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Examining the Role of Venture Capital in IPO Pricing and Performance Using a Data-Driven Framework: Evidence from India

Bhuyashi Talukdar and Rudra Prakash Pradhan
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur
West Bengal, India
bhuyashitalukdar4@gmail.com; rudrap@vgsom.iitkgp.ac.in

Abstract

Venture Capital (VC) plays a crucial role in promoting entrepreneurship and innovation, enabling start-up firms to access public markets; yet, its impact on Initial Public Offering (IPO) performance remains contested. This study analyzes the impact of VC backing on IPO pricing efficiency, investor demand, and short-term performance after listing across different market regimes in India from 2009 to 2023. Using a comprehensive dataset of 426 IPOs, the study integrates causal machine learning (ML) with econometric modeling to estimate both the average and heterogeneous effects of VC participation. The OLS results indicate that the VC-backed IPOs leave more money on the table and experience greater upward revisions in offer price. However, such IPOs record lower short-term returns after listing. The causal forest analysis further reveals significant heterogeneity in the impact of VC backing, indicating that the certification and monitoring role of VCs is stronger during bearish or high-volatility market regimes when information asymmetry is elevated. Conversely, under bullish market conditions characterized by investor optimism, the incremental value of VC participation declines. The findings indicate that the impact of VC backing is dynamic and market-dependent, and underscore the importance of integrating data-driven approaches with econometric techniques in the study of entrepreneurial finance. This study offers valuable insights for entrepreneurs, investors, and policymakers by highlighting how market regime shapes the effectiveness of VC backing on IPO outcomes.

Keywords
Venture Capital, IPO Performance, Market regimes, Machine Learning, Emerging markets

1. Introduction
Entrepreneurship has emerged as one of the key catalysts for economic transformation in developing nations. Venture capital (VC) is a critical driving force in the development of entrepreneurial projects and speeding up innovation. VCs help young, high-growth companies overcome information asymmetries and credibility issues in their early stage by offering managerial support, access to strategic networks, and reputational signals in addition to financial capital. Combining financial risk-taking with operational governance, VCs tend to be the drivers of innovation-based growth and the enforcers of quality within the entrepreneurial ecosystem.

Over the past decade, India has become one of the most dynamic VC markets in the world. Government initiatives such as Startup India, Make in India, Atmanirbhar Bharat, and the boom in the digital economy have induced a surge in startup activity, thus attracting greater VC investments. The Indian Initial Public Offering (IPO) market has also undergone a remarkable evolution, with new-age tech companies experiencing high-profile debuts on the stock market in recent years. These listings not only indicate the maturity of the entrepreneurial ecosystem in India but also underscore the importance of VC investments for the growth of startups in the country.

However, the impact of VCs on the IPO performance remains a contested topic. Classical approaches to entrepreneurial finance propose a certification role of VCs at IPO. According to the certification hypothesis the participation of VCs in an IPO sends positive signals to the market regarding the quality of the firm because the VCs are expected to perform intensive due diligence, and it is in their own interest that the company succeeds (Megginson and Weiss 1991; Barry et al. 1990). This signaling effect diminishes IPO underpricing, enhances valuation accuracy and improves aftermarket returns (Barry et al. 1990; Chemmanur et al. 2010). However, on the contrary, the grandstanding hypothesis posits that VCs may engage in premature listing of the portfolio firms for their own reputation building, due to which VC-backed IPOs are more likely to be highly underpriced and underperform post-listing (Brav and Gompers 1997). These inconsistencies reveal that the effect of VC backing is not homogeneous, and it may vary depending upon various factors like time of issue, market sentiment, pre-issue firm characteristics and institutional and regulatory environment and macroeconomic factors.

One of the aspects of this debate that is important but remains relatively under-researched is the temporal and cyclical nature of VC influence, which has been termed in this paper as market regime sensitivity. In bullish markets, when there is optimism and abundant liquidity, it is possible to even have lower-quality firms raise funds successfully, lowering the marginal signaling value of VCs. On the other hand, in bearish or volatile regimes, when uncertainty is elevated and investor sentiment is fragile, the presence of reputable VCs can have much more substance in terms of reassuring investors and stabilizing valuations. That is, the intensity of the VC certification effect can vary with market regimes. Despite its relevance, limited empirical research has focused on this dynamic interpretation, especially in emerging markets such as India, where the market cycles and investor behavior vary significantly from those in developed markets.

The COVID-19 pandemic and its aftermath provide a natural experiment for studying this dynamic behavior. Between 2009 and 2023, the Indian IPO market experienced three distinct phases: a pre-pandemic expansion stage with consistent, but moderate volatility, the COVID-19 disruption period (2020-2021) characterized by high uncertainty and unstable investor sentiment, and the post-pandemic recovery phase that experienced unprecedented retail involvement, oversubscription, and speculative trading. This unique timeline offers an opportunity to examine how the effectiveness of VCs' impact on IPO outcomes changes with varying investor sentiment and market volatility.

This question is even more pertinent to the Indian context. The Indian entrepreneurial ecosystem is characterized by a greater degree of information asymmetry, dynamic regulatory mechanisms and different levels of investor sophistication, as opposed to the developed markets. The VC Funds Regulation (SEBI, 1996) and the reforms that followed have provided a base to institutional VC investments, but the provisions to exit are limited. Since the IPO happens to be the most popular and financially rewarding way for VCs to exit an investment, its effectiveness is crucial for private investment incentives as well as the growth of public markets. Thus, an understanding of how VC involvement affects IPO pricing and performance can be useful in entrepreneurship policy and capital-market governance.

Although VC-backed IPOs have been widely examined, the majority of the existing studies mostly rely on traditional econometric models, which capture the average effects but overlook the non-linear and heterogeneous relationships. Therefore, this study integrates econometric estimation with causal machine learning (ML) to identify both the average and heterogeneous effects of VC participation under varying market regimes.

The empirical findings reveal that VC-backed IPOs leave more money on the table and have greater upward offer price revisions, reflecting stronger investor demand and more aggressive pricing during the issuance. However, these IPOs record lower short-term returns after listing. The Causal Forest analysis uncovers significant heterogeneity in the impact of VC backing, indicating that VC-backed issues perform more effectively and deliver improved short-term returns during bearish or high-volatility market phases. In contrast, under bullish regimes characterized by investor optimism, the incremental value of VC involvement declines. These results confirm that the certification effect of VC is dynamic and context-dependent rather than uniform across market conditions.
This study contributes to the literature by providing empirical evidence from one of the fastest-growing VC and entrepreneurial ecosystems, presenting a regime-varying analytical lens of VC effectiveness and illustrating how data-driven causal inference enhances transparency and interpretability in entrepreneurial finance research.

The findings hold value for entrepreneurs, investors and policymakers by demonstrating the dynamic role of VCs

across market regimes in emerging economies.

1.1. Objectives

The purpose of this research is to investigate the role of VC in the efficiency of IPO pricing and short-term market performance in India using a data-driven analytical framework. In this section, the objectives of the study have been discussed, which are designed to have an organized approach to the research problem and to build a clear connection between theoretical perspective, empirical analysis, and methodological innovation. The specific objectives are -

1. To assess the impact of VC backing on the IPO pricing outcomes and immediate post-listing performance in the Indian market.
2. To determine how different market regimes (bearish, neutral, and bullish) moderate the relationship between VC backing and IPO performance.
3. To employ a data-driven causal ML framework to capture the heterogeneous impact of VC participation on IPO performance across different market conditions.

2. Literature Review

The literature review is presented in two parts. The first part presents the theoretical explanations in the existing literature related to the impact of VC and IPO performance, and also discusses the present studies in the Indian context in this domain. The second part discusses the use of ML in predicting IPO performance in studies globally and across India as well.

2.1. VC and IPO Performance: Theoretical Perspective

The two main theories that have been used to explain the relationship between VC and IPO performance are the certification and grandstanding hypotheses. The certification hypothesis states that VC investors certify the quality of the firm they invest in, reducing information asymmetry and improving pricing efficiency at the time of IPO (Megginson and Weiss 1991). In contrast, Gompers (1996) and Lee and Wahal (2004) argue that some VCs practice what is termed as grandstanding, where they push premature firms for an early listing to build their own reputation or to signal success to limited partners, potentially leading to high underpricing and weak post-listing returns.

The existing empirical results provide mixed evidence. According to Barry et al. (1990) and Chemmanur et al. (2010), VC-backed IPOs lead to lower underpricing and high post-issue returns, whereas Brav and Gompers (1997) and Bessler and Seim (2012) find long-run underperformance when compared to non-VC-backed firms, indicating that certification benefits may fade over time. Traditional cross-country research indicates that VC participation has the potential to improve the establishment of public firms, but the long-run returns of VC-backed offerings often tend to converge to or underperform those of non-VC-backed firms.

Recent studies focus on the idea that the impact of VC backing is context-dependent. Deb and Banerjee (2024) research 173 Indian IPOs with VC or private-equity (PE) backing and demonstrate that the performance of VC-PE backed IPOs is unsatisfactory post-listing and that their operating performance declines compared to other IPOs. They observe that persistent monitoring by VCs after IPO has a beneficial impact, although the exit of VC investors leads to poor long-term performance. Comparing Indian IPOs that report risk factors in their advertisement and those that do not, Katti et al. (2023) find that risk-disclosing firms are 31% more underpriced and get greater institutional subscription, but also outperform on post-IPO performance. Sivaprasad and Dadhaniya (2020) categorize Indian IPOs into sponsored (VC/PE) and non-sponsored and demonstrate that sponsored IPOs, and in particular, those supported by a PE, have significantly better operating and market performance. These findings demonstrate that the perception of investors about certification is based on disclosure practices and the type of sponsorship as well.

Studies also identify the effects of other institutional mechanisms and market cycles. Ranganathan and Saha (2023) prove that more detailed use-of-proceeds disclosures reduce mispricing and enhance after-market performance, which indicates that transparency is complementary to certification. According to Sharma et al. (2024), anchor investors act as additional certifiers and increase the number of subscribers and minimize mispricing. Similarly, studies by Garg et al. (2024) discover the same effects on sovereign wealth fund anchor investment, which emphasized the importance of institutional investors in the IPO pricing. All these studies demonstrate that the certification role of VCs is dynamic and is effective depending on the disclosure practices, investor demand and the duration of VC investment.

2.2. ML in predicting IPO performance

The conventional econometric models tend to assume that there are linear relationships and homogeneous effects, and thus limit their ability to capture complex interactions in predicting IPO outcomes. The field of ML and artificial intelligence (AI) is being actively used in recent studies to predict IPO pricing and performance. Random forests (Breiman 2001) and gradient-boosting methods like XGBoost (Chen and Guestrin 2016) are popular decision-tree ensembles that are used to reveal non-linear patterns and process high-dimensional data. As demonstrated by Katsafados et al. (2023), more textual data in the prospectus, along with ML algorithms (random forest and gradient boosting), can significantly enhance the process of predicting IPO underpricing. The models incorporating textual and financial variables show better performance compared with the models relying on one kind of input. Supsermpol et al. (2025) create an XGBoost to forecast post-IPO underpricing and prove that the adoption of an ML approach substantially enhances classification accuracy. Alahmadi (2025) suggests a risk-optimal ML model to predict short-term IPO underperformance and includes investor sentiment and risk measurement; the model holds higher results compared to the normal logistic regressions. A subsequent investigation by Alahmadi (2025) demonstrates that deep-learning ensemble models significantly improve IPO performance prediction in sustainability-oriented contexts. When comparing multinomial logistic regression and ML models, Alahmadi and Yilmaz (2025) observe that combining financial and textual variables enhances predictive performance. These developments indicate that ML and AI can reveal complex relationships that traditional econometric models might overlook and encourage the use of the former techniques to predict the heterogeneous impact of VC on IPO outcomes across market regimes.

The existing literature provides a comprehensive but fragmented overview of the impact of VC backing on IPO pricing and subsequent performance. The majority of the studies concentrate on average effects and employ linear models, resulting in two significant gaps. First, there is limited evidence regarding the impact of market regimes – bearish, neutral, or bullish conditions – on the certification role of VCs, especially in emerging markets like India. Secondly, there is a dearth of studies that integrate contemporary ML techniques with econometric analysis to capture non-linear and heterogeneous patterns. These gaps motivate the present research.

3. Data Collection

The study employs a comprehensive dataset of Indian IPOs issued between 2009 and 2023, a time frame that encompasses market liberalization, rapid growth of the VC ecosystem, and notable structural changes in investor participation. The sample period includes different stages, such as pre-pandemic expansion (2009-2019) and COVID-19 disruption (2020-2021), and post-pandemic boom (2022-2023), such that the analysis could examine regime-specific changes in the impact of VC backing. Data were compiled from the Prime database, CMIE Prowess database and the individual prospectuses of IPO firms disclosed on the SEBI website. Following the cleaning and merging of the data, the final dataset consists of 426 IPOs, out of which about 31% are backed by VC.

Three dependent variables have been employed in this study to measure IPO outcomes, i.e., Money Left on the Table (MloT), Offer Price Revision (OPR) and Cumulative Abnormal Return (CAR). The key independent variable is a VC dummy. A market regime variable was constructed using a rolling volatility index (VIX) to classify IPOs as occurring during bullish, bearish, or neutral periods, in order to enable a regime-sensitive analysis. Several control variables have been included in this study: firm size, firm age, leverage, and profitability. All continuous variables have been winsorized at the 1st and 99th percentiles to minimize the effect of outliers and ensure robust estimation. A description of all the variables used in this study has been presented in Table 1.

Table 1. Variable Description

Variable	Definition /Measurement
Money Left on the Table (MLoT)	Difference between first-day closing price and offer price, multiplied by the number of shares offered (INR million)
Offer Price Revision (OPR)	Percentage change between the final offer price and the midpoint of the indicative price band
Cumulative Abnormal Return (CAR)	Cumulative market-adjusted return over 21 trading days post-listing
VC Dummy	1 if the IPO is VC-backed, 0 otherwise
Firm Size	Natural log of total assets prior to IPO (₹ million)
Firm Age	Years between incorporation and IPO year
Leverage	Ratio of total debt to total assets prior to IPO
Profitability (ROA)	Net profit divided by total assets prior to IPO (%)
Market Regime (VIX)	Classified as bullish, neutral, or bearish based on the NSE rolling volatility index during IPO month

4. Methods

Consistent with the research objectives, the following section discusses the hypothesis of this study along with the econometric and ML models used to test the proposed hypothesis. The combination of econometric methods with the interpretative ML methods ensures that the methodology is both robust and explanatory, and provides a holistic overview of the IPO pricing and performance dynamics.

4.1. Hypothesis Development

The paper bases its propositions on two strands of literature that are interconnected and relate to understanding the role of VC in the performance of IPO, i.e. the certification and grandstanding hypotheses. Based on the institutional setting of India and the recent empirical evidence from emerging markets. The study proposes the following hypothesis:

H_1: VC backing has a significant impact on the IPO pricing outcomes and short-term returns post-listing in the Indian market.

H_2: The prevailing market regime moderates the impact of VC backing on IPO performance.

H_3: Data-driven ML framework can identify heterogeneous effects of VC backing on IPO performance.

4.2. Methodology

The study uses a two-step analytical model that incorporates both the conventional econometric modelling and contemporary data-driven ML methods to estimate both the average and heterogeneous impact of VC backing IPO pricing and performance.

In the first stage, the OLS regressions are employed to estimate the baseline relationship between VC backing and IPO outcomes. The baseline model is specified below –

$$Y_{it}=\alpha+\beta_1 VC\ Dummy_i+\beta_2 Market\ Regime_t + \beta_3(Firm\ controls)_{it} + \beta_4 (VC\ Dummy_i \times Market\ Regime_t) +\epsilon_{it}$$

Where the dependent variable Y_{it} indicates IPO performance indicators (MloT, OPR, and CAR). The independent variable VC dummy indicates whether a firm is backed by a VC or not. Market Regime is a dummy variable that captures prevailing market conditions. Firm controls include firm age, firm size, leverage and profitability. The model controls for year and industry fixed effects.

The second stage involves the use of a Causal Forest-based heterogeneous treatment effect framework, an extension of the Random Forest algorithm. This method measures the conditional impact of VC engagement on IPO outcomes across varying market regimes without the homogeneity and linearity assumptions. The model sequentially breaks down the sample into subgroups of VC-backed and non-VC-backed firms with similar characteristics, estimating treatment effects in each subgroup. Five-fold cross-validation is used in order to optimize the parameters and prevent overfitting.

The research uses both OLS and Causal Forest techniques to provide statistical interpretability and predictive flexibility. While OLS measures the mean certification impact of VC, Causal Forest measures the hidden, non-linear and market-specific patterns. Together, they constitute a data-driven analytical model that demonstrates the dynamic and context-specific nature of the impact of VC on the performance of IPOs.

5. Results

The following section presents the empirical results and analytical findings of this study. The results have been presented in two parts: the numerical results and the graphical results.

5.1. Numerical Results

The results of the descriptive statistics provided in Table 2 indicate that IPOs in the sample exhibit substantial heterogeneity. The mean MLoT is INR 145.32 million with a median of INR 118.45 million, indicating a right-skewed distribution. This suggests that although the majority of the offerings leave moderate amounts of money on the table, some are significantly underpriced. The mean OPR is 5.41%, indicating that price bands are often revised upwards during the book-building process, consistent with strong investor demand. The mean CAR of 3.27% with a standard deviation of 6.12% confirms the volatility of the aftermarket performance of IPOs. The median firm age of 9 years and the mean the leverage ratio of 0.42 suggest that young and relatively mature, debt-financed firms form part of the sample. Although the mean ROA stands at 7%, the dispersion in profitability, ranging from -12% to 24%, indicates wide performance variation between loss-making and profitable firms.

Table 2. Descriptive statistics

Variable	Mean	Median	Std.Dev	Min	Max	N
MLoT (INR million)	145.32	118.45	96.48	12.1	512.84	426
OPR (%)	5.41	4.05	7.62	-8.5	25.6	426
CAR (%)	3.27	2.96	6.12	-11.42	21.39	426
Firm size (INR million)	9.47	9.35	1.21	6.8	12.25	426
Firm age (years)	11.36	9	8.42	1	45	426
Leverage (ratio)	0.42	0.38	0.29	0.02	1.24	426
ROA (%)	0.07	0.06	0.06	-0.12	0.24	426

The correlation matrix, as shown in Table 3, indicates that the correlation coefficient between the key explanatory variables does not exceed the threshold level of 0.8, indicating that multicollinearity is not an issue. Therefore, the dataset is well-suited for all subsequent analysis. The VC Dummy indicates a positive correlation with MloT and OPR, which indicates that VC-backed IPOs leave more money on the table and have higher offer price revisions. In contrast, its negative correlation with CAR suggests that VC-backed IPOs underperform in the short run after listing.

The results of the OLS regressions, as depicted in Table 4, reveal that VC backing exerts a significant impact on IPO pricing and performance. The independent variable VC dummy is positive and significant at 1% level for MloT and OPR. This indicates that VC-backed IPOs leave INR 46.21 million more on the table and revise the offer prices upward by approximately 4.22 % relative to non-VC-backed IPOs. These results are consistent with the literature that VCs promote aggressive pricing to ensure oversubscription or to convey a signal of confidence in their portfolio companies. However, the VC dummy, on the other hand, has a negative and significant impact on CAR, which indicates that VC-backed IPOs perform poorly in the short-term by an average of 2.09%. The Market Regime dummy is positive and significant for both MloT and OPR, which implies that IPOs issued in volatile regimes are more underpriced and experience more price revisions. But the Market Regime dummy has no statistically significant relation with CAR, indicating no direct impact on short-term aftermarket returns. More importantly, the interaction term (VC x Regime) provides crucial insights into the conditional impact of VCs on IPO outcomes. The interaction term is negative and significant at 5% level for the dependent variables MloT and OPR, but it is positive and significant at 5% level in the case of CAR. This shows that during times of market volatility and fluctuation, VC backing is associated with lower MLoT and smaller OPR, and leads to improved short-term returns, compared to non-VC-backed issues, demonstrating a stronger certification and monitoring role of VCs during uncertain market conditions.

Table 3. Correlation matrix of the key explanatory variables

Variables	1	2	3	4	5	6	7	8	9
(1) MLoT	1								
(2) OPR	0.42	1							
(3) CAR	–0.18	0.07	1						
(4) VC Dummy	0.33	0.24	–0.19	1					
(5) Market Regime	0.26	0.22	–0.11	0.17	1				
(6) Firm Size	–0.41	–0.18	0.09	–0.15	–0.22	1			
(7) Firm Age	–0.28	–0.09	0.06	–0.11	–0.08	0.37	1		
(8) Leverage	0.19	0.13	–0.25	0.09	0.05	–0.21	–0.17	1	
(9) ROA	–0.12	–0.06	0.31	–0.15	–0.09	0.29	0.17	–0.18	1

In contrast, under bullish market regimes, higher investor optimism leads to larger MloT and stronger OPR values, and poor after-market returns, implying that VC influence weakens when market conditions become favorable. These findings underscore that the impact of VC on IPO outcomes is contingent upon the prevailing market conditions. The moderating role of market regime dummy indicates that the certification and monitoring role of VCs is intensified when the market is bearish or experiences high volatility, but such effects are limited when the market sees a bullish phase and investor optimism is high. In terms of the control variables, the firm size has a significant negative impact on MloT, which confirms that larger firms experience less information asymmetry and are more efficiently priced. Firm age does not have a significant impact on any of the dependent variables, indicating that firm maturity has no measurable effect on pricing outcomes. Leverage has a positive correlation with MLoT and a negative correlation with aftermarket returns, which is in line with the idea that the higher the debt level, the greater is the perceived financial risk and reduced investor confidence. ROA, on the other hand, has a positive correlation with short-term performance, which implies that financially stable firms are in a better position to maintain investor interest after listing. Taken together, these results substantiate the asymmetric information and signaling theories in IPO markets, emphasizing that the impact of VC backing is inherently dynamic – most stabilizing during bearish markets and least significant during periods of market optimism.

Table 4. OLS results

Variables	MLoT	OPR	CAR
VC Dummy	46.21 *** (13.71)	4.22 *** (1.52)	–2.09 ** (0.95)
Market Regime	31.45 ** (12.79)	3.60 ** (1.79)	–1.12 (1.27)
VC × Market Regime	–28.15 ** (13.58)	–2.95 ** (1.49)	2.34 ** (1.11)
Firm size	–18.28 *** (4.46)	–0.87 (0.65)	1.08 (0.74)
Firm age	–2.04 (1.32)	–0.09 (0.15)	0.11 (0.17)
Leverage	27.15 ** (12.29)	1.26 (1.47)	–3.44 *** (1.12)
Profitability	–1.22 (0.85)	–0.05 (0.09)	0.43 ** (0.21)
Constant	241.06 *** (41.57)	9.84 *** (2.84)	3.75 (3.44)
N	426	426	426
Adjusted R^2	0.4	0.31	0.29

*Note: *, **, *** indicate statistical significance at 10%, 5%, and 1% respectively.*

5.2. Graphical Results

The graphical outputs derived using the ML models complement the results of the regression analysis by visually highlighting the differential impact of VC under different market regimes. Figure 1 describes the heterogeneous impact of VC backing on the two outcome measures, MloT and CAR, across market regimes. The findings indicate that the impact of VC has a prominent regime-dependent trend. The positive impact of VC backing on MloT and CAR is most

pronounced in bearish markets, which is determined by the strong certification and monitoring roles of VCs in their efforts to alleviate information asymmetry and foster investor confidence during uncertain market conditions. As the markets shift towards a neutral and bullish regime, the VC effect becomes weaker and at one point becomes negative, which means that VC-backed IPOs lose their comparative advantage in optimistic markets.

Overall, these results highlight how market regimes affect the effectiveness of VC support on IPO performance, with it being the most effective during periods of downturns, and least effective, or even counterproductive, when markets are buoyant.

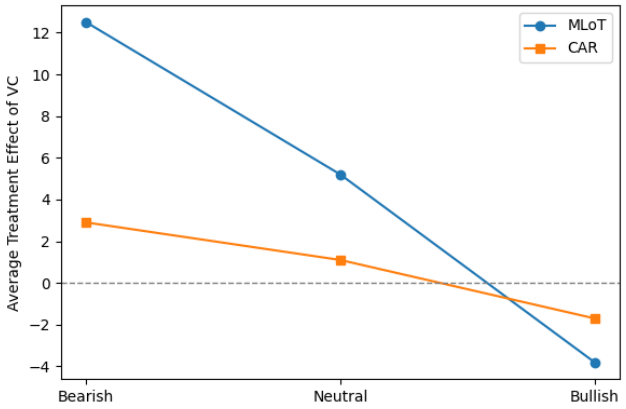

Figure 1. Average treatment effect of VC on IPO outcomes across market regimes

6. Conclusion

The study effectively addresses all the stated objectives by providing a comprehensive examination of the impact of VC on the pricing and short-run performance of IPOs in India, using a data-driven framework that blends classical econometric modeling with causal ML techniques. By analyzing the impact of VC on three important IPO metrics, i.e., MloT, OPR and CAR, the study finds that the impact of VC backing is complex and context-dependent. The results of the OLS regressions indicate that VC-backed IPOs are priced more aggressively, thus leaving more money on the table and exhibit stronger offer price revisions. However, such IPOs underperform in the immediate future post-listing, as exhibited by a decline in CAR. The interaction term between VC and the Market regime further points out an important dynamic in the impact of VCs on IPO performance. The results indicate that the efficacy of VC backing is conditional upon the market conditions. During bearish or volatile markets, the certification and monitoring role of VCs is stronger, leading to a lower amount of money left on the table, reduced offer price revisions, and increasing short-run performance. However, when the markets are bullish, the signaling value of VC is weaker, as the pricing process is dominated by market optimism and demand oversubscription. This heterogeneity in the role of VCs is further supported by the causal forest results, which indicate that the average treatment effect of VCs is weakest (or even negative) in bullish markets and highest during bearish phases.

Taken together, these findings suggest that the effect of VC is contingent, rather than generic, which underscores the importance of considering market regimes in evaluating the effectiveness of VCs and pricing efficiency in emerging economies like India. These findings have both theoretical and practical implications for the field of entrepreneurial finance. First, they elaborate upon the certification hypothesis by showing that VC backing has a dynamic and heterogeneous effect. While VC backing has a positive effect on the pricing and performance of IPOs in stressed markets, it can decline or actually reverse during euphoric cycles. Secondly, it demonstrates the significance of data-driven methods in addition to traditional econometric methods. Causal-Forest models helped understand complicated relationships and heterogeneous treatment effects that are not captured in simple regression models, thus providing a more comprehensive picture of the impact of VCs. Third, by emphasizing the Indian market, this study fills a gap in the emerging economy research, highlighting how market regimes and institutional environments influence the impact of VC backing on IPO performance.

Despite these contributions, this study has a few limitations, which also pave the way for new research directions.

Since the sample of this study is limited to IPOs in India and to a particular time frame, it may not be generalizable to other contexts with distinct legal systems, capital-market structures, or VC-ecosystems. Also, the impact of VC on the long-term performance of IPOs has not been covered in this study. Moreover, only one ML method has been employed; future studies could use other algorithm-based models like deep neural networks, Bayesian additive trees, or graph-based models to capture different aspects of VC impact.

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Biographies

Bhuyashi Talukdar is a PhD scholar at Vinod Gupta School of Management, Indian Institute of Technology, Kharagpur, India. She holds a B. Com in Accountancy from Gauhati University, Assam and an MBA in Finance from Tezpur University, Assam. Her areas of research interest include corporate and entrepreneurial finance. She has presented her research work at reputed national and international conferences.

Rudra Prakash Pradhan is a Professor at Vinod Gupta School of Management, Indian Institute of Technology, Kharagpur, India. He holds a PhD from the Indian Institute of Technology, Kharagpur, India. He has over a decade of experience in teaching and research. His research interests include Infrastructure Finance, Foreign Direct Investments and Econometric modeling. He has published several research papers in various national and international refereed journals.