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INFORMATION ASYMMETRY AND SIGNALING BEHAVIOR IN MARKET ENTRY GAMES: LABORATORY AND FIELD EXPERIMENTAL EVIDENCE

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Abstract

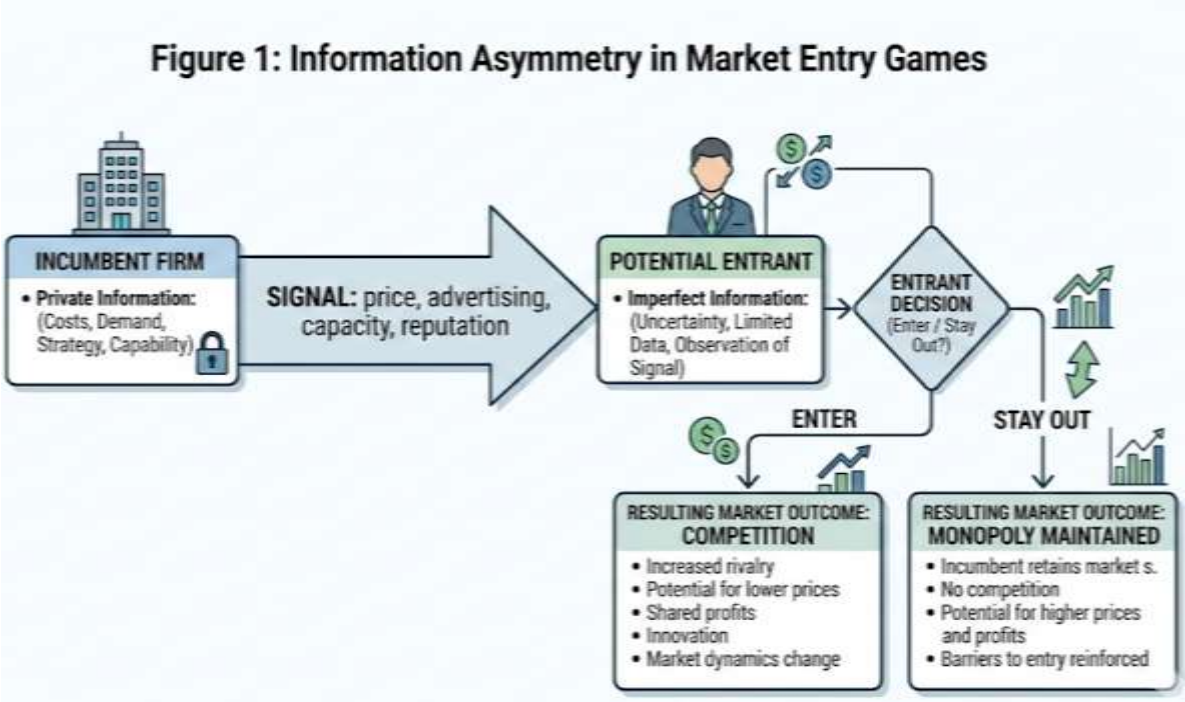
Information asymmetry profoundly shapes strategic interaction in market entry games, where incumbents possess private knowledge about costs, demand, or type those potential entrants lack, creating incentives for costly signaling to deter entry, coordinate outcomes, or reveal quality. This review synthesizes theoretical models and experimental evidence from laboratory and field settings on signaling mechanisms limit pricing, excess capacity, advertising, reputation building, and predatory pricing under incomplete information. Core frameworks include Spence-style signaling, Milgrom-Robert's limit pricing, and Bagwell-Ramey models of dissipative advertising, with equilibrium outcomes depending on signal costliness, credibility, and separating versus pooling dynamics. Laboratory experiments consistently show that incumbents over-invest in deterrence signals when entry threats are salient, while entrants exhibit cautious behavior and excess entry occurs less frequently than predicted by symmetric-information models. Field evidence from industries such as pharmaceuticals, e-commerce, and retail reveals mixed deterrence success, with reputation and repeated interaction often proving more effective than one-shot costly signals. The analysis highlights behavioral deviations overconfidence, loss aversion, and bounded rationality that drive deviations from equilibrium predictions, as well as welfare implications: while signaling can reduce inefficient entry, excessive deterrence may harm consumer surplus and innovation. The review concludes that effective policy design must account for both rational strategic incentives and empirical behavioral regularities to balance entry barriers and market efficiency.

INTRODUCTION

The strategic dynamics of market entry are fundamentally dictated by the distribution and quality of information among competing agents. In the standard neoclassical framework, firms are often assumed to possess perfect information regarding market demand, production costs, and the strategic intentions of rivals (Saadatmand et al., 2018). However, real-world markets are characterized by profound information asymmetries, where incumbent firms possess private knowledge that potential entrants lack (Akerlof, 1970). This asymmetry creates an imbalance of power, often shifting the "scale" of transaction towards the party with superior information (Bergh et al., 2019). In response to these imbalances, firms engage in signaling behavior the use of observable, costly actions to convey unobservable traits to deter entry, establish reputations, or coordinate on efficient outcomes (Bagwell & Ramey, 1988).

This report provides a comprehensive review of the theoretical foundations and experimental

evidence surrounding signaling and information asymmetry in market entry games. By synthesizing findings from laboratory settings, where variables can be isolated with precision, and field experiments, which capture the complexity of actual industrial competition, the analysis explores how signals such as limit pricing, advertising, and reputation mechanisms influence market structure and welfare (Ellison & Ellison, 2011). Figure 1 illustrates the basic structure of information asymmetry in market entry games, where incumbents possess private information and may transmit signals to potential entrants.



2. Theoretical Foundations of Signaling and Information Asymmetry

At the core of information economics is the distinction between situations of symmetric uncertainty and asymmetric information. While the former involves risks that are shared by all parties, the latter involves private information that can lead to market failures such as adverse selection and moral hazard (Milgrom & Roberts, 1982). Signaling theory suggests that the informed party can mitigate these failures by sending credible signals to the uninformed party (Spence, 1973).

2.1. The Signaling Mechanism and Incentive Compatibility

A signal is only effective if it is credible, and credibility is generally derived from cost. If a signal were costless to produce for all types of firms, a pooling equilibrium would emerge where high-quality and low-quality firms are indistinguishable (Steigenberger, 2025). For a signal to facilitate a separating equilibrium where the receiver can perfectly infer the sender's type the signal must satisfy the condition of differential cost: it must be more expensive for a low-type (high-cost) firm to mimic a high-type (low-cost) firm than it is for the high-type to send the signal itself (Connelly, 2025).

The theoretical literature distinguishes between indices and signals. Indices are observable, unalterable attributes, whereas signals are observable characteristics that an agent can manipulate at a cost, such as education level or advertising budget (Liang et al., 2018). In the context of market entry, the incumbent's price and advertising expenditures are primary signaling instruments used to convey the

underlying cost structure or market demand to potential entrants (Lawford, 2025).

2.2. Equilibrium Concepts and Refinements

The analysis of signaling games relies on the Perfect Bayesian Equilibrium (PBE), which imposes consistency between strategies and beliefs. In a PBE, the sender's action must be optimal given the receiver's expected response, and the receiver's belief must be updated via Bayes' Rule whenever possible (Cobb et al., 2013). This rule states that the probability of a sender being a certain type, given the observed signal, is calculated by dividing the probability of that signal being sent by that specific type (multiplied by the initial likelihood of that type) by the sum of probabilities across all possible types (Tuzlukov, 2018).

Signaling games often suffer from a multiplicity of equilibria. To address this, economists employ refinements such as the Intuitive Criterion or Undefeated Equilibrium (Tirole, 1988). These refinements eliminate implausible equilibria by examining out-of-equilibrium beliefs. For instance, the intuitive criterion suggests that if a specific action could only be profitable for a low-cost incumbent and not a high-cost one, the entrant should reasonably believe the incumbent is low-cost upon observing that action (Nicholson et al., 2023).

Table 1: Characteristics of Equilibrium Types in Signaling Games

Equilibrium Type	Sender Behavior	Receiver Inference	Market Outcome
Separating	Different types choose different signals.	Perfect inference of type.	Efficient sorting; entry only if profitable.
Pooling	All types choose the same signal.	No update to prior beliefs.	Potential for excessive or insufficient entry.
Semi-Pooling	One type randomizes between signals.	Partial inference (probabilistic).	Mixed strategies; reputation building over time.

These theoretical structures provide the scaffolding for the Milgrom-Roberts model of limit pricing, which remains the cornerstone of modern industrial organization theory regarding entry deterrence (Margaria, 2023).

3. Strategic Deterrence through Limit Pricing and Advertising

The Milgrom-Roberts (1982) model demonstrates that an incumbent firm may lower its price even in the absence of capacity commitment to signal that its production costs are low. This behavior, known as limit pricing, serves as a rational signal of strength (Camerer, 2018). The logic is that a low-cost incumbent can afford to maintain low prices and still remain profitable, while a high-cost incumbent would incur unsustainable losses if it attempted to mimic the low price to deter entry (Sánchez Cartas, 2018).

3.1. The Role of Multidimensional Signaling

Theoretical extensions have enriched the Milgrom-Roberts framework by incorporating advertising as a secondary signaling instrument. In models where both price and advertising are chosen, a cost-reducing distortion occurs (Lai & Ng, 2023). The incumbent behaves as if its costs were lower than they truly are. This leads to a downward distortion in price and, in some cases, an upward distortion in demand-enhancing advertising (Romano, 2021).

Unlike dissipative advertising (pure money-burning), demand-enhancing advertising directly affects the post-entry game by increasing market size. However, the signaling value of advertising is distinct: it communicates to the entrant that the incumbent's margins are high enough to justify aggressive marketing (Winter, 2020). Interestingly, experimental data suggest that while costly signals are theoretically more credible, the presence of multiple signals can sometimes lead

to signal dilution or noise, where the receiver finds it difficult to distinguish genuine intent from strategic manipulation (Lauer et al., 2021).

3.2. Dynamic Limit Pricing and Entry Delay

While static models focus on whether entry is deterred, dynamic models analyze the intensive time margin how long entry can be delayed. In continuous-time models, the potential entrant faces an optimal stopping problem, gathering information from a noisy price signal over time (Cetemen & Margaria, 2023). In these models, the change in the observed signal over time is viewed as a function of the incumbent's output and the true state of demand, plus a random noise component (Eaton et al., 2021).

The incumbent, anticipating the entrant's learning process, has an incentive to manipulate the trend of the signal. This often results in pooling at capacity, where both types of incumbents produce at maximum levels to hide their true type (Parry, 2025). Even if entry eventually occurs, the strategic signaling can create significant welfare losses by delaying the arrival of competition and the resulting consumer surplus (Bimpikis & Mantegazza, 2023).

4. Laboratory Evidence: Coordination, Reputation, and Sorting

Laboratory experiments provide a unique vantage point to observe how real decision-makers navigate the complexities of signaling games. These experiments typically utilize N-player market entry games where participants must choose between "In" and "Out" based on market capacity and the expected actions of others (Mahmood & Rehbeck, 2022).

4.1. N-Player Entry Games and Information Treatments

In games with symmetric information, theory predicts that groups of players should coordinate on an asymmetric pure-strategy Nash equilibrium a process known as sorting. However, the speed of this coordination is highly sensitive to the information environment. Experimental treatments typically vary the amount of feedback provided to subjects after each round (Duffy & Hopkins, 2005).

Table 2: Comparison of Information Treatments and Coordination Results

Information Treatment	Feedback Provided	Observed Coordination Speed
Limited Information	Only the subject's own payoff.	Very slow; requires roughly 100 periods.
Aggregate Information	Payoff function and total number of entrants.	Surprisingly similar to Limited; poor efficiency.
Full Information	Specific choices and payoffs of every opponent.	Rapid convergence to pure-strategy equilibrium.

The results from laboratory studies suggest that human agents rely on individual-level data to sort into roles. This challenges standard reinforcement learning models, which often ignore the identity of rivals. The Full Information treatment allows for the emergence of tacit coordination, where players use past behaviors as signals of their intended future actions (Dong et al., 2025).

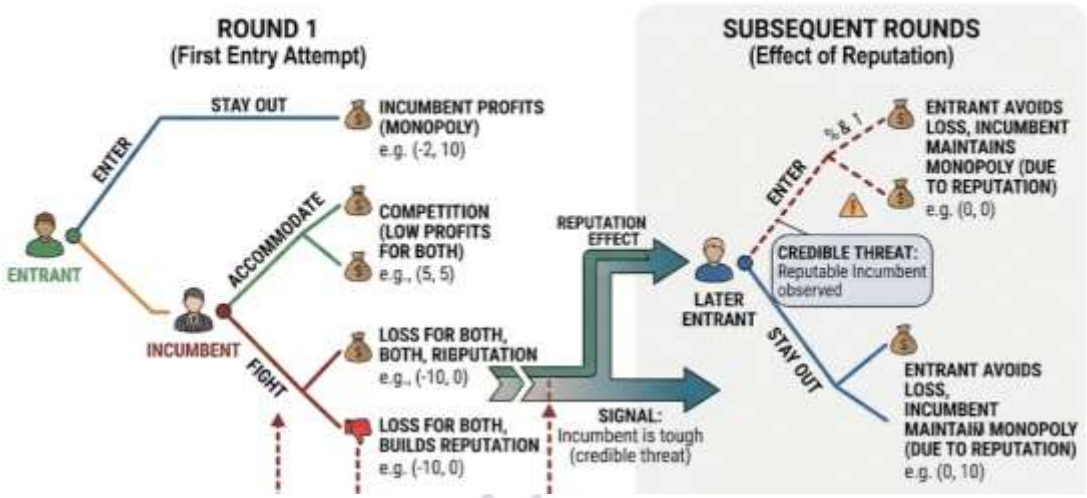
4.2. Reputation Building in the Chain-Store Game

The Chain-Store Paradox provides a classic conflict between backward induction and intuitive signaling behavior. In a finite series of interactions, an incumbent should theoretically always accommodate entry in the final round, which means they should accommodate in all rounds (Zhao, 2025).

Weak incumbents frequently fight early entrants to build a reputation for toughness, mimicking the behavior of strong types for whom fighting is a dominant strategy (Jung et al., 1994). This

reputation building is significantly more effective in continuous-time settings than in discrete-time settings (Jung et al., 1994). In continuous time, the incumbent can adjust actions at any moment, sending clearer entry-deterring signals that establish a high level of reputation as early as the first round (Beck, 2024). Figure 2 illustrates the sequential structure of the chain-store game. Early aggressive responses can build a reputation that deters future entrants.

Figure 2: Reputation Building in the Chain-Store Game



4.3. Signaling through Cheap Talk and Costless Threats

While traditional theory suggests that costless signals (cheap talk) should be ignored in conflict-prone environments, experimental evidence indicates otherwise. In entry-deterrence games, when incumbents are allowed to send costless threats to potential entrants, they frequently succeed in deterring opponents in early periods (Garg et al., 2025).

Remarkably, these costless signals change the behavior of the sender as well; after issuing a threat, defenders become more likely to fight if the entrant challenges them. This suggests a psychological mechanism where communication creates a sense of commitment. In contrast, in multi-player games where everyone plays the same role, cheap talk intentions are often exaggerated and discounted by others (Walter, 2006).

5. Field Evidence: Strategic Deterrence in Actual Markets

Field experiments and empirical studies in industrial organization provide real-world validation for the theoretical predictions of signaling behavior, particularly in high-stakes environments like the pharmaceutical and airline industries (Ellison & Ellison, 2011).

5.1. Non-Monotonicity in Pharmaceutical Entry Deterrence

A critical challenge in identifying strategic entry deterrence in the field is that many deterring actions (like advertising) are also profit-maximizing for an incumbent regardless of the entry threat. Ellison and Ellison (2011) developed a novel test for strategic deterrence by examining the relationship between incumbent behavior and market size (Das et al., 2022).

By testing for this relationship, researchers found that pharmaceutical incumbents in intermediate-sized markets significantly reduced their journal advertising prior to patent expiration. This reduction acts as a signal of low market profitability, successfully deterring generic entrants (Uhari, 2021).

5.2. The Southwest Effect: Pre-Entry Price Signaling

The airline industry provides another compelling example of dynamic signaling. The Southwest Effect describes the dramatic price cuts incumbents make on routes when Southwest Airlines threatens to enter. While these cuts increase consumer surplus, they are often strategically motivated to signal low marginal costs (Margaria, 2023).

Empirical patterns show that these price cuts are most aggressive in markets with an intermediate probability of entry, consistent with the patterns observed in pharmaceuticals. In some cases, these signals are successful in warding off entry, while in others, they simply delay the arrival of competition (Lawford, 2025).

6. Behavioral Biases and Information Processing

Standard economic models assume that agents are Bayesian learners with perfect cognitive capabilities. However, both lab and field evidence suggest that behavioral biases systematically distort market entry and signaling outcomes (Lussange et al., 2020).

6.1. Overconfidence and Competition Neglect

Overconfidence is a primary driver of excessive entry in winner-take-all markets. Individuals often overestimate their skill relative to others, leading them to enter markets even when the expected value is negative (Laferrière et al., 2023).

Table 3: Impact of Behavioral Biases on Entry and Signaling

Behavioral Bias	Impact on Entry Signaling	Market Consequence
Overconfidence	Entrants ignore signals of incumbent strength, believing their own skills will prevail.	Excess entry; high failure rates; negative industry profits (Mahmood et al., 2023).
Herding	Firms mimic the entry decisions of others, treating them as a positive signal of demand.	Market bubbles and rapid congestion (Mahmood et al., 2023).
Loss Aversion	Firms are more sensitive to potential losses from entry than to equivalent gains.	Suboptimal under-entry in high-stakes markets.

This overconfidence is exacerbated by an individual's inability to correctly estimate their position in the performance distribution. In the field, researchers have found that overconfidence primarily empowers individuals already embedded in entrepreneurial networks, suggesting that social reinforcement can amplify cognitive biases (Xie & Song, 2025).

6.2. The Congestion Effect vs. the Inference Effect

In markets with demand uncertainty, the entry of a competitor can be interpreted in two ways. The congestion effect suggests that more competition dissipates profit, deterring further entry. Conversely, the inference effect suggests that the presence of others is a signal of high market demand, encouraging entry (Zhang et al., 2022).

A field experiment found that when buyer demand was hidden, the inference effect dominated: more sellers signaled a better market, increasing entry. However, when demand was explicitly disclosed, the congestion effect took over, and more sellers reduced the propensity to enter (Goldfarb & Tucker, 2019).

7. Signaling in Digital Platforms and Crowdfunding

The digital economy has introduced new signaling mechanisms, from user feedback and professional investor endorsements to blockchain-based technological trust (Tan et al., 2023).

7.1. Professional Investors as Quality Signals in Crowdfunding

In crowdfunding environments, information gaps between entrepreneurs and investors are vast. Research indicates that professional investors play a crucial signaling role. When professional investors enter a campaign early, it serves as a high-quality signal that reduces uncertainty for ordinary investors, significantly increasing the likelihood of reaching funding goals (Connelly et al., 2025).

7.2. Feedback and the Lemon Market Problem in E-Commerce

While Akerlof's (1970) original lemon market model predicted market collapse under asymmetry, modern e-commerce utilizes signals like website certifications and consumer reviews to maintain trade (Shchory, 2020). Laboratory experiments show that while consumer feedback helps restore trust, it is not a perfect solution; feedback can be gamed or faked, and irrelevant information can obscure legitimate signals, leading to suboptimal equilibria (Hossain et al., 2018).

7.3. Two-Sided Market Entry and Network Effects

Platform markets are characterized by cross-side network effects, where the value of the platform to one group depends on the number of users in the other group. Entry signaling in these markets often involves subsidies offering one side of the market free access to build critical mass (Kalayci et al., 2015).

Experiments on two-sided entry games show that when multiple equilibria exist, players can coordinate via tacit coordination under strategic uncertainty. However, if network effects are asymmetric or if the willingness to enter is lopsided, coordination failure is common (Dong et al., 2025).

8. Evolution of Honesty: Animal Signaling and the Handicap Principle

To understand the biological origins of economic signaling, researchers have turned to animal models. The handicap principle in evolutionary biology posits that costs stabilize honesty in signaling. A laboratory experiment using blue jays demonstrated that honest signaling persists when costs are high and disappears when costs are low (Whitfield, 2003).

Table 4: Stability of Signaling Honesty Based on Cost Parameters

Parameter	High Signaling Cost	Low Signaling Cost
Stability of Honesty	Stable; signal reliably predicts underlying trait.	Unstable; dishonest signaling emerges.
Conflict of Interest	Overcome by the handicap (cost).	Leads to signaling collapse.

9. Digital Markets and Time-Based Competition: The Meta Study

Recent field experiments have challenged traditional antitrust market definitions by analyzing how digital platforms compete for user time. A massive field experiment involving Facebook and Instagram users demonstrated that when usage on one platform drops, only a small fraction shifts to other social networks; the majority of time is redistributed to offline activities, gaming, or YouTube (Goldfarb & Tucker, 2019).

This research highlights a signaling dimension of platform ads: Meta internalizes that lowering ad loads on one platform can boost advertiser demand on the other. Breaking up such a joint-ownership structure might actually harm users by increasing overall ad loads, as separate entities would no longer coordinate their pricing signals (Lauer et al., 2021).

10. Synthesis: Implications for Market Design and Policy

The synthesis of laboratory and field evidence indicates that information asymmetry is not a static condition but a dynamic strategic environment. Signaling behavior performs a

critical function in facilitating market entry and coordination (Bergh et al., 2019).

Key insights derived from the evidence include:

1. The Persistence of Predation: Reputations for toughness are real and effective, especially in high-frequency interaction environments like continuous-time markets (Zhao, 2025).
2. The Information-Coordination Trade-off: Providing individual-level data is far more effective at achieving market sorting than aggregate data (Duffy & Hopkins, 2005).
3. The Strategic Use of Non-Monotonicity: Policy makers can identify anti-competitive deterrence by looking for unusual behavior in medium-sized markets (Ellison & Ellison, 2011).
4. Behavioral Correction: Market designs must account for competition neglect and overconfidence by providing more explicit signals of market capacity (Camerer & Lovallo, 1999).

The transition from traditional industrial sectors to digital and platform-based markets has shifted the signaling burden from sunk costs to data and network signals. However, the fundamental tension identified by Akerlof and Spence remains: without credible, costly, and verifiable signals, markets risk sliding into a suboptimal equilibrium of low quality and high distrust (Connelly et al., 2025).

Conclusion

Information asymmetry remains a central driver of strategic behavior in market entry contexts, transforming simple coordination problems into complex signaling games where credibility, cost, and credibility constraints determine equilibrium outcomes. Theoretical models provide elegant predictions of separating equilibria under sufficient cost differentials, yet laboratory and field experiments reveal systematic departures: incumbents frequently over-signal to deter entry even when rational models suggest restraint, entrants display heightened risk aversion, and behavioral factors overconfidence, reference dependence, and social preferences amplify or dampen deterrence effects. These findings imply that real-world entry barriers are often stronger than symmetric-information benchmarks would suggest, with welfare consequences that are ambiguous: deterrence can prevent wasteful duplication but may also stifle competition and innovation. Policy interventions, including antitrust scrutiny of predatory conduct, transparency requirements, and subsidies for credible information disclosure, must therefore incorporate both game-theoretic rigor and empirical behavioral insights. Future research should prioritize hybrid lab-field designs, dynamic multi-period settings, and integration of machine learning to better predict how boundedly rational agents navigate asymmetric-information environments, ultimately informing more effective regulatory frameworks for fostering competitive yet efficient markets.

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