[2] https://www.nytimes.com/2019/07/15/business/media/apollo-11-television-media.html.
[3] https://www.pewresearch.org/science/2018/06/06/majority-of-americans-believe-it-is-essential-that-the-u-s-remain-a-global-leader-in-space/.
[4] https://www.theverge.com/2018/2/6/16981730/spacex-falcon-heavy-launch-youtube-live-stream-record.
[5] https://socialblade.com/youtube/c/nasa.

attention.

Our choice of satellite launches as exogeneous shocks to investor attention is motivated by the following reasons. First, although satellite launches and their outcomes (i.e., success or failure) can have a direct impact on firms in the aerospace industry, they are largely independent of financial markets.[6] Second, space exploration holds nationwide interest in the U.S., given its crucial role in national security. Owing to the competition with Russia and China in the aerospace industry, the U.S. government allocates approximately $40 billion annually to civilian and military space programs.[7] In addition, public interest in the space industry and its related technologies has increased notably in recent years. Projections estimate that the industry could be valued between $1 trillion and $1.4 trillion by 2040, and approach nearly $3 trillion by 2050.[8] Based on this information and background facts, we conjecture that satellite launches can draw a great deal of investor attention on days when these events occur, particularly in the context of space competition between superpowers. Given that the human mind is naturally subject to limited cognitive capacity, and hence, resorts to selective attention to collect and process information (e.g., Kahneman, 1973), we argue that investors become more attentive to market-wide information than to firm-specific information during periods of high attention. This view is consistent with Peng and Xiong (2006) and Huang et al. (2019). Therefore, we predict that stock prices reflect more market shocks than firm-level shocks on satellite launch days, leading to higher return comovement with the market.

To test our prediction, we use 300 U.S. satellite launch events from 1957 to 2019. First, we examine the difference in investor attention between satellite launch days and non-launch days. We find that share turnover decreases significantly on launch days, suggesting that investors reduce their trading and investment activities when a satellite is launched. We also find that both the normal and abnormal Google Search Volume Index (SVI) for the word "satellite" sharply increased on launch days, but the SVI for abbreviations of firm names significantly decreased on those days. These results confirm our expectation that investors are distracted from their stock investments and attracted by satellite launches.

Next, we separately calculate stock return comovements with the market for launch and non-launch days and obtain the difference for each firm. We measure return comovement using the Pearson correlation coefficient between excess stock returns and excess market returns and the adjusted R^2 from the market model (e.g., Barberis et al., 2005; Anton and Polk, 2014; Huang et al., 2019). We find that the mean correlation coefficient between launch and non-launch days has a difference of 0.03. This represents an economically and statistically significant increase of 11% compared with the correlation coefficient on non-launch days. The difference in the mean adjusted R^2 is 0.019, indicating a substantial increase of 22% from the average R^2 on non-launch days. The median results are similar in both statistical and economic terms. By identifying the main drivers of the change in return comovement, we find that the change in the correlation coefficient with the market is primarily driven by a change in covariance rather than a change in volatility, which is consistent with the literature (e.g., Huang et al., 2019).

Considering that public attention to a satellite launch may intensify a few days before the official event and diminish a couple of days later, we also probe this spillover effect of investor attention on return comovement. We scrutinize the effects for 2 and 4 trading days before and after the launch days, which we refer to as "spillover days". We find that stock return comovement with the market is smaller on spillover days than on launch days, yet it is stronger than the return comovement on non-launch days. Motivated by the implications of the recent Russia–Ukraine War, we propose that concerns about national security can significantly contribute to the impact of satellite-driven investor attention on financial markets. The war underscores the escalating importance of satellites to concerns about national security.[9] We investigate this hypothesis using three settings. First, we compare stock return comovements induced by military-related launches with other launches in the U.S. We find that stock return comovement with the market is significantly higher on military-related launch days than on other launch days. Second, we categorize U.S. satellite launches into two periods: pre- and post-Soviet Union dissolution. We consistently find that stock return comovement is significantly larger on launch days in the pre-dissolution period than in the post-dissolution period. This underscores the fact that U.S. investors paid substantially more attention to satellite launches during the Cold War. Third, we explore whether the U.S. stock market is strongly distracted by worldwide competition in the aerospace industry. For this purpose, we collect international satellite launches and divide them into three groups: U.S. satellite launches; launches by Russia, China, and India (RCI); and those by other countries.[10] We replicate the main analysis and obtain interesting results. The stock return comovement with the market is the largest on RCI launch days, followed by U. S. launch days, then other countries' launch days. As expected, the return comovement is smallest on U.S. non-launch days (excluding days that overlap with launch days in countries other than the U.S.). The results affirm that satellite launches by influential foreign

[6] We address this issue by performing a robustness check with a subsample that excludes firms in the aerospace industry. Our findings remain highly consistent.

[7] https://www.forbes.com/sites/gregautry/2017/07/09/americas-investment-in-space-pays-dividends/?sh=1edbcf22639b.

[8] https://www.morganstanley.com/ideas/investing-in-space; https://www.cnbc.com/2020/10/02/why-the-space-industry-may-triple-to-1point4-trillion-by-2030.html.

[9] https://www.gao.gov/products/gao-22-106106#:~:text=Commercial%20satellite%20companies%20can%20play,and%20the%20impact%20of%20attacks.

[10] We group these three countries together for the following reasons. A Morning Consult poll conducted on February 12–15, 2021 shows that 52% (45%) of the respondents consider China (Russia) a "major threat" to the U.S. leadership in space research, https://morningconsult.com/2021/02/25/space-force-travel-exploration-poll/. Meanwhile, the Indian space program (Indian Space Research Organization, ISRO) is among the most cost-effective programs such that comparable missions could be completed at a much lower cost than those of NASA. For example, the Martian orbit of India was launched at a cost of around $74 million, while a similar mission of NASA's Mars probe, Maven, cost $651 million. Moreover, the ISRO is the first space organization to have had a successful first launch attempt. In an unreported test, we include only Russian and Chinese satellite launches and find similar results.

countries considerably divert U.S. investors' attention away from their stock investments, causing stock returns to comove more with the market. Overall, the results of these three analyses consistently suggest a heightened focus on the national security implications of satellite launches. For further analysis, we use event status and description information to categorize the satellite launch events into (1) pioneering and standard events, (2) successful and failed events, and (3) crewed and uncrewed events. Our findings based on this classification are noteworthy. First, the increase in stock return comovement on launch days is significantly larger for pioneering launches than for normal ones. Second, stock return comovement with the market increases markedly more for unsuccessful launch events than for successful ones. This is consistent with findings in the psychology literature (e.g., Taylor, 1991; Rozin and Royzman, 2001), which document a considerably stronger cognitive effect of negative events on humans than that of positive events. Third, stock returns exhibit greater comovement with the market on the launch days of crewed satellites compared to uncrewed ones. We also study stock return comovements with those of their respective industries and identify patterns similar to those observed in market comovements. The return correlation between a stock and its industry is higher on satellite launch days than on non-launch days. Finally, to address concern that some firms operate in the aerospace industry, and hence, the events might not be completely exogenous to financial markets, we perform a robustness check by excluding these firms. The results remain consistent.

Our study contributes to the literature connecting rational inattention to financial market phenomena. Peng and Xiong's (2006) pioneering work introduces a rational inattention framework to explain enigmatic asset pricing phenomena. Subsequently, rational inattention has been employed to elucidate home bias (Nieuwerburgh and Veldkamp, 2009), and under-diversification (Nieuwerburgh and Veldkamp, 2010). Existing theoretical research (e.g., Veldkamp, 2006; Veldkamp and Wolfers, 2007) posits that exogenous shocks to investors' attention can cause individual stocks to comove more with the market, as investors are distracted from the financial markets and pay proportionally more attention to market-level rather than firm-specific information. However, empirical research linking investor attention to return comovement is relatively scarce, because of the challenge of identifying exogenous shocks to investor attention. Notable exceptions include studies by Huang et al. (2019), Zhaunerchyk et al. (2020), and Hu et al. (2021). While Huang et al. (2019) use large jackpot lotteries as an exogenous shock to test the theory in the Taiwanese market, two later studies exploit the same shock to replicate Huang et al. (2019) in the Chinese market. Our study identifies a unique shock, the satellite launch, which allows us to test the theory in the U.S. market, which is the most significant market in the world.[11]

In addition to identifying a unique shock, we further contribute to the literature by drawing an important financial implication from our main findings. Specifically, we design a trading strategy to exploit the potential stock mispricing that arises because of increased attention to market-wide shocks and reduced focus on firm-specific shocks. For each satellite launch event, we estimate the "additional" sensitivity of a stock's returns to satellite launches in the prior year ending on day $t - 10$ before the event. This additional sensitivity, called the satellite beta, is the value of beta that is on top of the stock beta on non-launch days. We decompose the satellite beta of each stock depending on whether the market price increased or decreased on the launch days in the previous year.

We conjecture that for two similar stocks, one is insensitive to satellite launch events, and the other comoves more with the market on event days owing to investor inattention; the latter tends to be overpriced (underpriced) if the market goes up (down) on those days. As a result, we term the satellite beta as "overpriced" ("underpriced") beta for an increasing (a decreasing) market condition. We then sort stocks into five portfolios based on their "overpriced" ("underpriced") betas and calculate the portfolio returns for different holding windows around launch events. If our conjecture is supported, we should obtain significant abnormal returns for longing the highest "underpriced" beta portfolios and shorting the highest "overpriced" beta portfolio. Indeed, our empirical results show that this long–short strategy yields an annualized abnormal risk-adjusted return of between 10% and 17% within a 3-day window around the launch date.

Our study also contributes to the literature on return comovement in financial markets. For example, stock return comovement is driven by cultural factors (Eun et al., 2015), similarity in investors' country origin (Meng and Pantzalis, 2022), impact on fundamental value due to climate disasters (Ma et al., 2022), and economic linkages (Chen et al., 2021). Investors' tendency to categorize stocks into investment groups based on their characteristics also leads to return comovement (Barberis and Shleifer, 2003). Existing literature has documented return comovement for stocks included in the same index (e.g., Barberis et al., 2005; Greenwood, 2008; Boyer, 2011); companies headquartered in the same geographic location (Pirinsky and Wang, 2006); those covered by the same analysts (Israelsen, 2016), sharing common mutual fund ownership (Anton and Polk, 2014); and possessing similar characteristics, such as price (e.g., Green and Hwang, 2009), size and book-to-market ratio (Kumar, 2009), dividend payment (Hameed and Xie, 2019), and financial leverage (Do et al., 2022). We distinguish our study from previous research by linking investors' attention to stock return comovement using a unique exogenous shock and further propose a new trading strategy to exploit this short-term mispricing phenomenon.

The remainder of this paper is structured as follows. Section 2 describes the data selection and descriptive statistics. Section 3 validates U.S. satellite launches as exogenous shocks to investor attention. Section 4 discusses the empirical results of return comovement with the market triggered by satellite launches. Section 5 investigates the role of national security concerns in attracting investor attention to satellite launch events. Section 6 proposes a trading strategy as an important financial implication of the main finding. Additional analyses and robustness checks are presented in Section 7. Section 8 concludes.

2. Data selection and descriptive statistics

Our study employs three main databases, including (1) U.S. satellite launch events, (2) daily stock-related data and daily market

[11] Peress and Schmidt (2020) use sensational news on television as exogenous shocks to noise traders. They find that on these news days, trading activity and liquidity decrease significantly for stocks with large proportions of noise traders.

Table 1
Summary statistics (U.S. satellite launches).

	N events	Military	Non-military	Pioneering	Normal	Success	Fail	Crewed	Uncrewed
Pre-Soviet Union Dissolution									
1957–1970	95	60	35	49	46	68	27	25	70
1971–1980	27	17	10	10	17	25	2	7	20
1981–1991	48	32	16	16	32	47	1	37	11
Post-Soviet Union Dissolution									
1992–2000	68	28	40	20	48	65	3	54	14
2001–2010	48	21	27	7	41	42	6	34	14
2011–2019	14	7	7	3	11	10	4	4	10
Total	300	165	135	105	195	257	43	161	139

The table presents summary statistics on the number of U.S. satellite launch events in the period from 1957 to 2019. We use Soviet Union dissolution event in 1991 as a breakpoint year and present the sample distribution by approximate 10-year periods. Military indicates whether a satellite is launched for military purposes. Pioneering indicates whether a launch is of the first satellite, for a new mission, or with a new technology; otherwise, it is defined as normal. Other characteristics are whether a launch is considered a successful or failed mission, or whether the satellite has a crew or not.

return, and (3) Google SVI for the word “satellite”. We obtain U.S. satellite launch events between 1957 and 2019 from Wikipedia.[12] Each satellite launch event includes the launch date, launch country, satellite name, launch vehicle, status (i.e., success/fail), and description. We report the descriptive statistics of U.S. satellite launch events in Table 1. Our main sample includes 300 U.S. satellite launches. We consider the Soviet Union dissolution event in 1991 as a breakpoint year and present the sample distribution by approximately 10-year periods. Table 1 shows that the U.S. launched 170 and 130 satellites during the pre- and post-Soviet Union dissolution periods, respectively. In additional tests, we split our sample events into subsamples using available information. First, we separate satellite launches for military and non-military purposes. There were 165 (135) launches associated with military (non-military) purposes. Second, we define a launch as a pioneering event if the description contains a term “first” or “pioneering”, and otherwise a normal one. There were 105 (195) pioneering (normal) satellite launches. Third, we split our sample into successful and failed launches. We define a launch as a successful event if the status column is reported as “success” and otherwise a failed one. There were 257 successful and 43 failed launches. Finally, we divide our sample into crewed and uncrewed launches. There were 161 and 139 uncrewed launches. To examine the impact of international satellite launches on U.S. stock return comovements, we collect and use 222 satellite launches by the RCI nations and 95 satellite launches by other countries.

Next, we obtain daily stock-related data, such as stock returns, trading volumes, and shares outstanding, from the center for Research in Security Prices (CRSP). Our sample includes common stocks with share codes 10 and 11 trading on the NYSE/Amex and NASDAQ. We exclude firms that are less than 40 years old in the research period 1957–2019. Our final sample includes 2095 firms. We also obtain the daily and weekly Google SVI for the word “satellite” from Google Trends. As our study focuses on U.S. investors' attention, we select the U.S. as the search region. The data start on January 4, 2004, and end on December 31, 2019.[13]

3. Satellite launch events as exogenous shocks to investors' attention

In this study, we propose that long-term space competition between the U.S. and the Soviet Union (later Russia) prompts U.S. investors to focus on aerospace events. Specifically, on a satellite launch day, investors allocate more attention to the exciting event than to their stock investments, resulting in an increase in stock return comovement with the market. In this section, we validate satellite launches as exogenous shocks to investor attention using share turnover and Google search volume data. Following the literature (e.g., Gervais et al., 2001), we first use share turnover, measured as the ratio of daily trading volume to total shares outstanding, to proxy for investors' attention to the stock market. If investors are distracted from the stock market by a satellite launch event, we expect their stock trading activity to be lower on the event day than on other days. We measure daily share turnover as the daily trading volume divided by shares outstanding.

Consistent with our expectations, Panel A of Table 2 shows that the share turnover is lower on launch days than on non-launch days. Specifically, the mean and median differences in share turnover between the launch and non-launch days are −2.3% and −2.0%, which are statistically significant at the 1% level, respectively. We estimate a regression of share turnover on the launch-day dummy, controlling for firm, year, month, and day-of-week fixed effects. The results in Panel B show a statistically significant decrease of −2.9% in the daily share turnover on launch days.

Next, we follow Da et al. (2011) and use Google SVI for the key word “satellite” to capture investors' attention to satellite launch

[12] Find more information at: https://en.wikipedia.org/wiki/Timeline_of_artificial_satellites_and_space_probes. We cross-check satellite launch events from Wikipedia against other available data sources, such as the UCS satellite database, https://www.ucsusa.org/resources/satellite-database, the Indian Space Research Organization database, and the European Space Agency database). Moreover, to ensure the “cleanest” shock possible, we exclude all the commercial launches. In addition, we end our sample in 2019 to avoid the effect of COVID-19, which significantly delayed the development and launches of satellites owing to supply-chain disruptions and lockdowns.

[13] The earliest data available for SVI are from January 4, 2004. Find more information at: https://trends.google.com/trends/explore?q=satellite&geo=US

Table 2
Share turnover & Google search volume index.

Panel A: Overall results	Share Turnover		Firm ASVI		Satellite ASVI	
	Mean	Median	Mean	Median	Mean	Median
Launch Days	0.292	0.224	0.255	0.001	2.387	0.968
Non-Launch Days	0.315	0.244	0.297	0.013	0.057	−0.023
Difference	−0.023***	−0.020***	−0.041***	−0.012***	2.330**	0.991***
	(0.002)	(0.006)	(0.000)	(0.003)	(0.014)	(0.000)
Panel B: Military and Non-Military Satellite Launches						
(1) Military Launch Days	0.238	0.176	0.247	−0.004	3.567	1.767
(2) Non-Military Launch Days	0.294	0.231	0.267	0.002	1.783	0.601
(3) Non-Launch Days	0.315	0.244	0.297	0.013	0.057	−0.023
(1) - (2)	−0.056***	−0.055***	−0.020**	−0.006*	1.784**	1.166***
	(0.000)	(0.000)	(0.023)	(0.063)	(0.044)	(0.000)
(1) - (3)	−0.077***	−0.068***	−0.050***	−0.017***	3.510***	1.790***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (3)	−0.021***	−0.013*	−0.029***	−0.011***	1.726**	0.624***
	(0.005)	(0.081)	(0.000)	(0.000)	(0.048)	(0.000)
Panel C: Pre- and Post Soviet Periods						
(1) Launch Days in Soviet period	0.183	0.136	–	–	–	–
(2) Launch Days in post Soviet period	0.297	0.231	–	–	–	–
(3) Non-Launch Days	0.315	0.244	–	–	–	–
(1) - (2)	−0.114***	−0.095***	–	–	–	–
	(0.000)	(0.000)	–	–	–	–
(1) - (3)	−0.132***	−0.108***	–	–	–	–
	(0.000)	(0.000)	–	–	–	–
(2) - (3)	−0.018**	−0.013*	–	–	–	–
	(0.018)	(0.087)	–	–	–	–
Panel D: U.S. and RIC Satellite Launches						
(1) U.S Launch Days	0.292	0.224	0.255	0.001	1.890	0.669
(2) RIC Launch Days	0.275	0.208	0.231	−0.004	2.909	1.467
(3) Non-Launch Days	0.321	0.249	0.301	0.017	0.057	−0.023
(1) - (2)	0.017**	0.016**	0.024***	0.005*	−1.019**	−0.798***
	(0.039)	(0.025)	(0.000)	(0.078)	(0.035)	(0.000)
(1) - (3)	−0.029***	−0.026***	−0.046***	−0.016***	1.833***	0.692***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (3)	−0.046***	−0.041***	−0.070***	−0.021***	2.852**	1.490***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

This table shows investors' trading activity and Google Search Volume Index (SVI) for launch and non-launch days. Share turnover is measured as the ratio of daily trading volume to total shares outstanding. We follow Huang et al. (2019) to calculate daily normal and abnormal SVI for "satellite" using the below equations:
$SVI_{AD,t} = SVI_w \times (SVI_{UN,t} / MESVI_w)$ (1), $ASVI_{AD,t} = (SVI_{AD,t} - MDSVI_{AD,25\text{–}5}) / MDSVI_{AD,25\text{–}5}$ (2),.
where $SVI_{AD,t}$ ($SVI_{UN,t}$) is adjusted (raw) SVI for "satellite" on day *t*. SVI_w is the weekly SVI to which a raw daily SVI belongs. $MESVI_w$ is weekly average of $SVI_{UN,t}$. $ASVI_{AD,t}$ is the abnormal SVI for "satellite" on day *t* and $MDSVI_{AD,25\text{–}5}$ is the median of adjusted SVI from the previous 25th week to the 5th week. We apply the same process to calculate abnormal SVI for the names of firms in the S&P 500. *p*-values based on robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

events. We also extract the SVI for the names of firms in the S&P 500 index. These firms represent 75–80% of the U.S. stock market in terms of market capitalization. If satellite launches attract investors' attention, Google SVI for "satellite" should be higher on launch days than on non-launch days. By contrast, we expect a drop in firm SVI on event days. We follow Huang et al. (2019) to calculate daily normal and abnormal SVI for "satellite" as follows:

$$SVI_{AD,t} = SVI_w \times \left(SVI_{UN,t} \middle/ MESVI_w \right) \tag{1}$$

$$ASVI_{AD,t} = \left(SVI_{AD,t} - MDSVI_{AD,25-5} \right) \middle/ MDSVI_{AD,25-5} \tag{2}$$

where $SVI_{AD,t}$ ($SVI_{UN,t}$) is adjusted (raw) SVI for "satellite" on day *t*. SVI_w is the weekly SVI to which a raw daily SVI belongs. $MESVI_w$ is weekly average of $SVI_{UN,t}$. $ASVI_{AD,t}$ is the abnormal SVI for "satellite" on day *t* and $MDSVI_{AD,25\text{–}5}$ is the median of adjusted SVI from the previous 25th week to the 5th week. We apply the same process to calculate the abnormal firm SVI.

The results presented in Table 2 confirm our conjecture. Panel A shows the overall results for the entire sample, in which the mean and median differences in abnormal SVI between launch and non-launch days are 2.330 and 0.991, respectively, whereas the corresponding differences for abnormal firm SVI are −0.041 and −0.012, respectively. All differences are statistically significant at the 1% level. Overall, the results for share turnover and the Google SVI provide supportive evidence that investors are more attentive to satellite launch events and less attentive to stock investments.

We further perform difference tests in share turnover and SVI for three scenarios: (i) military versus non-military satellite launches; (ii) satellite launches during the pre- versus post-Soviet Union dissolution period; and (iii) satellite launches in the U.S. versus in the

Table 3
Individual stock return comovement with the market.

Panel A: Comovements				
	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
Launch Days	0.294	0.298	0.103	0.110
Non-Launch Days	0.264	0.271	0.085	0.088
Difference	0.030***	0.027***	0.019***	0.022***
	(0.000)	(0.000)	(0.000)	(0.000)
Panel B: Decomposition of the Changes in Correlation Coefficient				
	Percentage Contribution			%Δ in Covariance
	X	Y	Z	
Mean	131%***	−0.6%	−19%***	0.129***
	(0.000)	(0.945)	(0.000)	(0.000)
Median	108%**	−0.8%	−6%*	0.089**
	(0.030)	(0.955)	(0.055)	(0.042)

Panel A presents the correlation coefficients of excess stock returns and excess market returns for satellite launch and non-launch days separately. The CAPM model's adjusted R^2s are also obtained for the respective two groups. In Panel B, we follow Huang et al. (2019) and decompose the change in logged correlation coefficient as below:

$$log\frac{\rho_{SL,i}}{\rho_{NSL,i}} = log\frac{\sigma^{SL}_{i,Mkt}}{\sigma^{NSL}_{i,Mkt}} - log\frac{\sigma_{SL,i}}{\sigma_{NSL,i}} - log\frac{\sigma_{SL,Mkt}}{\sigma_{NSL,Mkt}} \quad (3)$$

where $\rho_{SL,i}$ and $\rho_{NSL,i}$ denote the correlation coefficients between stock i's excess returns and excess market returns on satellite launch and non-launch days, respectively. $\sigma_{SL,i}$ ($\sigma_{SL,Mkt}$) and $\sigma_{NSL,i}$ ($\sigma_{NSL,Mkt}$) denote excess stock (market) return volatilities on launch and non-launch event days, respectively. $\sigma^{SL}_{i,Mkt}$ and $\sigma^{NSL}_{i,Mkt}$ denote the excess return covariances between firm i and the market on launch and non-launch days, respectively. The percentage contribution of each component to the correlation change is calculated as below:

$$1 = \underbrace{\frac{\log\frac{\sigma^{SL}_{i,Mkt}}{\sigma^{NSL}_{i,Mkt}}}{\log\frac{\rho_{SL,i}}{\rho_{NSL,i}}}}_{X} + \underbrace{\left[-\frac{\log\frac{\sigma_{SL,i}}{\sigma_{NSL,i}}}{\log\frac{\rho_{SL,i}}{\rho_{NSL,i}}}\right]}_{Y} + \underbrace{\left[-\frac{\log\frac{\sigma_{SL,Mkt}}{\sigma_{NSL,Mkt}}}{\log\frac{\rho_{SL,i}}{\rho_{NSL,i}}}\right]}_{Z} \quad (4)$$

The last column in Panel B shows the percentage change in return covariance, i.e., $\sigma^{SL}_{i,Mkt}/\sigma^{SL}_{i,Mkt} - 1$. We apply the paired t-test for the mean difference and Wilcoxon signed-rank for the median difference. p-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

RIC countries. Regarding the second analysis, as the Google search volume is not available for the pre-Soviet Union dissolution, we perform the difference test only in share turnover. The results of the three analyses are presented in Panels B, C, and D of Table 2. In general, we find that for (i) military launches draw investors' attention away from the financial market more significantly than nonmilitary launches; for (ii) satellite launches attract investors' attention more significantly before the Soviet Union dissolution period; and for (iii) investors are more distracted by RIC satellite launches than by U.S. launches.

4. U.S. satellite launch events and stock return comovement

4.1. Baseline results

Given the above evidence of satellite-induced shocks to investors' stock market attention, this subsection tests whether there is an increase in comovement between stock returns and the market. Following the literature, we construct two proxies for stock return comovement.

The first proxy is the time-series Pearson correlation coefficient between excess stock return and excess market return (e.g., Anton and Polk, 2014; Huang et al., 2019). For each stock i, we calculate the correlation coefficients using the daily excess returns for launch and non-launch days separately, and denote them as $\rho_{SL,i}$ and $\rho_{NSL,i}$, respectively. We then test the mean and median differences between $\rho_{SL,i}$ and $\rho_{NSL,i}$ across the sample stocks. The second proxy is the adjusted R^2 of the capital asset pricing model (CAPM) using daily excess returns. We denote stock *i*'s adjusted R^2s for launch and non-launch days as $R2_{SL,i}$ and $R2_{NSL,i}$, respectively. We then test whether the mean and median differences between $R2_{SL,i}$ and $R2_{NSL,i}$ are significantly positive, as a higher R^2 indicates more (less) explanatory power of market (firm-specific) shocks to stock returns (e.g., Morck et al., 2000; Durnev et al., 2004).[14]

The results are presented in Panel A of Table 3. Consistent with our expectations, we find that individual stocks experience an increase in return comovement with the market on launch days. Specifically, the return correlation coefficient is higher on launch days than on non-launch days and the increase is statistically significant for both the mean and median coefficients. The mean (median) difference between $\rho_{SL,i}$ and $\rho_{NSL,i}$ is 0.030 (0.027), indicating an economically significant increase of 11% (10%) in the return correlation between stocks and the market. The results for the adjusted R^2 exhibit similar patterns. The mean adjusted R^2 value is 0.103 and 0.085 for the satellite launch and non-launch days, respectively, indicating a statistically significant change of 0.019 or a 22% increase in economic terms relative to the non-launch adjusted R^2. The median increase between $R2_{SL,i}$ and $R2_{NSL,i}$ is also statistically and economically significant. To put our results in perspective, Huang et al. (2019) report an average increase of 4% (10%) in correlation coefficient (adjusted R^2) on large jackpot days in Taiwan, and Ma et al. (2022) show a corresponding increase of 3% (5%) in climate disaster months. Our results provide the first evidence of an increase in stock-market return comovement due to investor distraction by satellite launch events.

4.2. Decomposition of changes in correlation coefficient

In this subsection, we investigate which primary factor drives the changes in correlation coefficient, following Huang et al. (2019) to decompose the difference in logged correlation coefficient between launch and non-launch days into three components, as follows:

$$log\frac{\rho_{SL,i}}{\rho_{NSL,i}} = log\frac{\sigma^{SL}_{i,Mkt}}{\sigma^{NSL}_{i,Mkt}} - log\frac{\sigma_{SL,i}}{\sigma_{NSL,i}} - log\frac{\sigma_{SL,Mkt}}{\sigma_{NSL,Mkt}} \tag{3}$$

where $\rho_{SL,i}$ and $\rho_{NSL,i}$ denote the correlation coefficients between stock *i*'s excess returns and excess market returns on satellite launch and non-launch days, respectively. $s_{SL,i}(s_{SL,Mkt})$ and $s_{NSL,i}(s_{NSL,Mkt})$ denote the standard deviations of excess stock (market) returns on launch and non-launch event days, respectively. $\sigma^{SL}_{i,Mkt}$ and $\sigma^{NSL}_{i,Mkt}$ denote the excess return covariances between firm *i* and the market on launch and non-launch days, respectively.

To determine how much (%) each of these three components contribute to the change in the correlation coefficient, we divide both sides of Eq. (3), by changing the correlation coefficient.

$$1 = \underbrace{\frac{\log\frac{\sigma^{SL}_{i,Mkt}}{\sigma^{NSL}_{i,Mkt}}}{\log\frac{\rho_{SL,i}}{\rho_{NSL,i}}}}_{X} + \underbrace{\left[-\frac{\log\frac{\sigma_{SL,i}}{\sigma_{NSL,i}}}{\log\frac{\rho_{SL,i}}{\rho_{NSL,i}}}\right]}_{Y} + \underbrace{\left[-\frac{\log\frac{\sigma_{SL,Mkt}}{\sigma_{NSL,Mkt}}}{\log\frac{\rho_{SL,i}}{\rho_{NSL,i}}}\right]}_{Z} \tag{4}$$

where X represents the percentage contribution of the covariance between excess stock returns and excess market returns. Y (Z) represents the percentage contribution of the volatility of excess stock (market) returns.

We report the results in Panel B of Table 3. The change in covariance, X, is the primary driver of the change in the correlation coefficient, with mean and median percentage contributions of approximately 131% and 108%, respectively. The results for Y and Z do not indicate any positive contributions from the stock and market return volatilities. In the last column, we calculate the percentage change in return covariance, that is, $\sigma^{SL}_{i,Mkt}/\sigma^{SL}_{i,Mkt} - 1$, and test whether this is significantly different from zero. The results show that the percentage change is positive and statistically significant, confirming that stock returns co-vary more with market returns on satellite launch days, which further supports our baseline results.

[14] Alternatively, as a robustness check for our main hypothesis, we investigate the difference between the proportion of the stocks moving in the same direction with the market on launch days and non-launch days. We perform the analysis using three approaches. In the first method, for each satellite day, we calculate the percentage of stocks whose returns move together with the market returns on each launch day as well as non-launch day. We then test the difference in terms of percentage points between these two series. In the second method, for each firm during launch days, we calculate the percentage of days on which its stock returns move together with the market returns. We repeat this step for each firm during the non-launch days. Thereafter, we test the difference in terms of percentage points for these two datasets. Finally, in the third method, for each firm, we have a series of trading days. We divide this series into four parts: (i) launch days on which the firm's stock return moves together with the market returns, (ii) launch days when its stock returns move opposite to the market returns, (iii) non-launch days on which its stock return moves together with the market returns, and (iv) non-launch days when its stock returns move opposite to the market returns. We then replicate the stock return comovement analysis as performed in Table 3 for these four separate samples. We obtain results that are consistent with our hypothesis for all three approaches. These results are presented in Table A1 in the Online Appendix. We thank an anonymous referee for this suggestion.

Table 4
Spillover effects of stock return comovement with the market.

	$k = 2$				$k = 4$			
	Correlation Coefficient		Adjusted R^2		Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
(1) Launch Day *t*	0.294	0.298	0.103	0.110	0.294	0.298	0.103	0.110
(2) Pre-Launch Days (*t* - *k*)	0.279	0.282	0.094	0.094	0.270	0.275	0.090	0.090
(3) Post-Launch Days (*t* + *k*)	0.281	0.283	0.095	0.093	0.277	0.274	0.089	0.090
(4) Non-Launch Days	0.262	0.270	0.081	0.086	0.263	0.271	0.083	0.087
(1) - (2)	0.014***	0.016**	0.009***	0.017***	0.023***	0.023***	0.013***	0.021***
	(0.002)	(0.041)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.000)
(1) - (3)	0.013***	0.015*	0.008***	0.017***	0.017***	0.024***	0.014***	0.02***
	(0.006)	(0.061)	(0.000)	(0.003)	(0.000)	(0.002)	(0.000)	(0.000)
(1) - (4)	0.032***	0.028***	0.022***	0.024***	0.03***	0.027***	0.02***	0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (3)	−0.001	−0.001	−0.001	0.001	−0.006	0.001	0.001	−0.001
	(0.761)	(0.911)	(0.569)	(0.976)	(0.136)	(0.911)	(0.457)	(0.857)
(2) - (4)	0.017***	0.011*	0.013***	0.008*	0.007*	0.005	0.007***	0.002
	(0.000)	(0.087)	(0.000)	(0.069)	(0.06)	(0.446)	(0.000)	(0.586)
(3) - (4)	0.019***	0.012*	0.014***	0.008*	0.013***	0.004	0.006***	0.003
	(0.000)	(0.076)	(0.000)	(0.086)	(0.001)	(0.543)	(0.000)	(0.468)

This table presents the correlation coefficients of excess stock returns and excess market returns for satellite launch days, their preceding and following *k* days, and other non-launch days separately. The CAPM model's adjusted R^2s are also obtained for the respective four groups. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

4.3. Spillover effects of satellite launch events

Given that a satellite launch date may be known in advance because of media coverage, it is likely that investor attention will begin to increase a few days before the event. In addition, attention toward the launch may remain relatively high before eventually diminishing completely after the event. If this is the case, we anticipate that the return comovement induced by the satellite launch will extend to the days surrounding the launch date. We test this spillover effect using 2 and 4 days before and after the event date and report the results in Table 4. In general, we find that stock return comovements with the market are lower on the preceding and following trading days than on the official launch day, but higher than on non-launch days. For example, the mean and median of the differences in return correlation with the market between launch days and the two preceding (following) days are 0.014 (0.013) and 0.016 (0.015), respectively, while the differences between the two preceding (following) days and non-launch days are 0.017 (0.019) and 0.011 (0.012), respectively. All difference tests are statistically significant. Additionally, we find no significant differences in the return correlation with the market between preceding and subsequent days. We also find robust results with the adjusted R2. The results remain consistent in the tests for the 4 preceding and 4 subsequent trading days. Fig. 2 illustrates a pattern of increasing stock return comovement with the market starting 4 days prior to the launch date, peaking on the event day, and then decreasing on the post-event days. The results indicate that satellite launch events start attracting investors' attention to some extent on pre-event days; their attention peaks on the official launch days before gradually dissipating after the event day.

5. The role of national security concerns

The recent and ongoing Russia–Ukraine conflict has further emphasized the important role of satellites in wars, or more generally, in national security.[15] Satellites provide essential services to authorities, aid in monitoring potential terrorist threats, and contribute to homeland security. They are also considered extremely useful in warfare, supporting military operations by helping to pinpoint targets, map battlefields, and detect enemy weapons, missiles, and nuclear threats. As a result, we posit that the national security aspect of satellite launches may play a more significant role in drawing investors' attention to these events than other aspects, such as curiosity or personal interest.

We employ three settings to test this hypothesis. First, we investigate the differences in satellite-induced stock return comovements between military-related and other launches. Second, we compare the satellite-induced stock return comovement between the pre- and post-Soviet Union dissolution periods. Third, we explore whether the U.S. stock market is strongly affected by worldwide competition in the aerospace industry by collecting international satellite launches and dividing them into three groups: U.S. satellite launches; launches by RCI; and those by other countries.

5.1. Military and non-military satellite launches

Based on the granularity of our dataset, we can classify whether a satellite launch is intended for a military purpose. We then

[15] https://www.space.com/ukraine-war-strategic-importance-private-satellites

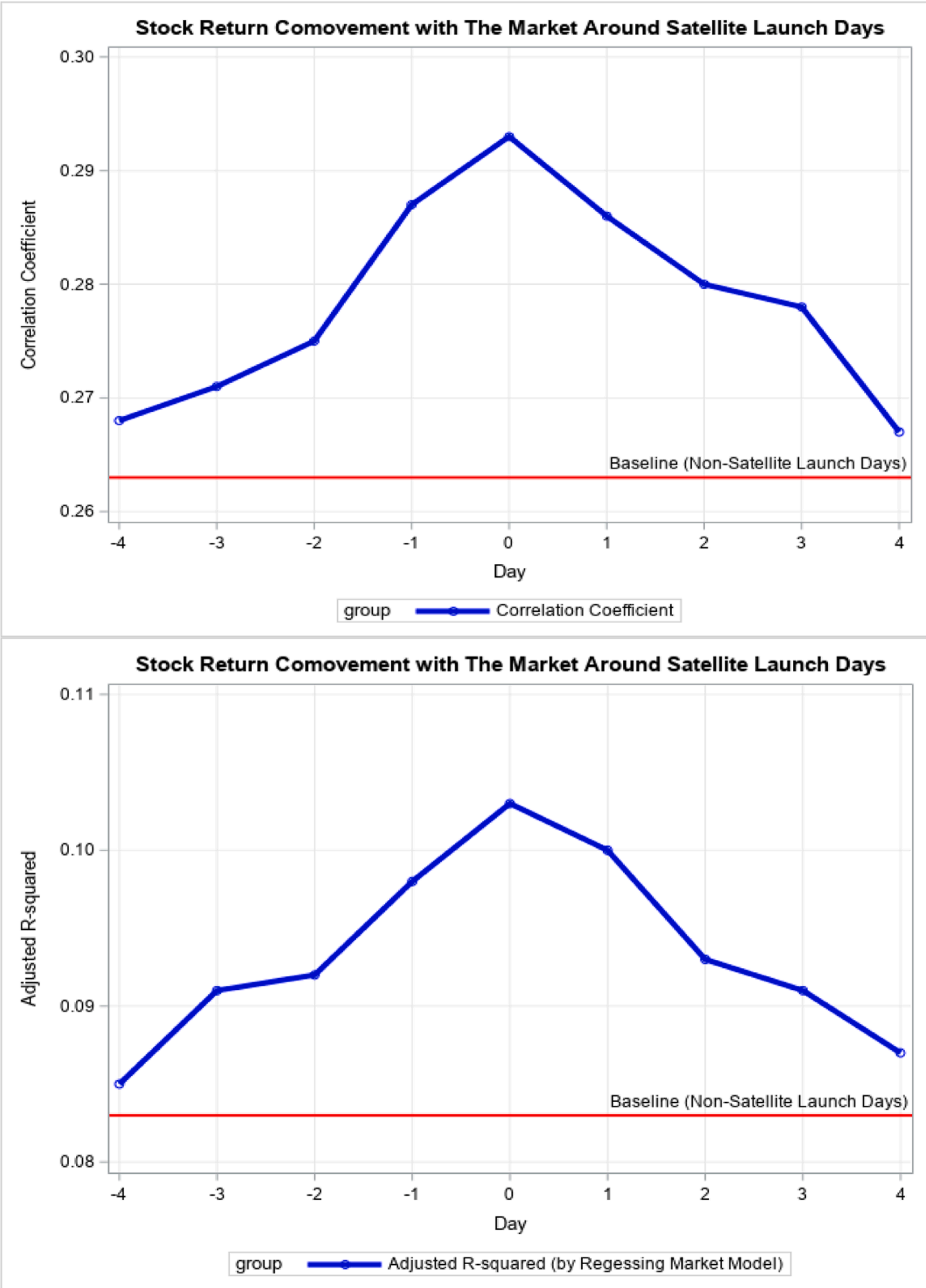

Fig. 2. Stock return comovement with the market around satellite launch days. The top panel shows the pattern of Pearson correlations of excess stock returns and excess market returns around satellite launch days in a comparison to the baseline correlation for the non-launch days. The bottom panel show the corresponding pattern for adjusted R^2.

calculate stock return comovement with the market on military launch days, nonmilitary launch days, and non-launch days. We argue that attention to military-related launches should align with national security concerns to a larger extent than launches for non-military purposes. Therefore, if national security concerns draw greater investor attention to satellite launches, we should find higher stock return comovement with the market on military launch days than on nonmilitary launch days. The empirical results are presented in Table 5.

We find strong evidence supporting this conjecture. Specifically, stock return comovements with the market on military launch days are, on average, about 34% higher than those on nonmilitary launch days (0.368 vs. 0.274), as measured by the correlation coefficient. Compared with non-launch days, stock return comovement with the market increases by only 3.8% (from 0.264 to 0.274)

Table 5
Stock return comovement for military and non-military satellite launches.

	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
(1) Military Launches	0.368	0.397	0.132	0.138
(2) Non-Military Launches	0.274	0.281	0.096	0.097
(3) Non-Launch Days	0.264	0.271	0.085	0.088
(1) - (2)	0.094***	0.115***	0.036***	0.041***
	(0.000)	(0.000)	(0.000)	(0.000)
(1) - (3)	0.105***	0.125***	0.047***	0.050***
	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (3)	0.010**	0.010*	0.011**	0.009*
	(0.013)	(0.080)	(0.023)	(0.097)

This table presents the correlation coefficients of excess stock returns and excess market returns for satellite launches for military and non-military purposes, respectively. The correlation coefficient for other days without any satellite launches is also estimated. The CAPM model's adjusted R^2s are obtained for the respective three groups. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

on nonmilitary launch days, whereas it experiences a significant increase of 39.4% (from 0.264 to 0.368) on military launch days. These results are highly consistent and more pronounced when we test for median differences or use the adjusted R^2 as an alternative measure of return comovement.

5.2. Pre- and Post-Soviet union dissolution (1991)

Prior to the dissolution of the Soviet Union, the Space Race between the two Cold War rivals, the U.S. and the Soviet Union, was aggressive. Even though the Space Race formally ended in the middle of 1975, the Cold War did not end until the Soviet Union dissolved in late 1991. As the two major rivals and the two giants in space exploration, geopolitical tensions and space competition between the U.S. and Soviet Union could intensify investor attention on satellite launches because of concerns about national security. Therefore, we conjecture that stock return comovement with the market on satellite launch days is larger in the pre-Soviet Union dissolution period than in the post-dissolution period.[16,17]

We test this conjecture by first separating our U.S. satellite launches into pre- and post-Soviet Union dissolution periods.[18] We then calculate stock return comovements with markets on launch and non-launch days in the pre- and post-Soviet Union dissolution periods separately. The results reported in Table 6 show that stock return comovements with the market on launch days are higher than those on non-launch days for both the pre- and post-Soviet Union dissolution periods, and that the differences are larger for the Soviet period. For example, compared to the 0.256 and 0.267 mean correlation coefficients on non-launch days during the pre- and post-Soviet Union dissolution periods, the mean coefficients on launch days for the corresponding period are 0.332 and 0.283, respectively, indicating an increase of 29.7% and 9%, respectively. In addition, the mean difference in the correlation coefficient between the launch days in the

[16] There can be a valid concern that Cold War period could cause a structural break that may drive our main findings because satellite launches used to be a more significant event during the Cold War than they are today. To address this issue, we have separately performed robustness analyses for 1957–1970 (Cold War) and 2001–2010 (politically stable) periods. As expected, we find a larger effect of the satellite launches on the stock return comovement during 1957–1970 than during 2001–2010 by about 3 percentage points, which is consistent across both employed proxies of comovement—the correlation coefficient and the adjusted R^2. In addition, the effect obtained for 2001–2010 is very close to the baseline result obtained for the whole sample presented in Table 3. This suggests that even though there was a significant increase in the effect during the intense stage of the Cold War compared to other more politically stable periods, the overall result remains consistent. We present this results in Table A2 in the Online Appendix. We thank an anonymous referee for this suggestion.

[17] In a combination with our results discussed in subsection 5.1, one may argue that as national security is of a greater concern, which leads to military-related launches drawing greater attention, we should expect that the effect of Soviet military-related satellite launches would have a greater effect during the Cold War than US military-related launches or non-military launches would have. To understand this, we conduct an analysis to compare the effect of military satellite launches by the Soviet Union on the U.S. stock return comovement during the Cold-War period (i.e., 1957–1970) with that of non-military launches. We also consider the effect of military and non-military launches by the U.S. during the Cold-War period. We consistently find that the effect of military related launches on stock return comovement is significantly larger than the non-military launches for both Soviet and U.S. launches. Interestingly, military launches by the Soviet Union had a larger impact than those by the U.S., and military launches by the U.S. during Cold-War period had a larger effect than the baseline result observed in Table 5. These findings are also consistent with the international competition angle in Table 7. In summary, this additional analysis strengthens our claim about the stronger effect of military-related launches than of non-military launches. We present these results in Online Appendix Table A3. We thank an anonymous referee for this suggestion.

[18] As there are significantly more military launches pre-Soviet Union dissolution period, we have conducted an additional robustness analysis that separately tests the difference in the effect of military versus non-military launches on stock return comovement during the pre- and post-Soviet Union dissolution periods. As expected, we find that while the military launches consistently have larger effects than the non-military launches do across both pre- and post-Soviet Union dissolution, the difference is much larger during the pre-Soviet Union dissolution period. We present the results in Table A4 in the Online Appendix.

Table 6
Stock return comovement pre- and post-soviet union dissolution.

	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
(1) Launch Days in Soviet Period	0.332	0.329	0.117	0.115
(2) Non-Launch Days in Soviet Period	0.256	0.255	0.070	0.065
(3) Launch Days post-Soviet Period	0.283	0.286	0.090	0.102
(4) Non-Launch Days post-Soviet Period	0.267	0.278	0.089	0.090
(1) - (2)	0.076***	0.073***	0.047***	0.05***
	(0.000)	(0.000)	(0.000)	(0.000)
(3) - (4)	0.015***	0.008*	0.002	0.013*
	(0.003)	(0.097)	(0.455)	(0.058)
(1) - (3)	0.049***	0.042***	0.027***	0.012*
	(0.000)	(0.000)	(0.000)	(0.071)
[(1) - (2)] - [(3) - (4)]	0.061***	0.065***	0.045***	0.037***
	(0.000)	(0.000)	(0.000)	(0.000)

This table presents the correlation coefficients of excess stock returns and excess market returns for satellite launch days during the Soviet and post-Soviet periods, and for non-launch days separately. The CAPM model's adjusted R^2s are also obtained for the respective three groups. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7
U.S. stock return comovement for international satellite launches.

	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
(1) U.S. Launch Days	0.294	0.298	0.103	0.110
(2) RIC Launch Days	0.331	0.331	0.122	0.132
(3) Other Launch Days	0.284	0.289	0.091	0.100
(4) Non-Launch Days	0.261	0.270	0.085	0.089
(1) - (2)	−0.038***	−0.033***	−0.019***	−0.022***
	(0.000)	(0.000)	(0.000)	(0.001)
(1) - (3)	0.009**	0.009	0.012***	0.010*
	(0.048)	(0.239)	(0.000)	(0.081)
(1) - (4)	0.032***	0.028***	0.019***	0.021***
	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (3)	0.047***	0.043***	0.031***	0.032***
	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (4)	0.07***	0.061***	0.037***	0.043***
	(0.000)	(0.000)	(0.000)	(0.000)
(3) - (4)	0.023***	0.018***	0.006***	0.011**
	(0.000)	(0.006)	(0.000)	(0.016)

This table presents the correlation coefficients of excess stock returns and excess market returns for satellite launches by the U.S., the RCI countries (i. e., Russia, China, and India), and other countries. The correlation coefficient for other days without any satellite launches is also estimated. The CAPM model's adjusted R^2s are obtained for the respective four groups. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

pre- and post-Soviet Union dissolution periods is 0.049, which is statistically significant and economically meaningful, because it represents a 17% higher satellite-induced return comovement during the Soviet period. The mean difference of 0.027 in the adjusted R^2 is economically even more astounding, because it indicates that stock return comovement with the market on launch days is 30% higher during the Soviet period than during the post-Soviet period. The results for the median differences are similar, albeit smaller in magnitude.

Overall, the empirical results from both analyses strongly support the idea that national security concerns play a greater role than other reasons in attracting investors' attention to satellite launches.

5.3. Satellite launch and stock return comovement: cross-border effects

Since World War II, the U.S. has maintained its position as a leader in space research and exploration. However, in recent decades, various international space organizations, notably from Russia and China, have emerged as potential challengers to U.S. dominance. Additionally, India's space program has garnered significant attention owing to its cost-effective yet successful missions. Consequently, we are intrigued by the possibility of exploring whether global competition in the aerospace industry also influences the attention of U. S. investors and consequently, impacts U.S. stock return comovements. To address this question, we calculate the U.S. stock return comovement with the market on launch days by the RCI group and by other countries, and then compare it with that on U.S. satellite launch days. We collect international satellite launches and obtain 222 events for the RCI group and 95 events for other countries; we then calculate stock return comovements around these events.

We report the results in Table 7. In general, we find that stock returns comove more with the market on launch days than on non-launch days. More interestingly, we find that the return comovement is lower on U.S. launch days than on RCI launch days, but higher than on other countries' launch days. Specifically, the mean difference in the correlation coefficient between the U.S. launch days and RCI (other) launch days was −0.038 (0.009), representing a decrease (increase) of 13% (3%). The mean correlation coefficient for the RCI launch days is 17% higher than that for other countries' launch days. We also find consistent results for adjusted R2 differences. Therefore, the results in Table 7 support our argument that U.S. investors are strongly attracted to worldwide competition in the aerospace industry, which distracts them from their stock investments on international launch days, leading to an increase in stock return comovement with the market.

6. Trading strategy

In this section, we delve into the financial implications of our main findings by designing a hypothetical trading strategy that capitalizes on investor inattention on satellite launch days. Our previous analysis reveals that when investors are distracted by satellite launches, they tend to prioritize market-level information over idiosyncratic information at the stock level, resulting in increased comovement between stock returns and market returns. This suggests that, on average, stocks may be somewhat mispriced in the short term because of this inattention, which delays the assimilation of stock-level information into stock prices around satellite launch days. As investor inattention dissipates, stock prices gradually adjust to incorporate the previously unaccounted stock-level information. Consequently, opportunities for profitable trading emerge. We conjecture that if a stock strongly comoves with the market on a satellite launch day and the market price increases (decreases) on that day, it is likely that the stock is overpriced (underpriced) on average owing to investor inattention. Therefore, if one takes a long position for a portfolio of underpriced stocks and a short position for a portfolio of overpriced stocks, the strategy can earn abnormal returns. We test this conjecture by performing the following analyses.

For each satellite event on date *t*, we employ 1-year data up to 10 days prior to the event (i.e., from *t*–375 to *t*–10) to run the regression presented in Eq. (5) below. We use this model to capture the "additional" sensitivity of a stock's returns to market returns on previous satellite launch days,[19] and decompose it depending on the direction of the market price movement.

$$\begin{aligned}(R_{i,w} - R_{f,w}) = \alpha_i + \beta_{i,o,t}(R_{mkt,w} - R_{f,w}) * I(R_{mkt,w} > 0) * Satellite_w + \beta_{i,u,t}(R_{mkt,w} - R_{f,w}) * I(R_{mkt,w} < 0) * Satellite_w \\ + \beta_1(R_{mkt,w} - R_{f,w}) + \beta_2 SMB_w + \beta_3 HML_w + \beta_4 RMW_w + \beta_5 CMA_w + e_{i,w}\end{aligned} \tag{5}$$

where $R_{i,w}$ is the return of firm *i* on day *w* ($w = t - 375, \ldots, t - 10$) and $R_{f,w}$ is the risk-free rate on day *w*. $Satellite_w$ is a dummy satellite event that takes a value of one on launch days and zero on other days within the estimation window. I(.) receives a value of one if the logical function is correct and zero otherwise. The controls are the five Fama–French common risk factors: the CRSP value-weighted market excess return (R_{mkt} - $R_{f,w}$), size (*SMB*), book-to-market (*HML*), operating profitability (*RMW*), and investment (*CMA*). As per our conjecture discussed previously, $\beta_{i,o,t}$ in Eq. (5) represents the additional sensitivity of the stock's returns to market returns, leading to the stock being overpriced on satellite launch days. Hence, we call $\beta_{i,o,t}$ "overpriced" beta. Similarly, $\beta_{i,u,t}$ can be considered "underpriced" beta. The higher the beta, the higher the possibility of mispricing.

Next, based on the values of the "overpriced" and "underpriced" betas for each satellite event, we sort each type of betas into quintiles to form the portfolios. We obtain five portfolios associated with "overpriced" betas, and five portfolios associated with "underpriced" betas corresponding to each satellite event. Finally, we assess the abnormal return of each portfolio, α_p, by regressing its excess returns on the Fama–French five factors using different holding periods *h*, where *h* = [−2, 0], [−2, 1], [−2, 2], [−3, 0], and [−3, 1]. For the "underpriced" ("overpriced") beta portfolios, we take long (short) positions for them at the beginning of a holding period and short (long) positions at the end of the holding period.

We report α_p in the equal- and value-weighted portfolio returns in Panels A and B of Table 8. The last columns show the alphas of long–short strategies that take long positions in the "underpriced" beta portfolios and short positions in the corresponding "overpriced" beta portfolios. Consistent with our conjecture, we find that only portfolios of stocks most sensitive to satellite launches (i.e., beta quintiles 4 and 5) experience a significant increase in alpha across the holding windows. These groups represent the portfolios of stocks with the highest possibility of mispricing induced by satellite launches. Meanwhile, the portfolios with the lowest "underpriced" or "overpriced" betas do not generate abnormal returns. These groups include stocks that are insignificantly affected by satellite-driven investor attention and, therefore, have the lowest possibility of mispricing induced by satellite launches. Interestingly, the long "underpriced" beta portfolios–short "overpriced" beta portfolios strategy generates larger abnormal returns when it starts 2 days before the satellite launch events, 15.2% (14.7%), 13.7% (14.5%), and 17.3% (17.2%) for equal weights (value weights) over the [−2, 0], [−2, 1], and [−2, 2] holding horizons, respectively.[20] These results can be interpreted through Fig. 2, which shows that the highest rate of increase in stock return comovement with the market starts 2 days prior to the event.

To address concerns about the reliability of the estimated coefficient due to the potential effects of unobserved variables, we apply

[19] This additional sensitivity is the amount of beta that is on top of the non-satellite day beta. We exclude firms related to the aerospace industry in this section to better focus on the investor inattention perspective of satellite launches.

[20] Based on Fong, Holden, and Trzcinka (2017), the average round-trip effective spread for U.S. listed stocks is approximately 2 basis points. Our strategy generates an average return between 15.6 and 20.6 basis points over a 3- or 4-day window surrounding the satellite launch date. This suggests that our trading strategy remains significantly profitable after adjusting for transaction costs.

Table 8
Trading strategy.

Panel A: Equal Weights

	"Underpriced" Betas					"Overpriced" Betas					Long-Short Strategy				
Holding Periods	1 (Lowest)	2	3	4	5 (Highest)	1 (Lowest)	2	3	4	5 (Highest)	1 (Lowest)	2	3	4	5 (Highest)
[−2, 0]	0.004	0.006	0.023	0.068***	0.101***	0.014	−0.003	0.01	0.035*	0.05**	0.018	0.003	0.033	0.103***	0.152***
	(0.024)	(0.022)	(0.02)	(0.02)	(0.02)	(0.023)	(0.021)	(0.019)	(0.021)	(0.024)	(0.047)	(0.042)	(0.038)	(0.041)	(0.044)
[−2, 1]	−0.002	−0.002	0.028*	0.052***	0.097***	−0.006	−0.003	0.015	0.026	0.04**	−0.008	−0.005	0.043	0.079**	0.137***
	(0.021)	(0.018)	(0.016)	(0.016)	(0.015)	(0.02)	(0.018)	(0.016)	(0.017)	(0.018)	(0.041)	(0.035)	(0.031)	(0.032)	(0.032)
[−2, 2]	0.019	0.02	0.033**	0.07***	0.115***	0.028	0.016	0.028*	0.041***	0.058***	0.047	0.036	0.061**	0.111***	0.173***
	(0.02)	(0.017)	(0.016)	(0.014)	(0.014)	(0.019)	(0.018)	(0.015)	(0.015)	(0.017)	(0.038)	(0.034)	(0.03)	(0.029)	(0.029)
[−3, 0]	−0.005	−0.013	0.018	0.062***	0.081***	−0.009	−0.003	−0.004	0.033*	0.017	−0.017	−0.022	0.029	0.064**	0.107***
	(0.023)	(0.02)	(0.018)	(0.019)	(0.019)	(0.024)	(0.02)	(0.018)	(0.019)	(0.022)	(0.04)	(0.035)	(0.03)	(0.032)	(0.033)
[−3, 1]	−0.005	−0.013	0.022	0.04**	0.077***	−0.012	−0.009	0.007	0.024	0.030*	−0.014	−0.016	0.014	0.095***	0.098**
	(0.02)	(0.018)	(0.016)	(0.016)	(0.015)	(0.021)	(0.018)	(0.015)	(0.016)	(0.019)	(0.046)	(0.038)	(0.035)	(0.037)	(0.04)

Panel B: Value Weights

	"Underpriced" Betas					"Overpriced" Betas					Long-Short Strategy				
Holding Periods	1 (Lowest)	2	3	4	5 (Highest)	1 (Lowest)	2	3	4	5 (Highest)	1 (Lowest)	2	3	4	5 (Highest)
[−2, 0]	0.008	0.01	0.025	0.071***	0.093***	0.016	0.008	0.014	0.042**	0.054**	0.024	0.018	0.039	0.113***	0.147***
	(0.024)	(0.022)	(0.02)	(0.02)	(0.021)	(0.023)	(0.021)	(0.018)	(0.021)	(0.024)	(0.047)	(0.041)	(0.037)	(0.041)	(0.044)
[−2, 1]	0.000	0.000	0.029*	0.061***	0.096***	0.002	0.008	0.019	0.039**	0.049***	0.002	0.008	0.048	0.101***	0.145***
	(0.021)	(0.018)	(0.016)	(0.015)	(0.015)	(0.02)	(0.018)	(0.016)	(0.016)	(0.018)	(0.04)	(0.035)	(0.031)	(0.031)	(0.032)
[−2, 2]	0.027	0.02	0.039***	0.071***	0.111***	0.03*	0.020	0.035**	0.051***	0.061***	0.057	0.04	0.074**	0.123***	0.172***
	(0.02)	(0.017)	(0.015)	(0.014)	(0.014)	(0.018)	(0.017)	(0.015)	(0.015)	(0.017)	(0.037)	(0.033)	(0.03)	(0.029)	(0.029)
[−3, 0]	−0.002	−0.011	0.024	0.044***	0.075***	−0.005	−0.006	0.009	0.025	0.034*	−0.007	−0.016	0.033	0.069**	0.108***
	(0.02)	(0.018)	(0.016)	(0.016)	(0.016)	(0.02)	(0.018)	(0.015)	(0.016)	(0.018)	(0.04)	(0.035)	(0.03)	(0.032)	(0.033)
[−3, 1]	0.001	−0.01	0.02	0.066***	0.078***	−0.004	0.000	0.002	0.036*	0.033	−0.003	−0.01	0.021	0.102***	0.111***
	(0.023)	(0.02)	(0.018)	(0.019)	(0.019)	(0.023)	(0.019)	(0.017)	(0.019)	(0.022)	(0.045)	(0.038)	(0.034)	(0.037)	(0.04)

Panel C: Oster (2019) Test for Coefficient Stability

$\hat{\delta}$	2.010	2.901	2.021	2.521	2.894	2.887	2.091	2.654	2.689	2.967

This table presents the abnormal returns of each portfolio, α_p, by regressing its excess returns on the Fama–French five factors using different holding periods. Note that for the "underpriced" ("overpriced") beta portfolios, we long (short) them at the beginning of a holding period and short (long) at the end of the holding period. The last five columns represent the abnormal returns of the long "underpriced" beta portfolio and short "overpriced" beta portfolio in the corresponding quintile. The portfolios are formed corresponding to quintiles of the "underpriced" betas ($\beta_{i,u,t}$), and "overpriced" betas ($\beta_{i,o,t}$), which are estimated by firm by satellite events as follows. For each satellite event on date t, we employ one year data up to 10 days prior to the event (i.e., from $t-375$ to $t-10$) to run the following model:

$(R_{i,w} - R_{f,w}) = \alpha_i + \beta_{i,o,t}\,(R_{mkt,w} - R_{f,w})^{*}\mathrm{I}(R_{mkt,w} > 0)^{*}Satellite_w + \beta_{i,u,t}\,(R_{mkt,w} - R_{f,w})^{*}\mathrm{I}(R_{mkt,w} < 0)^{*}Satellite_w + \beta_1\,(R_{mkt,w} - R_{f,w}) + \beta_2 SMB_w + \beta_3 HML_w + \beta_4 RMW_w + \beta_5 CMA_w + e_{i,w}$ (5).

where $R_{i,w}$ is the return of firm i on day w ($w = t-375,\ldots, t-10$) and $R_{f,w}$ is the risk-free rate on day w. $Satellite_w$ is a dummy satellite event that takes a value of one on the launch days and zero in other days within the estimation window. I(.) receives value of one if the logical function is correct and zero otherwise. The controls are the Fama–French five common risk factors: the CRSP value-weighted market excess return (R_{mkt} - $R_{f,w}$), size (*SMB*), book-to-market (*HML*), operating profitability (*RMW*), and investment (*CMA*).

Panel C shows the average values of δ following the proposition 3 of Oster (2019), in which each δ_i for stock i model is estimated for zero treatment effects (i.e., betas of the models with controls are equal zeros) with the maximal R^2 set at 1.3 times of the R^2 of the models with controls. Note that all these δ estimates are statistically and significantly greater than 1 at the 1% significant level. Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9
Stock return comovement for different characteristics of satellite launches.

	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
(1) Non-Launch Days	0.264	0.271	0.085	0.088
Panel A: Pioneering/Normal Launch				
(2) Pioneer Launches	0.359	0.387	0.121	0.126
(3) Normal Launches	0.280	0.287	0.094	0.099
(2) - (3)	0.080***	0.099***	0.027***	0.027***
	(0.000)	(0.000)	(0.000)	(0.000)
(2) - (1)	0.095***	0.116***	0.036***	0.038***
	(0.000)	(0.000)	(0.000)	(0.000)
(3) - (1)	0.016***	0.016**	0.009***	0.011**
	(0.000)	(0.019)	(0.000)	(0.024)
Panel B: Successful/Failed Launch				
(4) Successful Launches	0.272	0.292	0.091	0.098
(5) Failed Launches	0.336	0.348	0.131	0.135
(4) - (5)	−0.064***	−0.056***	−0.040***	−0.037***
	(0.000)	(0.000)	(0.000)	(0.000)
(4) - (1)	0.009**	0.021***	0.006***	0.009**
	(0.025)	(0.001)	(0.000)	(0.03)
(5) - (1)	0.072***	0.077***	0.046***	0.047***
	(0.000)	(0.000)	(0.000)	(0.000)
Panel C: Crewed/Uncrewed Launch				
(6) Crewed Launches	0.300	0.326	0.114	0.129
(7) Uncrewed Launches	0.273	0.292	0.099	0.106
(6) - (7)	0.027***	0.034***	0.015***	0.023***
	(0.000)	(0.000)	(0.000)	(0.001)
(6) - (1)	0.036***	0.055***	0.029***	0.041***
	(0.000)	(0.000)	(0.000)	(0.000)
(7) - (1)	0.009**	0.020***	0.014***	0.018***
	(0.018)	(0.002)	(0.000)	(0.000)

This table presents the correlation coefficients of excess stock returns and excess market returns for non-launch days and for satellite launches classified as pioneering or normal, successful or failed, and crewed or uncrewed. The CAPM model's adjusted R^2s are obtained for the respective seven groups. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Oster's (2019) approach to test coefficient stability under the selection of unobserved variables.[21] Our parameter of interest is δ, whose estimated values are presented in Panel C of Table 8. We estimate δ parameter for zero treatment effect (i.e., betas of the models with controls restricted as zeros) with maximal R^2 set at 1.3 times the R^2 of the controlled model in each case of Eq. (5) as per Oster's (2019) suggestion. A δ value of 1 can be interpreted as selection on unobserved variables needs to have an equivalent impact as selected observables to drive away the results. Given this interpretation, the average estimates of δ parameter in our case ranging between 2.01 and 3.245 imply that the unobservables' impacts need to be at least two times larger than that of the observables to negate our results. These results confirm that our findings are immune to the problem of omitted variables.

7. Additional and robustness analyses

7.1. Subsamples based on launch characteristics

In this subsection, we present the additional tests. We split satellite launch events into (1) pioneering and normal events, (2) successful and failed events, and (3) crewed and uncrewed events, and replicated the main analysis. The results are presented in Table 9.

First, since launches that involve the first satellite of a certain type, a new mission, or use of a new technology tend to draw stronger interest among the public than flights without any unique features, we expect that the satellite-induced return comovement for these pioneering launches is likely to be higher than that for normal launches. To test our hypothesis, we manually check the information in the description column and divide the satellite launches into two subgroups: pioneering and normal satellite launches. We define a pioneering satellite as the first satellite to go to space or to discover a new aspect of the universe. For example, we identify Explorer 1 launched by the U.S. on January 31, 1957, as a pioneering event, as it is described by Wikipedia as the "first American satellite in space". Other examples are Mariner 2 launched on August 27, 1962, described as the "first spacecraft to visit another planet [Venus]",

[21] For details of the methodology, refer to Subsection 3.3 and proposition 3 of Oster (2019).

Table 10
Stock return comovement with associated industries.

	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
(1) Launches Days	0.289	0.281	0.090	0.087
(2) Non-Launch Days	0.269	0.268	0.083	0.079
(1) - (2)	0.020***	0.013*	0.007***	0.008*
	(0.000)	(0.076)	(0.001)	0

This table presents the correlation coefficients of excess stock returns and excess industry returns for satellite launch and non-launch days separately. The adjusted R^2s by regressing excess stock returns on excess industry returns are also obtained for the respective two groups. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

and Intelsat 1 launched on April 6, 1965, described as the "first commercial communications satellite in orbit".[22]

We identify 105 launches as pioneering events and 195 as normal events. We re-estimate the return comovement proxies for these two groups separately, and compare them with the corresponding estimates on non-launch days. The results in Panel A of Table 9 show that while both return correlation coefficients for pioneering and normal launches are higher than those on normal launch days, the coefficients for pioneering events are substantially larger. For instance, the pioneering–normal correlation difference is, on average, 0.080, representing an increase of 29% relative to the correlation coefficient for normal launches. The corresponding percentage difference in the adjusted R^2 is also significantly high at 29%. These results confirm our hypothesis on the effect of pioneering launches on satellite-induced stock return comovement with the market.

Second, it is important to note that satellite launches can either be successful or fail. Therefore, we also examine whether investors exhibit different levels of attraction to successful and failed launch events, potentially resulting in divergent comovement patterns between stocks and markets on these particular days. Our conjecture is motivated by findings in psychology literature (e.g., Taylor, 1991; Rozin and Royzman, 2001), which show a remarkably stronger cognitive effect of negative events on humans compared to positive events. Specifically, Pratto and John (1991) provide experimental evidence that people automatically direct their attention away from the current task toward extraneous stimuli, and this shift is faster and remains longer for stimuli with negative traits than for those with positive traits. Baumeister et al. (2001) and Rozin and Royzman (2001) review the literature on the power of negative events and find that negative stimuli, which include social information, seem to command more attention and that their impact on attention is stronger and spreads more rapidly than positive stimuli do. In addition, media outlets generally consider bad events and depressing stories to be more newsworthy and attract more reader attention (e.g., Trussler and Soroka, 2014).

Our database reports the outcomes of satellite launches. We divide our sample into two subgroups: 257 successful and 43 failed satellite launches. As before, we obtain the means, medians, and differences in return comovement for these successful and failed launch events. The results in Panel B of Table 9 show that the mean returns correlation coefficient for failed (successful) launches is 0.336 (0.272), representing a significant increase of 24% relative to the coefficient for successful launches. The corresponding failure–success mean difference in the adjusted R^2 is 0.040, or a considerably large increase of 44% from the adjusted R^2 of successful events. As expected, the return comovements for both types of launches are higher than those on non-launch days. Therefore, the results in Panel B are consistent with the psychology literature regarding increased attention toward negative events, which yields increased stock return comovement with the market for failed satellite launches.

Third, the satellites can be either crewed or uncrewed. We define a launch as a crewed launch if the satellite is controlled by humans, and otherwise as an uncrewed launch. Neil Armstrong with the historic walk on the moon has been a hero in people's mind. A survey conducted by the Pew Research Center in 2015 shows that 59% (39%) of public participants agree (disagree) that human astronauts are vital for the future of the U.S. space program.[23] Therefore, we conjecture that investor attention to crewed and uncrewed launches can differ, with crewed launches having a larger impact. Our sample includes 161 crewed and 139 uncrewed launch events, for which we separately re-estimate the return comovement proxies and test their differences. Panel C of Table 9 reports the results. Apart from the expected pattern that both crewed and uncrewed launches generate higher return comovement with the market compared to non-launch days, we find that the return correlation coefficient for crewed launches is higher than that for uncrewed launches by 0.027 in mean correlation and 0.015 in mean adjusted R^2. These represent an increase of 10% and 15% for the two comovement measures, respectively. These findings support our prediction that increased public attention to space missions with astronauts results in greater investor inattention to the stock market and, hence, its associated increase in stock return comovement.

7.2. Stock return comovement with associated industries

On attention-grabbing days, investors tend to shift their focus toward category learning of market-wide information instead of firm-specific information. This category learning effect can also be extended to industry-level information on satellite launch days, albeit to

[22] Some examples in recent times include Mars Pathfinder in 1996 as the "first automated surface exploration of another planet," OSIRIS-Rex in 2016 as the "first American asteroid sample return spacecraft," and Parker Solar Probe in 2018 as "the first spacecraft to visit the outer corona of the Sun."

[23] https://www.pewresearch.org/science/2015/07/01/chapter-8-attitudes-on-space-issues/

Table 11
Stock return comovement excluding aerospace-associated firms.

	Correlation Coefficient		Adjusted R^2	
	Mean	Median	Mean	Median
(1) Launch Days - Aerospace Firms	0.298	0.360	0.108	0.156
(2) Launch Days - Non-Aerospace Firms	0.287	0.290	0.101	0.106
(3) Non-Launch Days	0.264	0.271	0.084	0.087
(1) - (3)	0.034*	0.089***	0.024**	0.069***
	(0.065)	(0.000)	(0.022)	(0.000)
(2) - (3)	0.023***	0.019***	0.017***	0.019***
	(0.000)	(0.005)	(0.000)	(0.000)

This table presents the correlation coefficients of excess stock returns and excess market returns for launch and non-launch days separately. The CAPM model's adjusted R^2s are also obtained. These comovement proxies are then grouped by firms in the aerospace industry and other industries. We apply the paired *t*-test for the mean difference and Wilcoxon signed-rank for the median difference. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 12
Alternative model specification and the oster coefficient stability test.

	Market Beta Coefficient				Adjusted R^2				Oster (2019)
	CAPM		Fama–French 5-Factor Model		CAPM		Fama–French 5-Factor Model		$\hat{\delta}$
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	
Launch Days	0.969	0.944	0.841	0.810	0.103	0.110	0.136	0.180	2.383
Non-Launch Days	0.812	0.819	0.722	0.721	0.085	0.088	0.096	0.111	1.678
Difference	0.156***	0.126***	0.120***	0.088***	0.019***	0.022***	0.040***	0.069***	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

This table presents the results obtained using different model specification as well as from the Oster coefficient stability test. The first four columns of the table report the mean and median of market beta coefficients estimated from CAPM and Fama–French 5-factor model. Next four columns report the mean and median of Adjusted R^2 obtained from CAPM and Fama–French 5-factor model. The last column reports the average estimates of the δ parameter following Oster (2019)'s proposition 3. For each stock i model with Fama–French factors as controls, we estimate δ_i for zero treatment effects (i.e., betas of the models with controls are equal zeros) with the maximal R^2 set at 1.3 times of the R^2 of the models with controls. Note that all these δ estimates are statistically and significantly greater than 1 at 1% significant level. *p*-values are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

a lesser degree. In this subsection, we test this prediction and investigate whether stocks comove more with their associated primary industry on launch-event days than on other days. As in SubSection 4.1, we use the return correlation coefficient and adjusted R^2 as proxies for return comovement. However, we replace market excess returns with industry excess returns based on two-digit Standard Industrial Classification codes and estimate these proxies for each sample firm for launch and non-launch days separately.

We present the results in Table 10. Consistent with our expectations, we find that individual stocks experience an increase in return comovement with their associated industry on launch days. The mean (median) increase is 0.020 (0.013) or 7% (5%) relative to the return correlation on non-launch days. The corresponding percentage mean (median) increase is 8% (10%) in adjusted R^2. Nonetheless, compared with the changes in return comovement with the market in Table 3, the findings in Table 10 are smaller in magnitude and weaker in statistical significance, which is in line with our expectations and the results of Huang et al. (2019).

7.3. Excluding firms in the aerospace industry

There may be concern that a satellite launch event can fundamentally affect the stock returns of aerospace-associated firms, which can subsequently drive the market. Hence, to address this concern, we perform a robustness test by excluding aerospace-associated firms from the sample and replicating the main analysis.

The results in Table 11 show that the increase in return comovement for non-aerospace firms remained highly significant on launch event days. For example, the mean correlation coefficient (adjusted R^2) difference is 0.023 (0.017), which is equivalent to a 9% (20%) increase relative to that on non-launch days. Although these percentage changes are smaller in magnitude than the corresponding 11% (22%) changes in Table 3 when aerospace firms are included, the message remains the same: investors become distracted due to satellite launches, resulting in the returns of their stock investments incorporating more market-level information on those event days. As expected, increases in return comovements on launch days are significantly larger across all tests, especially for the medians.

7.4. Coefficient stability

As we mainly use the CAPM model, there may be concern about the coefficient stability when more control variables are added; that is, our approach can be subject to the problem of omitted variables. Although the CAPM specification is most suitable for our purpose of investigating stock return comovement with the market because it explains how much variation in the stock return is

Table 13
Effect of satellite launches on investor sentiment.

	Baker's Investor Sentiment		VIX	
	(1)	(2)	(3)	(4)
Intercept	1.664***	1.663***	2.310***	2.311***
	(0.118)	(0.118)	(0.107)	(0.107)
Launch Day	0.012		−0.001	
	(0.027)		(0.026)	
Launch Day*Single		0.023		−0.008
		(0.028)		(0.028)
Launch Day*Multiple		−0.045		0.048
		(0.054)		(0.055)
Control variables				
S&P500 Returns	−0.652	−0.642	−1.399***	−1.406***
	(0.496)	(0.496)	(0.366)	(0.366)
Crude Oil Returns	0.027	0.033	−0.323***	−0.328***
	(0.156)	(0.156)	(0.115)	(0.116)
EUR/USD Returns	−0.801	−0.824	0.115	0.136
	(0.704)	(0.704)	(0.520)	(0.521)
Crisis	−2.392***	−2.391***	1.165***	1.163***
	(0.145)	(0.144)	(0.123)	(0.123)
Year Fixed Effects	Yes	Yes	Yes	Yes
Adj. R-squared	0.925	0.925	0.683	0.684
Number of Obs.	684	684	352	352

This table reports the effect of U.S. satellite launches on investor sentiment. Baker's investor sentiment represents the monthly change in Baker and Wurgler (2007) investor sentiment index, while VIX represents the monthly change in the CBOE's volatility index. The "single" is a dummy variable taking value of one if there is only one satellite launch in a month and zero otherwise while the "multiple" is a dummy variable taking value of one if there is more than one satellite launch in a month. Crisis is the Global Financial Crisis dummy. Standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

explained by the market return, it is worthwhile to check whether our results hold under the consideration of unobserved effects.

Therefore, two additional analyses are performed. First, we employ the Fama–French five factor model to replicate our baseline results for stock return comovement, as presented in Table 3. By using the Fama–French five factor model, we report the estimated market beta to represent stock return comovement with the market rather than the correlation coefficient, as seen in Table 3. Second, we follow Oster 's (2019) approach to test the coefficient stability, considering possible unobservable effects. Table 12 presents the results. For the alternative model specifications, we find a negligible change in the market beta, which supports the robustness of our results. For coefficient stability test, the main parameter to make a conclusion about the coefficient stability is δ as discussed in Subsection 3.3 and proposition 3 of Oster (2019). As suggested by Oster (2019) for an empirical application, we estimate the δ parameters for zero treatment effects with the maximal R^2 set at 1.3 times the R^2 of the controlled models for launch and non-launch days. We find that average estimates of δ are 2.383 and 1.678 for launch and non-launch day models, respectively. Following the interpretation of δ presented in Section 6, and given that our average estimates of δ are significantly greater than 1 in all cases, our results are highly robust; thus, the problem of selection on unobserved variables does not invalidate our main findings.

7.5. Investor sentiment

Because satellite launches can be thought of as indications of technological development, one may argue that they can lead to positive investor sentiment while simultaneously attracting investor attention, which may affect the reliability of our interpretation of the findings. We address this concern by conducting additional analyses to investigate whether satellite launches affect investor sentiment. We employ two proxies of investor sentiment, namely, the Baker and Wurgler's (2007) investor sentiment index and the VIX index, and regress their changes on the satellite launch day dummies, controlling for S&P500 returns, crude oil returns, change in exchange rates, a Global Financial Crisis dummy, and year fixed effects. Table 13 lists the estimated outputs. Overall, we consistently find that satellite launches do not significantly affect investor sentiment, suggesting that this factor does not affect our main findings.

8. Conclusion

Existing theoretical research forecasts that when investors are attracted away from the stock market, they allocate less attention to firm-specific information than to market shocks, resulting in higher correlations between individual stock returns and market returns. However, empirical studies testing this theory are limited owing to the challenge of identifying exogenous shocks to investor attention. Our study contributes to this body of literature by introducing satellite launches as unique exogenous shocks that capture U.S. investors' attention and influence stock return comovement. Furthermore, we provide significant financial implications by designing a trading strategy that can exploit potential short-term mispricing induced by a satellite launch. We first validate satellite launches as an exogenous shock to investors' attention using share turnover and Google SVI for firm names and the word "satellite". Our results indicate that investor trading activity decreases on the days when a satellite is launched. Investors' searches for firm names are also lower whereas their Google searches for the word "satellite" jump substantially on the event dates. Subsequent analyses using a classification of military and non-military launches or separating the Cold War period (i.e., before the Soviet Union's dissolution) and the post-Soviet period suggest that concerns about national security contribute a much larger extent to attracting investors' attention to satellite launches than other reasons do.

By linking satellite launches to stock return comovement, we find that stock returns comove more with market returns on launch days than on non-launch days. We find a similar, albeit weaker, comovement pattern between stock returns and associated industry returns. In addition, our results show that satellite launch events trigger a gradual increase in return comovement with the market on pre-event days, which peaks on the official launch days before declining on post-event days. We further explore the implications of our main finding by designing a trading strategy that aims to exploit potential mispricing due to investor inattention to stock-specific information on satellite launch days. Our empirical results show that by taking long positions in the portfolio of stocks with the highest satellite-induced comovements in a decreasing market and taking short positions in the portfolio of stocks with the highest satellite-induced comovements in an increasing market, we can generate an annualized abnormal risk-adjusted return of 10% to 17% within the 4-day window around the launch events.

We obtain other interesting findings when we partition the sample events based on their launch characteristics. First, stock returns comove much more with the market during pioneering, failed, and crewed satellite launches. Second, we extend our sample and include non-U.S. satellite launches to examine whether foreign launches also affect U.S. investors' attention and induce return comovement. Indeed, we find that the increase in stock return comovement with the market is the largest for launches by RCI, arguably the three old and rising main competitors to the U.S. in the aerospace industry. The results provide fresh evidence that U.S. investors are strongly attracted to international space competition. Finally, our findings are highly robust when we exclude aircraft-associated firms to distinguish between the impacts of investor attention and fundamentals on stock return comovement.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Supplementary materials

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