IOSR Journal Of Economics and Finance (IOSR-JEF)
e-ISSN: 2321-5933, p-ISSN: 2321-5925.Volume 17, Issue 2 Ser. 1 (Mar. – Apr. 2026), PP 58-64
www.Iosrjournals.Org

ISRO Announcements And Abnormal Returns In Indian Space Firms: An Event Study Approach

Dr. Muskan Karamchandani (Associate Professor),
Ms. Muskan Kushwah (Research Scholar), Mr. Prasuk Jain (Student)
(International Institute Of Professional Studies, DAVV, India)

Abstract:
The global space economy's swift growth has heightened investor focus on companies linked to space technologies and services. This paper explores the effects of prominent space program milestones on stock returns for firms within India's developing space ecosystem. Employing event study techniques, market reactions for 13 publicly traded companies active in aerospace engineering, defence electronics, precision manufacturing, and advanced technology services are assessed. These entities support India's space value chain through components, electronic systems, engineering services, and technological inputs for Indian Space Research Organisation (ISRO) missions. Analysis centres on six key events: the Chandrayaan-2 launch; Chandrayaan-3 launch and landing; Aditya-L1 mission; PSLV-C56 commercial satellite launch; and the 2024 Space Sector FDI Policy Reform. The expected returns are estimated via the market model, using the NIFTY 50 as benchmark. A 110-day estimation window precedes a 61-day event window (t−30 to t+30), with cumulative average abnormal returns (CAAR) computed over four sub-windows to trace short- and long-term responses. Empirical results show varied market reactions. Mission successes and policy changes yield positive CAAR in extended windows, reflecting rising investor confidence in space value chain participants. Certain events, however, elicit negligible or insignificant short-term effects, likely due to prior expectations and gradual information assimilation. These patterns offer investors signals from space developments for trading decisions. For policymakers and industry actors, they highlight how achievements and reforms shape capital inflows in India's space sector.

Keywords: *Event Study Methodology, Space Sector Stocks, Indian Space Industry, Abnormal Returns, Chandrayaan Missions, Space Policy Reforms, Stock Market Reactions.*

Date of Submission: 05-03-2026 Date of Acceptance: 15-03-2026

I. Introduction

The global space economy has evolved from a system largely driven by government-funded scientific exploration into a rapidly expanding commercial ecosystem. Today, it is valued at over $600 billion worldwide, supporting essential services such as telecommunications, satellite navigation, disaster monitoring, and Earth observation that underpin modern economic activity. In India, the national space program has been led by the Indian Space Research Organisation (ISRO) since its establishment in 1969. Over time, the organization has built a strong record of technological capability through more than one hundred spacecraft missions and numerous successful launches. Key milestones in this journey include the launch of the Aryabhata, the Mars Orbiter Mission Mangalyaan, and the series of Chandrayaan lunar missions that have strengthened India’s global standing in space exploration.

India has also established a strong reputation in the commercial launch market through the Polar Satellite Launch Vehicle (PSLV). Known for its reliability and cost efficiency, PSLV has deployed satellites for numerous international customers through Antrix Corporation. These missions have allowed India to participate actively in the global satellite launch market while maintaining comparatively lower operational costs than many established launch providers. Recent institutional reforms have further accelerated the development of India’s space ecosystem. The Indian Space Policy 2023 has opened the sector to increased private and foreign participation, including provisions allowing full foreign direct investment in satellite manufacturing. At the same time, the regulatory body IN-SPACe has authorized more than two hundred private entities to participate in space-related activities. Complementing these reforms, the Government of India has introduced a ₹1,000 crore venture support mechanism aimed at encouraging space startups. Together, these initiatives have expanded the domestic industry from only a few private participants in 2020 to an emerging sector that is expected to reach nearly $44 billion by 2033.

Financial markets typically respond quickly to new economic opportunities. However, despite the growing strategic and economic importance of India’s space program, the influence of major space missions and

policy announcements on the valuation of domestic space-related firms has received limited empirical attention. Earlier studies highlight that public investments in space programs often generate socio-economic returns exceeding 2.5 times the initial expenditure. Beyond technological advancement, such programs enhance national connectivity, strengthen disaster management systems, and support security capabilities. Yet the extent to which these developments influence the stock market performance of firms connected to the space supply chain remains unclear. This includes large public sector companies such as Hindustan Aeronautics Limited and Bharat Electronics Limited, as well as specialized private manufacturers like Data Patterns (India) Limited and MTAR Technologies that contribute components and technological solutions to the space sector. Without systematic evidence, investors must interpret such developments with limited guidance regarding their financial implications.

Event study methodology offers a well-established framework for examining how markets respond to new information. The approach, formally articulated by A. Craig MacKinlay, has been widely used to evaluate the impact of policy announcements and corporate events on stock prices. Prior organizational studies have also examined the operational efficiency and commercialization efforts of ISRO (Murthi et al., 2007). Nevertheless, the relationship between outcomes of space missions and the stock market behaviour of India's listed space ecosystem firms has not been systematically explored. In particular, little empirical evidence exists on whether major space-related announcements generate abnormal returns for the thirteen publicly listed companies associated with India's space supply chain. This absence of research leaves an important gap in understanding how technological achievements in the national space program translate into capital market outcomes.

The lack of such evidence has practical implications for multiple stakeholders. Investors need clearer insights into whether specific types of developments, such as high-profile lunar missions, routine commercial launches, or regulatory reforms, tend to influence market valuations. Policymakers may also benefit from understanding whether initiatives like foreign direct investment liberalization produce measurable financial responses that justify continued policy support and infrastructure investment. Industry analysts, meanwhile, face the challenge of evaluating emerging private launch providers and satellite enterprises without established benchmarks for valuation within the Indian market.

This study attempts to address this gap through a structured event study analysis. It evaluates abnormal returns for thirteen listed Indian companies associated with the space sector, using the NIFTY 50 as the market benchmark. The analysis focuses on six major developments between 2019 and 2024, including the launch of Chandrayaan-2, the launch and successful landing of Chandrayaan-3, the introduction of the solar mission Aditya-L1, the commercial launch PSLV-C56/DS-SAR mission, and the announcement of the space sector FDI policy. By examining market responses across multiple event windows, the study seeks to isolate the value created by these events from broader market fluctuations. In doing so, it provides an empirical perspective on how developments in India's space program influence the financial performance of domestic space-related firms, contributing to investment decision-making, policy evaluation, and the broader understanding of India's expanding commercial space economy.

II. Literature Review

Event study methodology is widely used in financial economics to analyse how specific events influence stock prices. The foundations of this approach were established by Eugene F. Fama, Lawrence Fisher, Michael C. Jensen, and Richard Roll (1969), who showed that financial markets respond rapidly to new information. Their findings provided empirical support for the Efficient Market Hypothesis, indicating that stock prices adjust quickly once relevant information becomes publicly available. Later, Stephen J. Brown and Jerold B. Warner (1985) strengthened the methodological reliability of event studies by examining their statistical performance and confirming that they effectively identify abnormal returns surrounding particular events. Further refinement came from A. Craig MacKinlay (1997), who provided a detailed explanation of event study procedures and clarified how abnormal returns can be estimated using defined event windows. His work helped standardize the major steps of the analysis, including identifying the event date, estimating expected returns, and testing statistical significance. Additional methodological discussions by John J. Binder (1998) and by John Y. Campbell, Andrew W. Lo, and A. Craig MacKinlay (1997) further expanded the econometric foundation of event studies, establishing them as a dependable empirical tool for analysing how financial markets respond when new information becomes available.

Researchers have applied this approach to a wide range of events that influence investor behaviour, including corporate announcements, mergers and acquisitions, regulatory changes, and technological developments. Monetary policy announcements are among the most extensively examined because financial markets are highly sensitive to signals from central banks that affect expectations about interest rates, inflation, and economic growth. For instance, Ben S. Bernanke and Kenneth N. Kuttner (2005) found that unexpected changes in monetary policy generate noticeable effects on stock market returns, suggesting that investors closely monitor such announcements when adjusting their investment strategies. Earlier research by Willem Thorbecke (1997) also documented a relationship between monetary policy shocks and stock market performance, as policy

rate changes influence discount rates and expectations about corporate earnings. Studies focusing on emerging markets show similar reactions. Research by Suchismita Bose and Dipankar Coondoo (2004) and by Alexander Kurov (2010) indicates that financial markets in developing economies often display abnormal returns around policy announcements. Evidence from the Indian market reflects comparable behaviour, where investors respond quickly to information related to interest rate decisions, liquidity measures, and economic outlook statements, consistent with the semi-strong form of the Efficient Market Hypothesis.

Political and technological developments have also been examined using event study methods. Elections, changes in government leadership, and policy transitions can create uncertainty regarding future economic direction. In this context, Kiran Chavali, Mohammad Alam, and Selva Rosario (2020) found that election outcomes can generate abnormal returns as investors reassess the economic implications of political change. Technological innovation likewise influences firm valuation. Research by Bronwyn H. Hall, Adam B. Jaffe, and Manuel Trajtenberg (2005) shows that innovation indicators such as patents affect firm value because investors interpret them as signals of future profitability, while earlier work by Zvi Griliches (1990) emphasized the broader role of research and development in driving productivity growth and long-term economic expansion.

Large public technology programmes provide another context where economic and financial outcomes intersect. Space programmes, for example, require substantial public investment and generate long-term technological spillovers across industries. Bart Hof, Carl Koopmans, Remco Lieshout, and Marijn Wokke (2012) proposed an evaluation framework that combines social cost–benefit analysis with multi-criteria assessment to capture both financial and broader societal impacts. Research focusing on India's space sector further highlights how institutional arrangements have supported the expansion of commercial space services. For instance, K. V. Murthi, R. Sankar, and K. Madhusudhan (2007) examined the organizational structure and commercialization strategies associated with the Indian Space Research Organisation, showing how policy and institutional support have enabled India to participate more actively in global satellite and launch markets. Reports from the Organisation for Economic Co-operation and Development (2019) and the Space Foundation (2020) also highlight the growing economic importance of the global space industry, where satellite communication, geospatial services, and space-based data applications support a wide range of economic activities.

Despite this expanding literature, research directly linking space-related developments to financial market outcomes remains limited. Much of the existing work focuses on macroeconomic announcements, political developments, or technological innovation in general rather than on milestones in national space programmes. This gap is particularly noticeable in emerging economies where the commercial space sector is expanding and attracting private investment. Understanding this relationship has therefore become increasingly important. Satellite launches, mission achievements, and policy initiatives related to the space sector may shape investor expectations about future industry growth, yet the financial market consequences of such developments have not been examined extensively. Analysing these reactions through event study methodology can help explain how investors interpret progress within the space economy, especially in emerging space nations such as India where private participation in the sector is growing rapidly.

III. Objective

This study examines how major developments in India's space sector influence the stock prices of listed companies connected to the industry. In particular, it evaluates the market response to six key space-related events associated with the Indian Space Research Organisation. The specific events taken up for study are: Chandrayaan-2 launch (22 July 2019), Chandrayaan-3 launch (14 July 2023), Chandrayaan-3 lunar landing (23 August 2023), launch of Aditya-L1 (2 September 2023), PSLV-C56 / DS-SAR commercial satellite launch (30 July 2023) and announcement of space sector foreign investment policy (16 April 2024), which allowed 100% foreign direct investment in satellite manufacturing. Market reactions for 13 publicly traded companies active in aerospace engineering, defence electronics, precision manufacturing, and advanced technology services are assessed for these events.

IV. Research Methodology

This study follows a quantitative and empirical research design based on the event study methodology commonly used in financial economics. The approach is applied to examine how major developments in India's space sector, such as mission launches, technological milestones, and policy announcements, affect the stock prices of listed firms associated with the industry. By comparing actual stock returns around the announcement dates with expected returns estimated from a pre-event period, the method identifies abnormal returns that can be attributed to these events while controlling for overall market movements. This framework makes it possible to observe investor reactions to developments linked with the Indian Space Research Organisation and to identify whether such events create measurable value for firms connected to the sector. The analysis involves several steps: identifying relevant events, estimating normal returns, calculating abnormal returns, aggregating these returns across firms and time, and finally testing their statistical significance.

Event Definition and Windows

The analysis is structured around three main periods: the estimation window, the event day (t = 0), and the event window. The estimation window consists of 110 trading days prior to the event period and is used to establish the normal behaviour of stock returns. The event window extends from t–30 to t+30, covering a total of 61 trading days around the event date, excluding non-trading days. Only clearly identifiable events with precise announcement dates are included in the analysis, such as major mission launches or policy announcements related to India's space programme.

Data Sources and Sample

The study focuses on thirteen publicly listed companies that are actively involved in India's space ecosystem through manufacturing, aerospace engineering, electronics, or defence-related technologies.

Table no. 1: Listed Indian Space Ecosystem Firms

S. No.	Company	Symbol
1	Centum Electronics Ltd	CENT
2	MTAR Technologies Ltd	MTAR
3	Paras Defence and Space Tech Ltd	PRAF
4	Avantel Ltd	AVNT
5	Tata Elxsi Ltd	TTEX
6	Hindustan Aeronautics Ltd	HIAE
7	Apollo Micro Systems Ltd	APLL
8	Walchandnagar Industries Ltd	WALC
9	Data Patterns (India) Ltd	DATP
10	Bharat Electronics Ltd	BAJE
11	Larsen & Toubro Ltd	LART
12	Godrej Industries Ltd	GODI
13	Astra Microwave Products Ltd	ASTM

Daily closing stock prices and return data for these firms were collected from publicly available financial databases, including NSE, Investing.com and Yahoo Finance.

Selected Space Events

Six major developments associated with India's space programme were selected for the analysis because they represent important technological achievements or policy changes.

Table no. 2: Key ISRO Announcements

S. No.	Event	Date	Description
1	Chandrayaan-2 Launch	22 July 2019	Lunar mission orbiter/lander (partial success)
2	Chandrayaan-3 Launch	14 July 2023	Successful lunar south pole mission
3	Chandrayaan-3 Landing	23 Aug 2023	India becomes 4th nation to soft-land on Moon
4	Aditya-L1 Launch	2 Sept 2023	First solar observatory mission to L1 halo orbit
5	PSLV-C56/DS-SAR	30 July 2023	Commercial satellite launch with 6 co-passengers
6	Space Sector FDI Policy	16 April 2024	100% FDI approval for satellite manufacturing

Estimation of Normal Returns

Daily stock returns for each firm are calculated using logarithmic returns:

$R_{it} = \ln\left(\frac{P_{it}}{P_{i,t-1}}\right)$……..……..……..(equation 1)

Normal (expected) returns are estimated using the market model:

$ER_{it} = \alpha_i + \beta_i R_{mt}$……..……..…..(equation 2)

where R_{mt}represents the daily return of the NIFTY 50 index, which serves as the market benchmark. The parameters $\alpha_i$and $\beta_i$are estimated using ordinary least squares regression based on data from the estimation window.

Abnormal Returns

Abnormal returns measure the difference between actual and expected returns:

$AR_{it} = R_{it} - ER_{it}$……..……..……..(equation 3)

These abnormal returns represent the portion of stock price movements that cannot be explained by general market fluctuations and may therefore reflect the impact of the event.

Average and Cumulative Abnormal Returns

To evaluate the overall effect across all firms in the sample, abnormal returns are averaged for each event day:

$AAR_t = \frac{1}{N}\sum_{i=1}^{N} A\,R_{it}$……..……..……..(equation 4)

Cumulative abnormal returns are then calculated by summing the average abnormal returns across the selected event window:

$CAAR = \sum_{t=t_1}^{t_2} AA\,R_t$……..……..……..(equation 5)

Statistical Significance Testing

To determine whether the abnormal returns are statistically meaningful, t-statistics are calculated. For average abnormal returns:

$t(AAR_t) = \frac{AAR_t}{\sigma_{N,e}/\sqrt{N}}$……..……..……..(equation 6)

For cumulative abnormal returns:

$t(CAAR) = \frac{CAAR}{\sigma_{N,e}\sqrt{(t+1)/N}}$……..……..……..(equation 7)

The standard deviation used in these tests is obtained from the estimation window:

$\sigma_{i,e} = \sqrt{\frac{1}{n-1}\sum(AAR_e - A\bar{A}R_e)^2}$……..……..……..(equation 8)

Through this structured analytical framework, the study evaluates how developments in India's space programme influence investor behaviour and stock price movements. The methodology enables the identification of abnormal market responses linked to specific space-related events while accounting for broader market trends, thereby providing insight into the interaction between technological achievements and capital market performance in India's evolving space economy.

V. Results And Findings

The event study analysis conducted across six major space-related events reveals heterogeneous market reactions among Indian space sector companies. The statistical significance of abnormal returns was tested at the 95% confidence level, with a critical t-value of ±1.96. The results indicate that while several events generated statistically insignificant abnormal returns, three events produced notable market responses. In particular, the Chandrayaan-3 launch generated sustained positive abnormal returns, the Chandrayaan-2 mission produced negative reactions, and the announcement of foreign direct investment (FDI) liberalization in the space sector triggered short-term positive investor sentiment.

Table no. 3: CAAR and t-Statistics across Multiple Event Windows for Selected Space Events

Event	Time Window	CAAR	T-Statistics Of CAAR
Chandrayaan-3 (Launch Event)	t_{-3} to t_{+3}	0.023	0.861
	t_{-5} to t_{+5}	0.015	0.434
	t_{-10} to t_{+10}	-0.007	-0.143
	t_{-30} to t_{+30}	0.186	**2.331***
Chandrayaan-2	t_{-3} to t_{+3}	-0.035	-1.382
	t_{-5} to t_{+5}	-0.069	**-2.190***
	t_{-10} to t_{+10}	-0.099	**-2.265***
	t_{-30} to t_{+30}	-0.155	**-2.088***
Aditya-L1	t_{-3} to t_{+3}	0.025	1.011
	t_{-5} to t_{+5}	0.005	0.144
	t_{-10} to t_{+10}	-0.005	-0.112
	t_{-30} to t_{+30}	0.077	1.044

Event	Time Window	CAAR	T-Statistics Of CAAR
FDI in Space Sector	t_{-3} to t_{+3}	0.065	**2.279***
	t_{-5} to t_{+5}	0.059	1.642
	t_{-10} to t_{+10}	-0.039	-0.790
	t_{-30} to t_{+30}	-0.145	-1.718
PSLV-C56/DS-SAR Mission	t_{-3} to t_{+3}	0.010	0.418
	t_{-5} to t_{+5}	0.010	0.328
	t_{-10} to t_{+10}	-0.013	-0.316
	t_{-30} to t_{+30}	0.034	0.472
Chandrayaan-3 (Landing Event)	t_{-3} to t_{+3}	0.038	1.514
	t_{-5} to t_{+5}	0.050	1.583
	t_{-10} to t_{+10}	0.057	1.290
	t_{-30} to t_{+30}	0.080	1.070

*Significant at 5% level.

Chandrayaan-3 Launch Event (14 July 2023): The short-term event windows show relatively small abnormal returns, with a CAAR of 0.023 and a t-statistic of 0.861 in the t−3 to t+3 window. However, the extended window (t−30 to t+30) indicates a stronger positive effect, where CAAR increases to 0.186 and the t-statistic reaches 2.331, exceeding the critical significance level. This pattern suggests that investor optimism toward India's renewed lunar exploration efforts developed gradually, resulting in sustained buying activity among the sampled space-related firms.

Chandrayaan-2 Launch Event (22 July 2019): The findings for the Chandrayaan-2 mission show a negative market response. CAAR values become progressively more negative across longer event windows, reaching −0.155 with a t-statistic of −2.088 in the extended window. The strongest reaction appears in the t−5 to t+5 window, where the t-statistic reaches −2.190. This movement in returns reflects investor disappointment following the unsuccessful soft landing of the Vikram lander and indicates that high-profile mission setbacks can influence investor expectations.

Aditya-L1 Launch Event (2 September 2023): The Aditya-L1 mission does not generate statistically significant abnormal returns. The t-statistics remain below the significance threshold across all event windows, with the highest value recorded at 1.044. CAAR values fluctuate within a narrow range between −0.005 and 0.077, suggesting that investors largely viewed the mission as part of ongoing scientific progress rather than a development likely to affect firm valuations in the short run.

FDI Policy Liberalization in the Space Sector (16 April 2024): The announcement of foreign direct investment liberalization in the space sector generated a short-term positive response. In the t−3 to t+3 window, CAAR reached 0.065 with a statistically significant t-statistic of 2.279. However, the extended event window shows weaker returns, with CAAR reaching −0.145 over the longer period. This pattern indicates that the policy announcement initially created optimism regarding increased investment opportunities, though the strength of this reaction reduced over time as investors reassessed the long-term implications.

PSLV-C56/DS-SAR Mission (30 July 2023): The commercial launch of PSLV-C56 carrying the DS-SAR satellite does not produce statistically significant abnormal returns. CAAR values remain small, ranging from 0.010 to 0.034, and t-statistics remain low across all event windows. This suggests that routine commercial launch activities are generally perceived as part of normal operational activity and therefore do not strongly influence investor behaviour.

Chandrayaan-3 Landing Event (23 August 2023): Despite its historic importance, the Chandrayaan-3 landing generates relatively limited stock market reaction. The highest CAAR is observed in the t−5 to t+5 window (0.050) with a t-statistic of 1.583, which does not reach statistical significance. Over the longer window (t−30 to t+30), the t-statistic is 1.070. This result indicates that the successful landing was largely anticipated and had already been incorporated into stock prices following the earlier launch announcement.

The findings indicate that investor responses vary depending on the nature of the space-related event. Major technological achievements tend to generate positive abnormal returns, while mission setbacks are associated with negative reactions in the market. Policy announcements may create short-term optimism, whereas routine operational events generally do not produce strong stock price responses. These results suggest that developments in the space sector are gradually becoming relevant signals for investors in the Indian capital market.

VI. Conclusion

The empirical findings suggest that space-related developments do not influence stock prices in a uniform manner. Among the six events analysed, three produced statistically significant abnormal returns. The launch of Chandrayaan-3 generated sustained positive abnormal returns, indicating that major technological achievements in space exploration can strengthen investor confidence in firms associated with the sector. In contrast, the outcome of Chandrayaan-2 resulted in negative abnormal returns, highlighting the sensitivity of investor sentiment to mission performance and technological outcomes. The announcement of foreign direct investment (FDI) liberalization in the space sector also led to a short-term positive market reaction, suggesting that policy reforms encouraging private participation may create optimistic expectations regarding industry growth.

Other events, including the launch of Aditya-L1, the PSLV-C56 commercial satellite mission, and the Chandrayaan-3 landing, did not produce statistically significant abnormal returns, indicating that routine or anticipated developments may already be reflected in stock prices, consistent with the semi-strong form of market efficiency.

Overall, the study highlights how technological progress and policy developments in the space sector influence financial markets in an emerging economy such as India. Major mission announcements and regulatory reforms can act as important information signals for investors, while supportive policies promoting private participation may enhance market confidence and sectoral growth.

However, the analysis is limited by the small number of listed firms associated with the space sector and the focus on selected major events. Moreover, the event study methodology primarily captures short-term market reactions and may not fully reflect the long-term financial implications of space programs, while stock prices may also be affected by broader market or macroeconomic conditions. Future research may expand the sample as the sector grows, examine additional events, and apply alternative approaches or cross-country comparisons to better understand the long-term financial impact of space initiatives.

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