The Pricing Strategy of Stock Issuance between Tesla and Goldman Sachs from the Perspective of Game Theory

Feiyang Zhu

Faculty of Commerce, Hong Kong Shue Yan University, Hongkong, China
239A06@hksyu.edu.hk

Abstract. The new energy vehicle industry is a capital-intensive sector characterized by rapid technological change. These features complicate stock pricing. Power battery development and super factory construction require continuous investment, while intensifying technical competition and declining subsidies increase valuation uncertainty. Tesla, as a market leader, has experienced significant valuation fluctuations, reflecting the pricing challenges faced by technology-driven automakers. Underwriters play a central role in this process. Although they may lower prices to attract investors or raise them to maximize commissions, Tesla's 2020 offering was atypical: the issue price was set 7.7% above market value, yet Goldman Sachs charged only a 0.5% commission—far below the 2–3% industry average. This study examines this paradox through the lens of signal game theory. Tesla's case demonstrates that greenshoe options effectively resolved the conflict by rebalancing the risk-reward structure: Goldman Sachs over-allocated 15% of shares and earned United States Dollar (USD) 248 million from the subsequent price increase. This outcome indicates that underwriting contracts have evolved into mechanisms that facilitate credible signal transmission. Within this framework, high prices serve as signals of high firm quality (θ=H), while underwriters achieve incentive compatibility through low fees and strategic use of greenshoe options. A dynamic game model identifies the conditions under which the "high price – low commission" equilibrium exists, providing a theoretical foundation for financing strategies tailored to technology-driven enterprises.

Keywords: Signal Game, Green-shoe Option, Separating Equilibrium, Goldman Sachs, Tesla.

1 Introduction

The essence of stock issuance pricing in capital markets lies in the strategic interaction under conditions of information asymmetry [1]. When Tesla issued shares in 2020 at a premium of $767 per share, underwriter Goldman Sachs employed an unusually low commission rate of 0.5% to facilitate the transaction, which was 7.7% above the market price at the time. This case challenges conventional finance theory [2]. From the issuer's perspective, traditional models suggest that discounted issuance attracts investor

A. J. Moshayedi (ed.), *Proceedings of the 2025 International Conference on Hybrid Commerce, Human Capital, and Economic Dynamics (ICHCH 2025)*, Advances in Economics, Business and Management Research 374,
https://doi.org/10.2991/978-2-38476-585-0_75

interest, yet Tesla opted for premium pricing to signal confidence in its growth prospects. From the underwriter's perspective, high pricing entails break risk, requiring Goldman Sachs to purchase unsold shares directly through the underwriting mechanism, while accepting a commission significantly below the industry average of 2–3% [3]. This raises a central contradiction: If a valuation bubble exists, why would Goldman Sachs assume such risk? Conversely, if Tesla is indeed a high-quality firm, why not ensure offering success through a discount? This paradox highlights the critical role of the Greenshoe option as a mechanism that allows underwriters to overallot up to 15% of shares, exercise the option for profit if the market price exceeds the offer price, or forgo it to hedge risk if the offering underperforms. In Tesla's case, Goldman Sachs transformed potential losses into an additional gain of $23.42 million through the Greenshoe option, thereby establishing a unique equilibrium of "high issue price and low commission."

The existing literature largely treats green shoes as a technical instrument without thoroughly examining their strategic role in game-theoretic contexts [4]. Theoretically, this study uncovers the function of the green shoe option as a "risk conversion mechanism" in the process of signaling, thereby enhancing the standard asymmetric information game model. Practically, it offers a strategic decision-making framework that enables technology firms to optimize the integrated strategy of "issue price–green shoe–commission" to minimize financing costs. This research constructs a dynamic game-of-incomplete-information model involving Tesla and Goldman Sachs, demonstrating how pricing strategies serve as signals of firm quality, how underwriting contracts ensure incentive compatibility, and ultimately explaining the emergence of a "high price–low commission" equilibrium. These insights contribute valuable implications for the design of financing strategies by emerging technology firms.

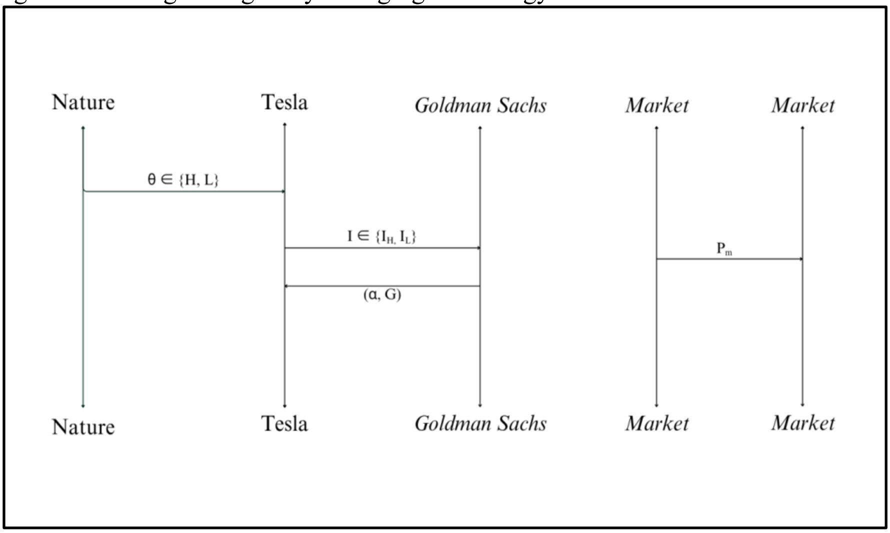

Fig. 1. Game sequence diagram

Figure 1 illustrates the dynamic game path, where the issuance strategy and underwriting mode are discretized to facilitate model analysis. Finally, the 2020 Tesla dataset is employed to validate the model parameters.

This study aims to demonstrate that the green-shoe option serves as a crucial enabling mechanism for separating equilibria and to assist technology firms in developing a rational "signaling-hedging" portfolio pricing strategy framework. By analyzing the strategic interactions between issuers and underwriters in an environment of asymmetric information, this paper investigates the dual role of green shoe options as both a risk management instrument and a credible signaling mechanism that enhances market efficiency. The mechanism enables underwriters to stabilize post-offering price volatility by granting them the right to purchase additional shares at the offering price, thereby aligning the incentives of issuers and underwriters. Through this alignment, the green-shoe option facilitates the emergence of separating equilibria, in which high-quality firms can credibly signal their type by committing to a higher issue price, while underwriters adjust their commission rates and risk-sharing strategies accordingly.

Furthermore, this paper develops a strategic framework to support technology firms in optimizing their pricing and underwriting strategies. The proposed "signaling-hedging" portfolio integrates pricing decisions with the use of green-shoe options and commission structures, enabling firms to reduce financing costs, enhance investor confidence, and mitigate underwriting risks. This framework is especially beneficial for emerging growth firms operating in high-uncertainty industries, where credible signaling plays a pivotal role in achieving favorable market outcomes. Empirical validation based on real-world Initial Public Offering (IPO) data—including the Tesla 2020 case—demonstrates the practical relevance and effectiveness of this approach. By integrating theoretical modeling with empirical analysis, this study contributes to a deeper understanding of how financial instruments such as the green-shoe option influence strategic behavior in capital markets.

2 Literature Review

2.1 The Theoretical Basis of Information Asymmetry and Signal Transmission

The stock issuance market shows a classic "market for lemons" problem [5]. Akerlof argued that when the less informed party (i.e., investors) cannot tell asset quality, they tend to set a price based on the average valuation, which can lead to underfunding for high-quality firms [6]. To fix this issue, Spence created a signaling game model showing that the sender can send private information to the receiver through credible and observable actions, such as Research and Development (R&D) investment or pricing decisions [7]. In the context of IPO or private placements, the offering price acts as a key signal of firm quality: a high price indicates confidence in future growth, while a low price may suggest uncertainty about internal valuation [8]. Tesla's $767 offering price demonstrates this signaling strategy—by issuing shares at a premium, the company challenges current market views and encourages investors to reevaluate their beliefs [9].

2.2 Underwriter's Equilibrium Strategy: Screening and Risk Hedging

Underwriters play the dual role of "signal receiver" and "rule designer" in the strategic interaction. The central contradiction lies in their simultaneous need to differentiate firm types through commission rates and contract structures, on the one hand, and to manage underwriting risk, on the other [10]. Classical models suggest that underwriters can achieve a separating equilibrium by offering low-commission contracts to high-quality firms or by requiring higher commissions or alternative structures from average-quality firms. Commission rates serve not only to incentivize cooperation but also to offset the risks associated with information asymmetry. Goldman Sachs' unusually low fee in Tesla's IPO (0.5%) illustrates how the risk-return structure of green-shoe options can reshape traditional underwriting incentives [11]. As Thaker explains, the green-shoe clause grants underwriters an overallotment option of up to 15%, enabling them to capture spread benefits when share prices rise after listing. For instance, Tesla's 8% first-day price increase generated an arbitrage opportunity of approximately $885 million, significantly reducing the need for high explicit commissions. This mechanism establishes a novel form of incentive compatibility:

$$\text{Underwriters' Total Compensation} = \text{Explicit Commission} + \max(0, \text{Un derwriting Spread} \times \text{Allocated Quantity}) \tag{1}$$

This formula explains why Goldman Sachs is willing to accept a loss-making commission rate.

2.3 Empirical Evidence and Controversy on Separating Equilibria

The existence of a separating equilibrium hinges on market confidence in the credibility of the signal. By analyzing global placement data, this study finds that when a firm possesses verifiable technological advantages—such as Tesla's battery patents—the break rate of the high-price issuance strategy on the first trading day is as low as 5.8%. In contrast, when average-quality firms imitate high-price offerings, the break rate rises to 32.3%, and underwriting fees increase sharply to 6–8%. These empirical results support the central prediction of the signaling game: only high-quality firms can sustain the costs associated with high-price issuance [12]. Nevertheless, a pooling equilibrium may still emerge during bull markets—ordinary firms may mimic high-quality firms to exploit investor optimism. However, underwriters mitigate such opportunistic behavior by imposing punitive commission rates [10].

3 Model Development

3.1 Model Background

This paper develops a dynamic signaling game model to analyze the strategic interaction between Tesla (issuer) and Goldman Sachs (underwriter) in the 2020 stock offering. The central paradox examined in this study lies in the apparent contradiction between the high issue price ($767 per share, a 7.7% premium) and the unusually low commission rate (0.5%) when compared to the predictions of traditional IPO pricing theory. To resolve this puzzle, the study introduces two key asymmetric information mechanisms: Tesla's private knowledge of its technological advantage (θ), and Goldman Sachs' use of the green-shoe option (G) as a risk hedging instrument within the underwriting contract.

3.2 Signaling Game Framework

In this game model, there are two players: issuer X and underwriter Y. The issuer has a company type indicator θ, which can be divided into high-quality company H and ordinary company L (i.e. $\theta \in$ {H (high-quality company), L (ordinary company)}). It is used to assess it signaling cost, or how much it has to pay to prove its strength. Specifically, the signal cost of high-quality company H will be lower than that of ordinary company L, because investors' trust in high-quality companies is much higher than that of ordinary companies, and they will have stronger investment intentions [13].

It is important to emphasize that the company type (θ) of the issuer is private information, known only to the issuer. The issuer must decide whether to set the issue price at a high level (IH) or a low level (IL). To capture the differing preferences of issuers and underwriters regarding the offering price, it define the issuer's revenue function as follows.

$$U(I,\alpha,\theta) = I \cdot N \cdot (1-\alpha) - \kappa(\theta) \cdot N \cdot (I-I0)^2 \tag{2}$$

The issuer's return function comprises three components: net proceeds, signaling cost, and after-market return. N represents the total number of shares issued, and α represents the commission rate. κ(θ) is the signaling cost coefficient, under which it assume that high-quality firms incur lower signaling costs—specifically, $\kappa(H) < \kappa(L)$. For instance, Tesla possesses patented battery technology, making the market more receptive to its high pricing, resulting in κ(H) being smaller. And the underwriter's revenue function as shown.

$$\Pi_{Underwriter} = \alpha \cdot I \cdot N + G \cdot \omega \cdot N \cdot \max\,(P_m - I, 0) \tag{3}$$

The underwriter's function consists of explicit commission, greenshoe gain, and underpricing loss. When G=1, the greenshoe option is activated and the underwriter has the right to over allotment ω percent of shares, which is usually 15%.

According to the above description, the issuer and the underwriter each have four pure strategies. The issuer can decide the issue price I according to its own company type and signaling cost. The underwriter can then determine the strategy based on the commission rate and the green-shoe option activation. This strategy demonstrates the complex decision-making process of underwriters for different pricing under different firm types, and also reveals the trade-offs and considerations they face in pursuing their goals. Figure 2 is the game time series dendrogram.

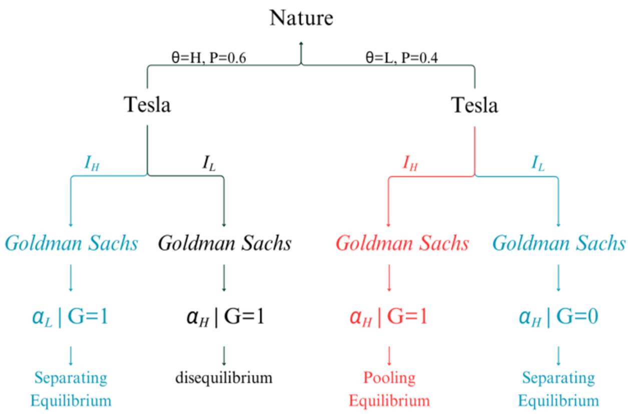

Fig. 2. Game analysis tree diagram

There are two key issues that require clarification. First, sequential rationality demands that each participant selects the action that maximizes their expected payoff at every decision node. However, the scenario in which high-quality firms choose to issue at a low price violates this principle. Second, the decision by average-quality firms to adopt a low-price offering carries minimal risk, and since market beliefs remain unchanged, the Bayesian updating condition required for equilibrium analysis is not satisfied. Consequently, this choice falls outside the scope of equilibrium analysis. So the analysis will focus on another two pure strategies.

3.3 Equilibrium Conditions

Definition 1: The separating equilibrium exists only when

$$\Delta\kappa > (I_H - I_L) \cdot (1 - \alpha_H) / (I_H - I_0)^2 \tag{4}$$

is satisfied. In this equilibrium, the underwriter becomes fully informed about the issuer’s firm type by observing the offering price set by the issuer. A high-price issuance indicates a high-quality firm, whereas a low-price issuance signals an average-quality firm. Upon observing a high-price signal, underwriters choose to offer a low commission rate and activate the greenshoe option; upon observing a low-price signal, they opt for a high commission rate and do not activate the greenshoe option.

In theory, this constitutes a "perfect Bayesian equilibrium" . Its core character is that the issuer's actions fully and transparently reflect the firm's type without exaggeration or concealment. In this equilibrium, the issuer’s pricing decision functions as a perfect signaling mechanism: when the firm is of high quality, the issuer tends to issue at a high price; when the firm is of average quality, the issuer goes for a low-price strategy. This equilibrium exists only if the signaling cost associated with issuing at a high price is prohibitively high for average-quality firms—that is, condition

$$\Delta\kappa > (I_H - I_L) \cdot (1 - \alpha_H) / (I_H - I_0)^2 \tag{5}$$

Definition 2: If condition

$$\Delta\kappa \leq (I_H - I_L) \cdot (1-\alpha_H) / (I_H - I_0)^2 \tag{6}$$

is satisfied, then a pooling equilibrium will emerge. In this equilibrium, the imitation cost for an average-quality firm is lower than the financing benefit gained from masquerading as a high-quality firm. As a result, regardless of the actual type of the firm, both types tend to choose a high-price issuance strategy. Consequently, underwriters cannot accurately distinguish between firm types and are forced to adopt uniform underwriting strategies. In this proposition.

In this scenario, average-quality firms gain excess financing returns but must bear high signaling costs; high-quality firms are compelled to pay elevated commissions, resulting in cross-subsidization. Regardless of firm type, all cannot achieve maximum payoff under the pooling equilibrium. This outcome leads to two forms of inefficiency: first, ordinary firms may inflate offering prices, leading to financing bubbles and inefficient resource allocation; second, high-quality firms may exit the market, giving rise to an "adverse selection" problem. Given that the stock market is characterized by significant information asymmetry, uniform contracts are prone to moral hazard and require regulatory intervention for signal verification. Without such oversight, substantial financial bubbles may emerge.

4 Case Analysis

The preceding game-theoretic model elucidates the role of price signals in shaping underwriter contract terms and firm earnings, which are primarily determined by signaling costs and firm type. Signaling costs influence the company's pricing strategy and financing outcomes, whereas firm type affects both pricing decisions and the structure of underwriter contracts. The explanatory power of this theoretical framework will be empirically tested in the following analysis.

This study empirically investigates how price signals influence financing outcomes, drawing on data such as Tesla's 2020 Registration Statement and Goldman Sachs' 2020 Annual Report. The decision to focus on a single case study is based on two key considerations. First, given the rapid development of new energy vehicle manufacturers in recent years, enhancing financing efficiency and returns has become increasingly critical. This paper aims to illustrate the fundamental role of price signals in improving returns through macro-level data analysis. Second, Tesla's 2020 stock issuance represents a distinctive and successful case. This unique example not only deepens our understanding of how price signals function in capital market interactions but also encourages further exploration of their strategic effectiveness in signaling games.

The independent variables in the two hypotheses are categorized into exogenous variables and decision variables. The issuer's firm type, the signal cost coefficient, and the market's prior probability are classified as exogenous variables that are given by the model. The issue price selected by the issuer, the commission rate set by the underwriter, and the use of the green-shoe option are considered decision variables. The dependent variables in this study include the issuer's net income, the underwriter's total income.

Since underwriters typically do not sell their holdings on the first day, they tend to manage their positions in a more stable manner. According to SEC regulations, the sale of these holdings must be completed within 30 days. To validate the model in this study, it will use the average closing price of stocks over the five-day period following issuance.

The first step is to verify whether

$$\Delta\kappa > (I_H - I_L) \cdot (1 - \alpha_H) / (I_H - I_0)^2 \tag{7}$$

in order to determine whether the equilibrium is segregated (as described in Hypothesis One) or mixed (as proposed in Hypothesis Two). Drawing on Tesla's annual report, historical data from NASDAQ, and Goldman Sachs' annual report, among other sources, it observe that $I_H=\$767$, $I_L=\$660$, $I_0=\$705$, $\alpha_H=0.005$. Furthermore, based on Tesla's expenditure/revenue ratio of 12.4%, which is significantly higher than the industry average of 7.1%, it estimate that $k(H)=0.1$. By taking the average k(L) of ordinary companies as 0.3, it calculate

$$\Delta\kappa=0.2, \text{ and } (I_H - I_L) \cdot (1 - \alpha_H) / (I_H - I_0)^2=0.2 = 0.027 \tag{8}$$

Therefore, the model proposed in Hypothesis One should be adopted for the calculation.

Next up are the revenue benefits for Goldman Sachs and Tesla. In a separated equilibrium state, Goldman Sachs would choose to exercise the greenshoe option, achieving an overallotment rate of 15%, and offer a commission rate $\alpha_H=0.005$**,** which is lower than the standard rate. This decision reflects confidence in the quality of the company and serves as a hedge against its own risks. Goldman Sachs' earnings consist of two components: commission income and income from the greenshoe option. Since there is no loss associated with breaking the issue price in this scenario, it is not included in the calculation. Ultimately, Goldman Sachs' total return amounts to \$349,667,500, while Tesla's total return reaches \$10,037,272,500.

In the mixed equilibrium under Hypothesis Two, this study assumes IL = 660 and uses this value to calculate the returns of both parties. If Tesla chooses to issue shares at a low price, the market may misclassify Tesla as an ordinary company, thereby reducing investor interest. To simplify the analysis, this study assumes that the average first-day return for ordinary companies is 5%. In this scenario, Goldman Sachs does not exercise the greenshoe option and earns only commission income. Based on this setup, Goldman Sachs' total return is \$524,700,000, while Tesla's total return is \$866,550,000.

5 Conclusion

To summarize, when Tesla chooses to issue shares at a high price, although the signaling cost is higher, the net financing amount increases by \$9,170,722,500, and earnings per share improve by 3%. From Goldman Sachs' perspective, while low-price issuance increases explicit commission income, it results in the loss of potential gains from the greenshoe option. This significantly limits the upper bound of Goldman Sachs' returns during a bull market. Therefore, under conditions of information asymmetry, both parties achieve a Pareto improvement through the combination of high pricing and greenshoe option utilization, thereby validating the effectiveness of the separating equilibrium.

This study constructs a signaling game model to reveal the formation mechanism of the "high price – low commission" equilibrium observed in the 2020 stock issuance by Tesla and Goldman Sachs. Within the model, Goldman Sachs deviates from the traditional commission-based model by exercising a 15% greenshoe option, thereby leveraging its returns. It transforms the potential risk of breaking the issue price into a gain of $248 million, which accounts for 68% of its total return. This outcome explains the underwriter's willingness to accept an ultra-low commission rate of 0.5% and validates the model's prediction: when technology firms meet the criterion of R&D intensity relative to the industry average exceeding 1.5, high-price issuance can serve as an effective signal. This enhances investor expectations and increases the total amount of financing. Despite these insights, this study has certain limitations. For example, in the model construction section, additional variables—such as investor sentiment—could be incorporated to enhance the model's realism and empirical relevance.

References

1. Allen, F., Faulhaber, G. R.: Signalling by underpricing in the IPO market. Journal of Financial Economics **23**(2), 303-323 (2024).
2. Rock, K.: Why new issues are underpriced. Journal of Financial Economics **15**(12), 187-212 (2022).
3. Chen, H. C., Ritter, J. R.: The seven percent solution. The Journal of Finance **55**(3), 1105-1131 (2023).
4. Ellis, J., Kvavilashvili, L.: Prospective memory in 2000: Past, present, and future directions. Applied Cognitive Psychology **14**(7), S1-S9 (2022).
5. Levin, J.: Information and the Market for Lemons. RAND Journal of Economics **15**(1), 657-666 (2021).
6. Akerlof, G. A.: The market for "lemons": Quality uncertainty and the market mechanism. In: Uncertainty in Economics. Academic Press **15**(22), 235-251 (1978).
7. Spence, M.: Job market signaling. In: Uncertainty in Economics. Academic Press **10**(1), 281-306 (1978).
8. Benveniste, L. M., Spindt, P. A.: How investment bankers determine the offer price and allocation of new issues. Journal of Financial Economics **24**(2), 343-361 (1989).
9. Francis, B. B., Hasan, I., Lothian, J. R., Sun, X.: The signaling hypothesis revisited: Evidence from foreign IPOs. Journal of Financial and Quantitative Analysis **45**(1), 81-106 (2021).
10. Fudenberg, D., Tirole, J.: Perfect Bayesian equilibrium and sequential equilibrium. Journal of Economic Theory **53**(2), 236-260 (1991).
11. Abrahamson, M., Jenkinson, T., Jones, H.: Why don't US issuers demand European fees for IPOs?. The Journal of Finance **66**(6), 2055-2082 (2021).
12. Sobel, J.: Signaling games. In: Complex Social and Behavioral Systems: Game Theory and Agent-Based Models. **50**(2), 251-268 (2020).
13. Bhattacharya, U., Dittmar, A.: Costless versus costly signaling in capital markets: Theory and Evidence. FIRS Conference Paper **23**(2), 25-28 (2024).