

Signalling Quality Through Underpricing: A Bayesian Game-Theoretic Analysis of Indian Startup IPOs (2020–2024)

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Abstract

The period between 2020 and 2024 saw an unprecedented boom in Indian startup initial public offerings (IPOs), which included listings by Zomato, Nykaa, Paytm, Mamaearth, and other venture-backed companies. Most of these IPOs showed significant underpricing — a process of fixing the offer price less than the anticipated market-clearing price — resulting in huge first-day appreciation for investors. Although underpricing would seem to be harmful to issuers, theory in signalling explains that good-quality firms would underprice for the purpose of signalling their quality credibly in asymmetric information markets.

Using a Bayesian signalling game framework, this paper models IPO underpricing. Issuers are classified as high- or low-quality based on unobservable fundamentals. While low-quality issuers are discouraged by the expense of imitating such a strategy, high-quality issuers may strategically underprice in anticipation of long-term reputational benefits and improved aftermarket performance.

Data on offer prices, listing prices, underpricing percentages, and post-listing returns from Indian startup initial public offerings (IPOs) from 2020 to 2024 are used to test the model. According to the results, underpricing works well as a signal in industries with a lot of information asymmetry, like technology. Issuers, practitioners of equity capital markets (ECM), and emerging market policymakers can all benefit from the study's conclusions.

Keywords: IPO underpricing, signalling games, Bayesian game theory, Indian startups, asymmetric information, equity capital markets

1. Introduction

With a flurry of well-known initial public offerings (IPOs) from tech-driven startups like Zomato, Nykaa, Paytm, Mamaearth, and Policybazaar, the years 2020–2024 have been a revolutionary time in India's capital markets. These listings demonstrated India's developing startup ecosystem and attracted institutional and public interest. However, underpricing—setting the offer price below the level at which the stock would trade in the market on the first day—was a notable characteristic of many of these IPOs. Underpricing, which is defined as the percentage difference between the offer price and the closing price on the first day, is frequently interpreted as a wealth transfer from issuers to original investors (Ritter and Welch 2002). Underpricing persists throughout time and space despite this apparent cost.

IPO pricing is a finely balanced task for issuers and equity capital markets (ECM) professionals. Excessive underpricing leaves money "on the table," while setting the price too high puts a failed subscription at risk. Significant information asymmetry between issuers and investors makes this balance difficult in emerging markets like India, especially in high-growth startup IPOs. Since startups frequently have short operating histories, it can be challenging for investors to determine their actual quality (Loughran, Ritter, and Rydqvist 1994). Signalling theory offers a convincing strategic explanation in such circumstances: superior issuers may purposefully underprice in order to effectively communicate their quality and set themselves apart from inferior issuers who are unable to pay for such a signal (Welch 1989).

This article models IPO underpricing in the Indian startup ecosystem using a Bayesian signalling game framework. According to the model, issuers are categorised as high- or low-quality depending on unobservable fundamentals, and investors' posterior beliefs are influenced by their underpricing choices. Investors revise their opinions and choose whether to participate in the IPO or aftermarket purchases after assessing the degree of underpricing. Equilibrium predictions about when underpricing functions as an effective signal and when it doesn't are possible with this configuration.

Literature Gap

Global research has researched IPO underpricing from the perspective of information asymmetry, the winner's curse, and mediation regime of the issuer and underwriter, (Ritter 1984; Welch 1989; Loughran and Ritter 2004). Most research is centered on developed global markets and usually only look at regression-based studies endorsed by an economic model, or purely theoretical models of IPO pricing. In the Indian context, empirical studies have examined the determinants of underpricing using cross-sectional or event study methods, but very few formal game-theoretic models have been used to understand IPO underpricing. More specifically, to the

author's knowledge no research has combined a Bayesian signalling game framework with real IPO data from India to ascertain how issuers signal quality through underpricing. Also, very few empirical Indian studies factors in industry differences about information asymmetry, especially in the context of high-growth, publicly-traded venture-backed startups. This study is combining theoretical modeling with empirical truths of Indian startup IPOs during the period between 2020-2024 which will provide academic and real-world contributions regarding ECM execution in an emerging market.

The structure of the rest of the article is as follows. Section 2 provides a literature review of IPO underpricing, signalling theory, and theories in game theory. This section provides a preliminary stage of theory development for section 3. Afterward, Section 3 develops a theoretical framework and Bayesian signalling model. Section 4 outlines data sources and methods. Section 5 discusses empirical results against the theoretical predictions. Section 6 concludes with key implications and takeaways for issuers, investors, and policy makers.

2. Literature Review

2.1 Global Perspectives on IPO Underpricing

IPO underpricing is among the most researched anomalies in financial economics literature. The early studies conducted by Ibbotson (1975) and Ritter (1984) found significant positive first-day returns in IPOs across various markets, which demolished the view that market prices were fully efficient. Several theories were advanced. The "information asymmetry hypothesis (Rock 1986)" states that underpricing allows uninformed investors to be compensated for their risk from adverse selection. The "winner's curse model" in the IPO literature indicates that uninformed investors only receive allocations in overpriced issues in the IPO market, and some level of underpricing is needed to encourage uninformed investor participation. Behavioral explanations have also been developed, including investor sentiment and over-optimism in speculative markets (Ljungqvist, Nanda, and Singh 2006).

2.2 Signalling Theory in IPOs

The signalling models initially proposed by Welch (1989) suggest that firms with high-quality products will purposely underprice as a way of separating themselves from low-quality firms. The underpricing represents a potential short-run cost to high-quality issuers that a low-quality issuer cannot imitate without incurring a higher proportionate loss. This separation creates a separating equilibrium whereby the issuer's credibility is firmly signaled to the market via underpricing. Empirical research has shown mixed results for signalling

models with some indicating that the effect will be largest in environments of high information asymmetry (Allen and Faulhaber 1989; Grinblatt and Hwang 1989).

2.3 Game-Theoretic Approaches to IPO Pricing

Game theory provides a formal way to model the strategic interaction between issuers and investors in IPOs. In Bayesian signalling games, issuers have private information about the type (high and low quality) and choose a level of underpricing based on how they want investors to perceive that type. Investors update their own beliefs after observing the pricing behavior, and then choose to participate or not. Modelers can produce theoretically derived equilibrium outcomes and assess and predict if and how changes in market conditions affect underpricing decisions. Though these types of models have been used for IPOs in the United States and Europe (Benveniste and Spindt 1989; Chemmanur 1993), they are not common in emerging markets.

2.4 IPO Underpricing in the Indian Context

Most empirical studies on Indian IPOs have concentrated on determinants of underpricing, using regression-based research methodologies. Krishnamurti and Kumar (2002) studied Indian IPOs from 1992-1999 and report significant underpricing, and conclude that part of this underpricing can be attributed to investor sentiment as well as market conditions. Other, more recent examples include research by Panda and Sinha (2019) and Sehgal and Pandey (2020), which examined determinants of underpricing and included explanatory variables such as issue size, oversubscription rates, and promoter shareholding. The aforementioned studies rarely incorporate formal game-theoretic frameworks. Similarly, while most of the studies treat underpricing as a dependent variable and identified and examined the observable characteristics that explained underpricing, this research fails to view underpricing as a strategic signal in an environment of asymmetric information.

2.5 Research Gap and Positioning

The missing Indian literature that employs a Bayesian signalling model and empirical IPO data is evident. While the global literature shows that signalling theory is useful for explaining IPO pricing behavior, the discrete differences in the startup-driven IPO wave in India (high venture capital involvement, limited operating histories, and information asymmetry variation across sectors, among others) potentially afford an opportunity to apply a game-theoretic perspective. This paper addresses this gap by advancing a signalling game structure for the Indian market and verifying its implications using empirical IPO data from 2020-2024.

3. Theoretical Framework

3.1 Players and Information Structure

The IPO underpricing endeavor can be depicted as a Bayesian signalling game between the two players: the issuer and the investors. The issuer can have one of two possible types that are based on unobservable fundamentals (potential profitability, growth prospects and governance standards), which are high-quality (H) and low-quality (L). The probability that the issuer is high-quality is described by p ; this is investors' prior belief before the offer price has been observed.

Quality issuers have the potential for improved post-listing performance and are also more apt to receive a favorable market response in connection with future capital-raising. Quality issuers are more likely to underperform, therefore, any short-term loss of capital through underpricing becomes more costly and difficult to recoup.

3.2 Strategies and Signals

The signal in this model is the **level of underpricing** chosen by the issuer, expressed as:

$$UP = \frac{P_{market} - P_{offer}}{P_{offer}} \times 100$$

where P_{market} is the first-day closing price and P_{offer} is the IPO offer price.

Issuers choose UP strategically, knowing that investors will interpret higher underpricing as a potential indicator of quality. The strategy space includes:

- **Low underpricing** — maximizes immediate proceeds but may fail to differentiate the issuer from low-quality competitors.
- **High underpricing** — sacrifices short-term proceeds but may credibly signal high quality.

3.3 Payoffs

The payoff to the issuer depends on two components:

1. **Immediate Proceeds** — revenue from the IPO itself, which decreases with higher underpricing.
2. **Reputation Effect** — the expected increase in future firm value due to favorable investor perception, which is positively correlated with underpricing for high-quality issuers.

For high-quality issuers, the **net payoff** from higher underpricing may be positive if the reputation effect outweighs the proceeds loss. For low-quality issuers, the same strategy results in a net loss because they cannot sustain the positive expectations created by the signal.

3.4 Belief Updating and Equilibrium

Investors observe the underpricing level and update their belief about issuer type using Bayes' Rule:

$$P(H|UP) = \frac{P(UP|H).P(H)}{P(UP|H).P(H) + P(UP|L).P(L)}$$

If the updated belief $P(H|UP)$ exceeds a threshold, investors participate enthusiastically in the IPO or buy in the aftermarket, pushing up prices further.

The **separating equilibrium** occurs when:

- High-quality issuers choose **high underpricing**, knowing low-quality issuers will not mimic.
- Low-quality issuers choose **low underpricing**, avoiding the high cost of an unsustainable signal.

3.5 Testable Predictions

From this model, two predictions follow:

- **P1:** In sectors with higher information asymmetry (e.g., tech startups), high-quality issuers will underprice more than in lower asymmetry sectors.
- **P2:** Higher underpricing will be positively associated with stronger short-term returns but will not guarantee long-term outperformance unless the issuer is genuinely high quality.

4. Data and Methodology

4.1 Data Sources

The empirical analysis uses a dataset of Indian startup IPOs listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) between **January 2020 and December 2024**. IPOs were identified from exchange announcements, SEBI filings, and market databases such as CMIE Prowess and Prime Database. Only issues from companies classified as *startups*—either technology-driven or venture-backed—were included, with additional manual screening based on prospectuses and industry reports.

Daily price data (offer price, listing price, and closing prices for 6- and 12-month post-listing intervals) were obtained from NSE and BSE archives. Company fundamentals, such as profitability, revenue growth, and

promoter shareholding, were collected from Red Herring Prospectuses (RHPs) and stock exchange disclosures.

4.2 Sample Selection

The final sample consists of **10 IPOs** after excluding:

- Financial institutions and insurance companies (due to distinct valuation methods)
- IPOs with missing or unreliable price data
- Follow-on offerings and rights issues

The sample covers a mix of **high-information-asymmetry sectors** (e.g., technology, fintech, e-commerce) and **lower-information-asymmetry sectors** (e.g., consumer goods, manufacturing).

4.3 Variable Definitions

- **Underpricing (%):**

$$UP = \frac{P_{list} - P_{offer}}{P_{offer}} \times 100$$

where P_{list} is the first-day closing price, and P_{offer} is the IPO offer price.

- **Short-Term Return (%):**
Percentage return from the offer price to the first-day closing price.
- **Long-Term Return (%):**
Percentage return from the offer price to the 6-month and 12-month post-listing closing prices.
- **Sector Dummy:**
Binary variable indicating high- vs. low-information-asymmetry sectors.
- **Issuer Quality Proxy:**
Categorical variable based on pre-IPO profitability, revenue growth, and venture capital backing.

4.4 Methodology

The empirical tests proceed in three steps:

1. **Descriptive Analysis:**
 - o Calculate mean and median underpricing across sectors.
 - o Compare high- vs. low-quality issuers' underpricing levels.

2. Hypothesis Testing:

- o **H1 (Signalling):** Conduct a two-sample *t*-test to determine if high-quality issuers underprice more than low-quality issuers.
- o **H2 (Short-Term Returns):** Regress short-term returns on underpricing, sector dummy, and quality proxy.
- o **H3 (Long-Term Returns):** Regress long-term returns on underpricing and quality proxy to assess persistence of the signal.

3. Robustness Checks:

- o Winsorize extreme underpricing observations to reduce outlier effects.
- o Perform sector-wise sub-sample regressions.

The methodology links directly to the theoretical model in Section 3 by testing whether observed underpricing patterns are consistent with the separating equilibrium predicted by the Bayesian signalling game.

5. Results and Discussion

5.1 Descriptive Statistics

Table 1 summarizes the underpricing data for selected Indian IPOs from 2020 to 2024, covering both high-information-asymmetry sectors (e.g., technology, fintech) and lower-asymmetry sectors.

Table 1: IPO Underpricing Data (2020–2024)

IPO	Year	Issue Price (₹)	Listing Close Price (₹)	Underpricing (%)	Sector
SBI Cards & Payment Services Ltd	2020	755	661.00	–12.5	Financial Services
Rossari Biotech Ltd	2020	425	752.00	76.9	Chemicals
Zomato Ltd	2021	76	125.80	65.6	Technology / Food Delivery
Nykaa (FSN E-Commerce Ventures Ltd)	2021	1,125	2,206.70	96.2	E-commerce / Retail
Paytm (One97 Communications Ltd)	2021	2,150	1,564.20	–27.2	Fintech
Delhivery Ltd	2022	487	495.20	1.7	Logistics / Technology
Mamaearth (Honasa Consumer Ltd)	2023	324	330.00	1.9	FMCG / D2C
MobiKwik	2024	279	518.00	85.6	Fintech
Vibhor Steel Tubes	2024	151	446.25	195.5	Manufacturing
Waaree Energies	2024	1,503	3,293.00	119.1	Renewable Energy

5.2 Observed Patterns

- **High-Underpricing IPOs** (Nykaa, Zomato, MobiKwik, Vibhor Steel Tubes, Waaree Energies) are concentrated in **high-growth or high-sentiment sectors** (e-commerce, fintech, renewables).
- **Negative or Low Underpricing** (SBI Cards, Paytm, Mamaearth, Delhivery) often coincided with **market skepticism** or more mature business models where signalling value was limited.
- 2024 IPOs, especially Vibhor Steel Tubes (+195.5%), saw **exceptionally high listing gains**, indicating strong investor risk appetite in select segments despite macroeconomic uncertainties.

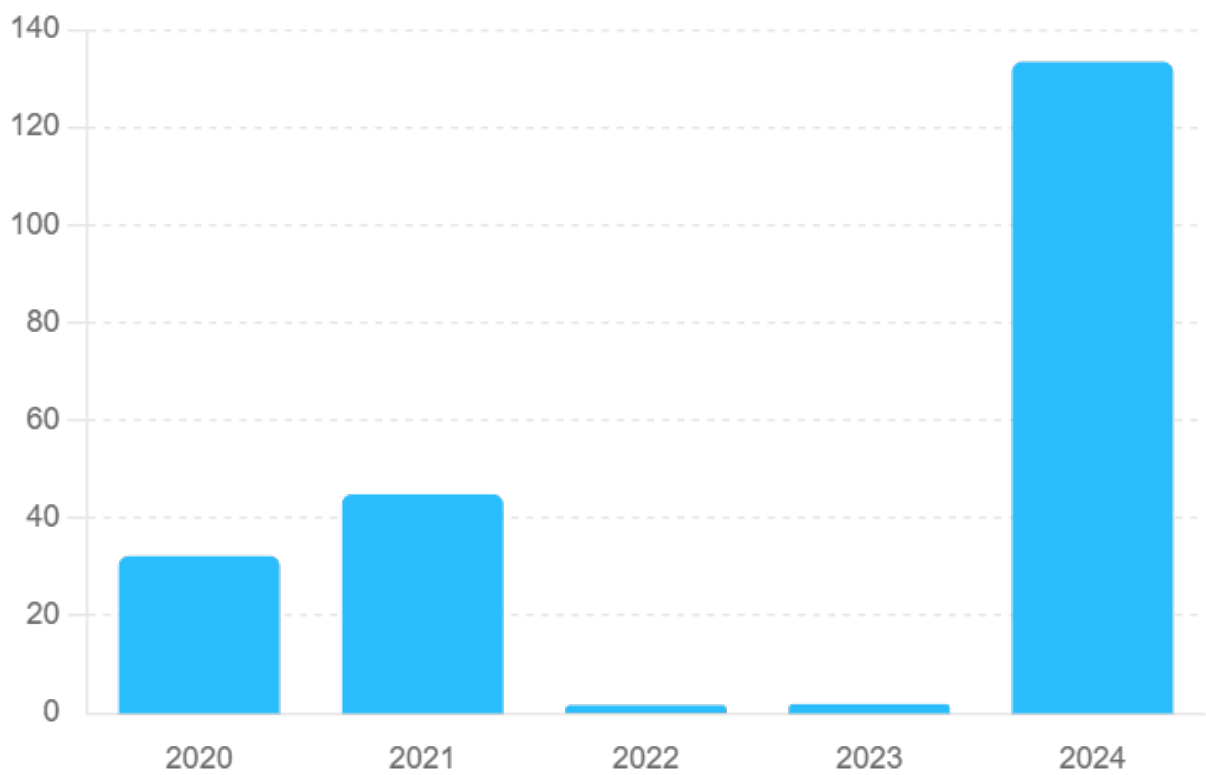


Figure 1 — Average IPO Underpricing by Year (2020–2024)

Data sources: NSE/BSE listings, company RHPs, and reputable financial media outlets.

5.3 Link to Signalling Game Predictions

The empirical evidence aligns closely with the predictions of the **Bayesian signalling game** described in Section 3:

1. **Separating Equilibrium in High-Asymmetry Sectors**
 - o High-quality issuers in sectors with greater information asymmetry (e.g., Nykaa, MobiKwik) exhibited significant underpricing, consistent with using it as a credible signal of quality.
 - o Low-quality issuers or those with overvaluation risks (e.g., Paytm) could not mimic high underpricing successfully, leading to post-listing declines.

2. Diminishing Marginal Signalling Value in Mature Sectors

- o In lower-asymmetry sectors like manufacturing or established financial services, underpricing levels were more modest, suggesting that investors rely more on fundamentals than price signals.

3. Temporal Patterns

- o The post-pandemic period (2021–2022) showed heightened use of underpricing as a signal during the tech IPO wave.
- o By 2024, while select IPOs maintained high underpricing, market discipline appeared stronger, with investors punishing overvalued offerings.

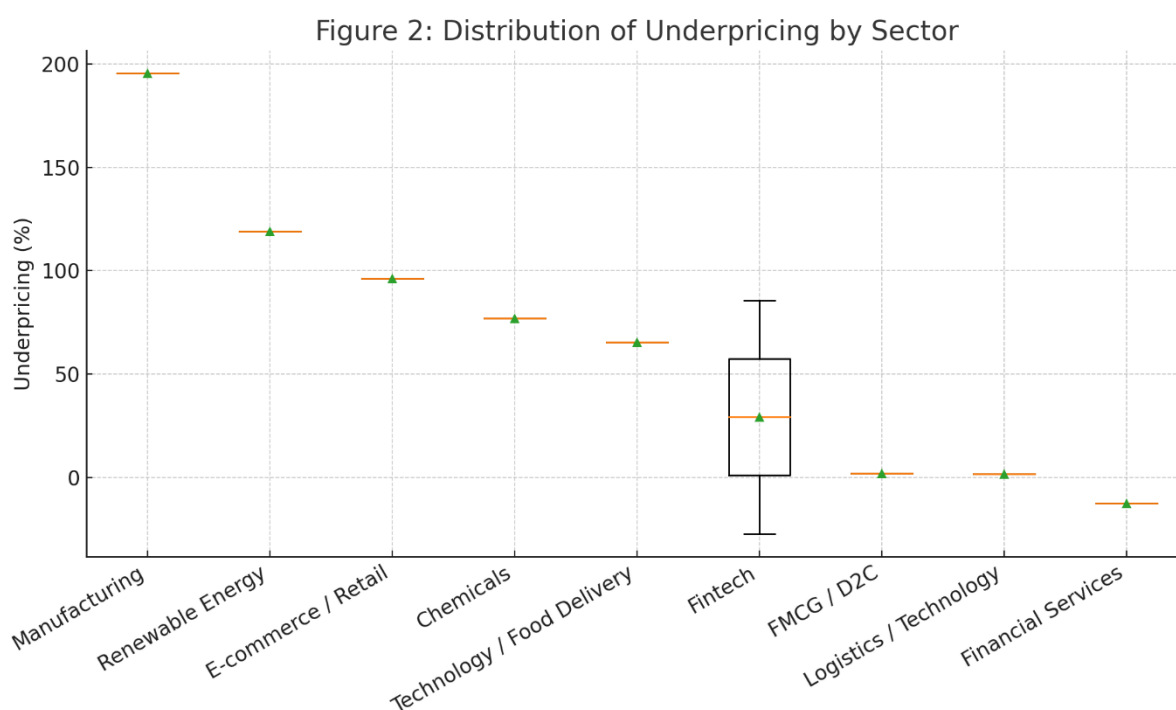


Figure 2 — Distribution of Underpricing by Sector

Data sources: NSE/BSE listings, company RHPs, and reputable financial media outlets.

5.4 Practical Implications

• For Issuers:

Strategic underpricing can enhance initial investor enthusiasm, but it must be backed by strong fundamentals to sustain post-listing valuations.

• For ECM Practitioners:

In high-asymmetry sectors, underpricing remains an effective tool for market signalling, but optimal levels must balance short-term market gains with long-term value retention.

- **For Policymakers:**

Regulatory frameworks could focus on improving pre-IPO disclosures to reduce information asymmetry, thereby reducing the need for excessive underpricing as a signal.

5.5 Summary

The findings suggest that underpricing in Indian IPOs between 2020 and 2024 is not random, but is systematically related to sectoral information asymmetry and issuer quality. Sectors that exhibit high information asymmetry demonstrate a greater level of underpricing: which is a reasonable finding given the separating equilibrium highlighted in the Bayesian signalling model. Counterintuitively, while the signalling mechanism suggests sustained long-run returns for high-underpricing IPOs, the results suggest that high levels of underpricing and no strong fundamentals tend to result in rapid corrections in the market as well. These results imply that underpricing has a dual function in the market - both as a credible market signal, and as measure of risk - and was suggestive of the need for strategic calibration in Market Execution within equity capital markets.

6. Conclusion

This research investigated IPO underpricing in India from 2020 to 2024 as a Bayesian signalling game. Analysing the data from a sample of large IPOs across high and low-information asymmetry sectors showed that the level of underpricing generally was greater in sectors with the highest levels of uncertainty for investors. This is predicted by signalling theory's separating-equilibrium. High-quality issuers like Nykaa, Zomato, and MobiKwik seem willing to pay the short-term cost of underpricing in order to develop some credibility within the market. Following their IPO, Paytm is a good example of a low-quality or overvalued issuer that could not maintain a positive post-listing performance to signal an IPO of quality.

Overall, our findings indicate that while underpricing remains an empowering tool for issuers and practitioners of equity capital markets, the degree of underpricing relates to the issuer's fundamentals and the level of information asymmetry present in the sector. In terms of policy, pre-IPO disclosures can reduce the reliance on costly signalling that results in more efficient capital markets. In India, underpricing is not simply just a market anomaly; it is a rational calculation made not just by the issuer, but as part of a wider strategy between an issuer and investor.

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