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Payment Methods and Market Feedback in Mergers and Acquisitions*

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Abstract

We document that M&A withdrawals are more sensitive to acquirers' announcement returns when the deal is financed entirely with cash, suggesting an intriguing interaction between payment methods and market feedback. Motivated by this evidence, we develop a model in which managers learn about deal synergies from post-announcement stock prices, with the payment method shaping the informativeness of this feedback. Our theory not only explains these differing feedback patterns but also yields unique predictions for how the choice of payment method depends on financial market characteristics. We test these predictions in a merger-arbitrageur setting and find supporting evidence.

Keywords: Mergers and Acquisitions, Payment Methods, Managerial Learning, Deal Withdrawal, Merger Arbitrageurs

JEL Classification: G14, G34, D82, D83

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1 Introduction

The insights of price theory, as articulated by [Hayek \(1945\)](#), emphasize the central role of market prices as aggregators and conveyors of dispersed information within an economy. Hayek’s analogy to telecommunications captures the essence of prices functioning as signals, efficiently transmitting knowledge about fundamentals across economic agents without the need for centralized coordination. This perspective, although originally applied to the allocation of goods and services, is arguably salient in financial markets, where asset prices could encapsulate and disseminate diverse information relevant to firm value and strategic decision-making prices (e.g., [Bond et al., 2012](#); [Goldstein, 2023](#)). In particular, [Goldstein et al. \(2025\)](#) survey almost all Chinese listed firms and find that the vast majority of managers monitor the stock market to gather new information for their corporate investment decisions.

The concept of stock price informativeness in the context of market feedback extends beyond their forecasting ability; prices become a critical input for managerial decisions. The current studies on market feedback effects show that managers, faced with complex and value-relevant choices, learn from the signals embedded in stock prices. A case in point is mergers and acquisitions (M&As), one of the most prominent forms of corporate investment. An acquiring firm’s manager has the incentive to actively learn from the market perceptions of deal quality, synergies, and potential risks, which can be outside the manager’s information set. For example, [Luo \(2005\)](#) demonstrates that M&A deals are more likely to be abandoned when negative price reactions provide adverse signals, particularly when managerial uncertainty is high and deals are relatively easy to reverse. Following this line of research, in this paper, we propose a model to formalize the market feedback effect on M&A withdrawal decisions, with a focus on examining whether the method of payment is related to revelatory price efficiency.

Our focus on payment methods is motivated by several observations. First, M&A deals are executed using different payment structures in practice. For example, in our sample of 7,810 U.S. domestic M&A transactions between 2000 and 2022, approximately 6% were

all-equity deals, 38% were all-cash, and 56% used a cash-equity mix.

Second, we confirm that the probability of deal withdrawal generally declines with higher announcement returns—which manifests the feedback effect in the M&A context. Third, and more importantly, we further document that this sensitivity is much more pronounced in all-cash deals, suggesting important interactions between market feedback and payment methods. Specifically, a one-standard-deviation decline in announcement returns raises the predicted withdrawal probability by about 2.07% for all-cash deals versus about 1% for non-all-cash deals. These empirical patterns motivate us to develop a theory that examines whether—and how—managerial learning patterns vary across payment methods, while also generating additional testable predictions.

Our model features an acquiring firm and a target firm. The key actors are the firms’ managers—who determine the payment method and the decision to withdraw from the deal—and financial traders, who trade the firms’ stocks. The economy begins with the two firms bargaining over the payment method. This is characterized by the cash amount paid to the target and the fraction of the merged entity’s value it will receive. The M&A’s potential synergy is uncertain. Both managers learn about this synergy by observing stock prices and use this information to decide whether to cancel the deal. Their withdrawal decisions form a simultaneous game: the deal proceeds if and only if neither firm chooses to withdraw. Stock prices reveal noisy information about the synergy due to the trading of two types of financial agents: speculators, who trade on private information about the synergy, and hedgers, who trade to hedge their pre-existing endowment positions

We analytically characterize the firms’ withdrawal equilibrium and the financial market equilibrium. In the equilibrium we construct, firm managers withdraw the deal if and only if the noisy signal about the synergy, which is inferred from stock prices, is sufficiently low. Stock prices admit a threshold form: when the deal is withdrawn, prices reveal that the noisy synergy signal is below a specific threshold; when the deal continues, prices reveal the actual realization of the noisy signal.

We note that solving a rational expectations equilibrium in a trading model with market feedback is notoriously difficult. The solution involves multiple fixed-point problems, and the standard “conjecture-and-verify” approach typically requires strong linearity assumptions, such as players’ strategies being linear in their signals. Despite the inherent nonlinearity of our setting—for instance, the firm managers’ actions are binary—we are able to construct a rational expectations equilibrium analytically, which we view as a methodological contribution to the literature.

After solving the firms’ withdrawal strategies and the financial market equilibrium, we examine the equilibrium choice of payment method. We first establish that in a benchmark setting without managerial learning, cash and stock payments are equivalent and irrelevant for expected payoffs, leaving the payment method indeterminate. In contrast, when managers learn from the stock price, the payment method is uniquely determined. Furthermore, by varying key parameters, our model can generate all-cash, mixed, and all-stock payments in equilibrium, as observed in practice.

We next conduct two exercises to investigate the interactions between payment methods and market feedback in our model. First, we demonstrate that our model can rationalize the key empirical fact that motivates our study: the sensitivity of deal withdrawal to stock prices is higher for all-cash deals than for all-equity or mixed-payment deals. This exercise thus focuses on the implications of payment methods for market feedback, which is captured by firms’ withdrawal behavior conditional on stock prices. Second, we conduct a comparative static analysis with respect to the population size of hedgers. This examines how managers actively choose payment methods in anticipation of subsequent market feedback on firm values. We find that a larger population of hedgers in the financial market makes firms more likely to choose cash over stock as the payment method.

Finally, we test the model’s predictions on payment method choices using the setting of merger arbitrageurs, who correspond to the financial hedgers in our model. Specifically, after hearing the public announcement of an M&A deal, merger arbitrageurs typically establish a

long position in the target’s shares, which corresponds to the endowment shocks of hedgers in our framework. Following [Dutordoir et al. \(2022\)](#), we measure effective hedging strength with a lending-market proxy, interpreting higher lending supply as an increase in the effective mass of hedgers. We find that a higher lending supply indeed predicts a greater likelihood of an all-cash payment. Furthermore, we show that this result is stronger for firms with stronger pre-deal managerial learning tendencies, as measured by a high firm-level learning coefficient that captures the sensitivity of a firm’s future investment to both its own value and stock-price informativeness.

Our paper contributes to the literature in several ways. First, our model shows that the telecommunications function of prices, i.e., aggregating the dispersed judgments and private information of market participants, in managerial M&A withdrawal decisions is affected by the deals’ method of payment. When a deal is financed by cash, the managerial learning incentives are stronger, thereby leading to higher revelatory price efficiency. Acquiring firms’ managers, recognizing their informational constraints, rely on the market’s collective wisdom to update their beliefs and revise their withdrawal decisions. Our theory and empirical findings embed market feedback in M&As, pioneered by [Luo \(2005\)](#), within the fabric of Hayek’s price theory. Our paper thus differs from the studies on the information acquisition aspect of market feedback (e.g., [Goldstein et al., 2013](#); [Edmans et al., 2015](#); [Goldstein and Yang, 2015](#); [Dow et al., 2017](#); [Goldstein and Yang, 2017](#); [Goldstein and Yang, 2019](#); [Goldstein et al., 2025](#)), as the central gist is on the differential learning motives of managers due to the deals’ payment method. From a methodological standpoint, we contribute to the recent literature on rational expectations equilibrium that incorporates nonlinear price functions in financial markets (e.g., [Breon-Drish, 2015](#); [Chabakauri et al., 2022](#); [Albagli et al., 2023](#); [Albagli et al., 2024](#); [Banerjee et al., 2024](#); [Banerjee et al., 2025a](#); [Banerjee et al., 2025b](#)).

Second, our paper documents an underexplored phenomenon in M&As: the withdrawal probability is higher among all-cash deals than mixed payment deals. Our theoretical framework provides a consistent explanation that the combination of stronger information

acquisition and managerial learning in all-cash deals leads to a higher sensitivity of deal withdrawal probability to announcement returns of acquiring firms, thereby adding to the literature on the determinants of M&A deal completion and withdrawal (e.g., [Schwert, 2000](#); [Officer, 2003](#); [Boone and Mulherin, 2007](#); [Aktas et al., 2010](#); [Bharath and Dittmar, 2010](#)). In addition, our analysis offers a novel prediction on payment method choices from a managerial learning perspective, and we use a merger-arbitrageur setting to provide supporting evidence. These results contribute to the literature on payment methods in M&A (e.g., [Hansen, 1987](#); [Fishman, 1989](#); [Berkovitch and Narayanan, 1990](#); [Eckbo et al., 1990](#); [Morellec and Zhdanov, 2008](#); [Dutordoir et al., 2022](#)).

2 Data and Motivating Facts

In this section, we describe the dataset construction and present the stylized facts that motivate our paper.

2.1 Data

We assemble a deal-level panel of U.S. domestic mergers and acquisitions announced between 2000 and 2022 by linking SDC to CRSP/Eventus in order to compute announcement-window cumulative abnormal returns (restricting to ordinary common-stock acquirers), and then limiting the sample to completed or withdrawn transactions with non-missing deal values, de-duplicated announcement dates, and corrected completion dates. We require stock-price availability on both the announcement and effective dates and, when necessary, impute the effective-date price as the mean of the three nearest subsequent prices. These pre-screening steps yield a sample of 21,174 deals. We then merge Compustat accounting information and apply economic-significance filters (deal value at least \$10 million and relative size above 10 percent). Finally, we retain observations with firm and deal controls, producing a regression sample of 7,810 deals used in the baseline analyses. [Table A1](#) in Appendix A summarizes the filtering pipeline and intermediate counts.

2.2 Stylized Facts

We now document three stylized facts on methods of payment and market feedback in M&A transactions: (i) substantial cross-sectional variation in payment methods across M&A transactions; (ii) acquirers' announcement returns predict withdrawal decisions; and (iii) the sensitivity of withdrawal decisions to market reactions varies systematically with the method of payment.

[Insert [Table 1](#) Here]

Panel A of [Table 1](#) reports the summary statistics for the key variables used in the analysis. In our sample of 7,810 M&A transactions, 2,960 deals are financed entirely with cash, while 4,850 involve some equity component, including 500 pure all-stock deals. This distribution underscores the substantial cross-sectional variation in payment structures observed in real-world M&A activity, providing rich empirical scope to examine how financing choices interact with market feedback.

Panel B of [Table 1](#) examines the sensitivity of deal withdrawal to announcement-period abnormal returns, using linear probability models with firm and deal controls, year and industry fixed effects, and two-way clustering by year and industry. Column (1) pools all observations and shows that $CAR(-2, +2)$ is negatively related to the likelihood of withdrawal (-0.107 , $t = -4.36$), indicating that adverse market reactions are followed by a higher probability of termination. This replicates the classic result that managers respond to negative price signals by withdrawing value-destroying deals in [Luo \(2005\)](#).

Columns (2) and (3) split the sample by method of payment. For all-cash deals (Column 2), the slope is large and negative (-0.230 , $t = -5.20$), whereas for non-all-cash offers (Column 3) the slope is smaller in absolute value (-0.112 , $t = -3.67$). Using the standard deviation of $CAR(-2, +2)$ (0.090) in Panel A, a one-standard-deviation decline in announcement returns raises the predicted withdrawal probability by about 2.07% for all-cash deals (0.230×0.090) versus about 1% for non-all-cash deals (0.112×0.090). The all-cash response is therefore

roughly twice as strong as the non-all-cash response, consistent with sharper market feedback when financing is entirely in cash.

For completeness, the pooled interaction specification (Column 4) confirms the differential sensitivity: the base CAR slope for non-all-cash deals is -0.098 ($t = -3.05$), and the additional slope for all-cash is -0.155 ($t = -3.82$), implying a total slope of approximately -0.253 for all-cash offers. The positive level effect on All-Cash (0.135 , $t = 7.91$) indicates a higher baseline withdrawal probability for cash bids at a given return realization. Taken together, Columns (1)–(4) show that while negative announcement returns predict withdrawal in the full sample, the mapping from prices to cancellation is economically and statistically stronger under all-cash financing.

To verify that the cash-sensitivity result is not driven by pooling all-stock into “non-all-cash,” Table A3 in Appendix A re-estimates the regressions in the all-cash versus all-stock subsample. In the pooled sample (Column 1), $\text{CAR}(-2, +2)$ is negatively related to withdrawal (-0.081 , $t = -3.16$). Splitting by payment method shows that the effect is concentrated in all-cash bids: Column 2 ($N=2,960$) yields a slope of -0.230 ($t = -5.22$), whereas Column 3 (all-stock, $N=500$) is smaller and insignificant at -0.118 ($t = -1.26$). The pooled interaction in Column 4 confirms the contrast: the baseline CAR slope for stock is -0.065 ($t = -0.68$) and the incremental all-cash effect is -0.188 ($t = -2.17$), implying an all-cash slope near -0.253 . Using the Panel A standard deviation of CAR (0.092), a one-standard-deviation decline in returns translates to about 2.1 percentage points higher withdrawal probability for all-cash deals (0.230×0.092), versus roughly 1.1 percentage points for all-stock. The evidence therefore isolates a sharper price-withdrawal mapping under all-cash financing even when all-stock deals are considered separately.

3 A Model of M&A with Market Feedback

We develop a model in which the acquiring firm’s and the target firm’s managers decide to complete or withdraw an M&A deal after observing the market response to the M&A

announcement. The model has four dates and Figure 1 describes the timeline. Since our analysis focuses on the firms' withdrawal decisions in response to stock price movements (i.e., market feedback), we begin at the stage where the acquirer and the target have already initiated the deal. Specifically, at $t = 0$, the M&A payment scheme is determined and publicly announced. At $t = 1$, financial speculators and hedgers trade both firms' stocks in the financial market. At $t = 1.5$, firm managers observe stock prices and decide whether to withdraw the deal. At $t = 2$, the players' payoffs are realized.

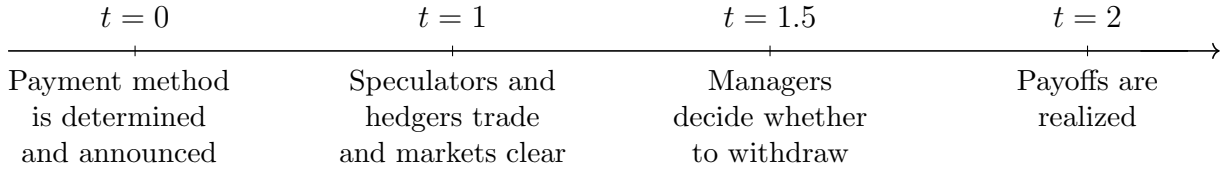


Figure 1: Timeline of events.

Payment methods and firm value. Both the acquirer and the target are public firms.¹ Without the M&A deal, the acquirer's standalone value at $t = 2$ is $\tilde{v}_A \sim N(\bar{v}_A, \tau_A^{-1})$ and the target's standalone value at $t = 2$ is $\tilde{v}_T \sim N(\bar{v}_T, \tau_T^{-1})$.² If the acquirer acquires the target, then the total value of the merged firm at $t = 2$ is $\tilde{v}_A + \tilde{v}_T + \tilde{v}_S$, where $\tilde{v}_S \sim N(\bar{v}_S, \tau_S^{-1})$ is the synergy resulting from the acquisition.

We assume that $\tilde{v}_S$ is private information to some traders in the date-1 financial market, referred to as speculators. This information cannot be directly observed by the firms' managers. Nonetheless, speculators can observe the realization of $\tilde{v}_S$ and use this information to trade at $t = 1$. Their trading injects information about $\tilde{v}_S$ into the date-1 stock price. Managers can then learn about $\tilde{v}_S$ from the prices and use this inference to determine whether to withdraw the deal (the "feedback effect").

At $t = 0$, a payment scheme (β, M) is determined. If the M&A deal is completed, then the target receives cash $M \geq 0$ and a fraction $\beta \in [0, 1)$ of the merged company, so the date-2

¹The results are also robust to assuming the target firm is private.

²Throughout the paper, we use a tilde ($\tilde{\cdot}$) to indicate a random variable.

values of the acquirer and the target are $(1 - \beta)(\tilde{v}_A + \tilde{v}_T + \tilde{v}_S - M)$ and $M + \beta(\tilde{v}_A + \tilde{v}_T + \tilde{v}_S - M)$, respectively. If the deal is withdrawn at $t = 1.5$ (either by the acquirer or by the target), then the values of the acquirer and the target remain at $\tilde{v}_A$ and $\tilde{v}_T$, respectively.

Firm managers. Firm managers aim to maximize their firms' date-2 values conditional on their information sets. This objective can be interpreted as the managers representing the interests of long-term investors. For this reason, we use the terms "acquirer," "acquiring firm," and "acquiring firm's manager" interchangeably. The same convention applies to the target firm. Firm managers make two decisions, payment method choices at $t = 0$ and withdrawal decisions at $t = 1.5$. We start with their withdrawal behavior.

At $t = 1.5$, the managers of the two firms engage in a Nash bargaining game, deciding whether to withdraw or continue the deal based on the observed stock prices. We denote the withdrawal decision of the acquirer by $a_A \in \{0, 1\}$, where $a_A = 1$ ($a_A = 0$) represents that the acquirer chooses withdrawing (completing) the deal (where the letter a refers to "abandoning the deal"). Similarly, the withdrawal decision of the target is denoted by $a_T \in \{0, 1\}$. The deal fails if at least one firm chooses to withdraw. Consequently, the final withdrawal outcome, denoted a , is determined by the decisions of both firms as follows: $a = \max\{a_A, a_T\} = 1 - (1 - a_A)(1 - a_T)$.

The date-2 payoff of the acquirer's stock is

$$\tilde{p}_2 = (1 - a)(1 - \beta)(\tilde{v}_A + \tilde{v}_T + \tilde{v}_S - M) + a\tilde{v}_A, \quad (1)$$

and the date-2 payoff of the target firm's stock is

$$\tilde{q}_2 = (1 - a)[M + \beta(\tilde{v}_A + \tilde{v}_T + \tilde{v}_S - M)] + a\tilde{v}_T. \quad (2)$$

As mentioned above, firms make withdrawal decisions to maximize their expected date-2 values, conditional on the date-1 prices $\tilde{p}_1$ and $\tilde{q}_1$. That is, the acquiring firm's withdrawal

decision at $t = 1.5$ is

$$\max_{a_A \in \{0,1\}} E[\tilde{p}_2 | \tilde{p}_1, \tilde{q}_1]. \quad (3)$$

Similarly, the target firm's manager's withdrawal decision at $t = 1.5$ is

$$\max_{a_T \in \{0,1\}} E[\tilde{q}_2 | \tilde{p}_1, \tilde{q}_1]. \quad (4)$$

We next describe the determination of the payment method at $t = 0$, which we model as a Nash bargaining game between the two firm managers. If the acquirer and the target are “in agreement”, then the ex ante expected payoffs to them are $U_A(\beta, M) \equiv E[\tilde{p}_2]$ and $U_T(\beta, M) \equiv E[\tilde{q}_2]$ respectively, where $\tilde{p}_2$ and $\tilde{q}_2$ are given in equations (1) and (2). If they are “out of agreement”, then their ex ante expected payoffs are the unconditional expectations of their firms' standalone values, $\bar{v}_A$ and $\bar{v}_T$. The equilibrium payment scheme is the solution to the following problem:

$$\max_{(\beta, M)} (U_A - \bar{v}_A)^\delta (U_T - \bar{v}_T)^{1-\delta}, \text{ s.t. } \beta \in [0, 1), M \geq 0, U_A \geq \bar{v}_A, U_T \geq \bar{v}_T, \quad (5)$$

where $\delta \in (0, 1)$ is the acquiring firm's bargaining power. In practice, the parameter δ can be positively associated with the acquirer's size relative to the target, or with its competitive position in the case of multiple acquirers.

Financial markets. Our trading game at $t = 1$ is similar to that of [Banerjee et al. \(2025b\)](#). Specifically, there exist two types of traders in the financial market: speculators and hedgers. The mass of speculators is $\lambda_s \in (0, 1]$ and the mass of hedgers is $\lambda_h \in [0, 1)$. The total mass of traders is 1, that is, $\lambda_s + \lambda_h = 1$. These traders represent short-term investors that react to the M&A announcement.

Speculators possess private information about the synergy and trade upon it. For simplicity, we assume each speculator perfectly observes $\tilde{v}_S$. Hedgers can be interpreted as “merger arbitrageurs” in practice; they typically establish a long position in the target firm upon the

public announcement of an M&A deal (see Section 6 for institutional details). We model this by assuming each hedger is endowed with $\tilde{z}$ units of the target's shares, where $\tilde{z} \sim N(\bar{z}, \tau_z^{-1})$ and $(\tilde{v}_A, \tilde{v}_T, \tilde{v}_S, \tilde{z})$ are mutually independent.

Both types of traders have CARA utility with absolute risk aversion coefficient $\gamma > 0$. The traders are price takers and trade both the acquirer's and target's stocks in a financial market. The problem for a speculator at $t = 1$ is

$$\max_{m_s, n_s} E [-\exp \{-\gamma[m_s(\tilde{p}_2 - \tilde{p}_1) + n_s(\tilde{q}_2 - \tilde{q}_1)]\} | \tilde{v}_S, \tilde{p}_1, \tilde{q}_1], \quad (6)$$

where m_s and n_s represent the speculator's trading in the acquirer's stock and the target's stock, respectively. Similarly, the problem for a hedger at $t = 1$ is

$$\max_{m_h, n_h} E [-\exp \{-\gamma[m_h(\tilde{p}_2 - \tilde{p}_1) + n_h(\tilde{q}_2 - \tilde{q}_1) + \tilde{z}\tilde{q}_2]\} | \tilde{z}, \tilde{p}_1, \tilde{q}_1], \quad (7)$$

where m_h and n_h represent the hedger's trading in the acquirer's stock and the target's stock, respectively.

The stock prices $\tilde{p}_1$ and $\tilde{q}_1$ are determined through market clearing. The market clearing conditions for the acquirer's and target's stocks are, respectively,

$$\lambda_s m_s + \lambda_h m_h = 0 \text{ and } \lambda_s n_s + \lambda_h n_h = 0. \quad (8)$$

That is, the total trading across all speculators and hedgers sums up to zero.

4 Model Solution

An equilibrium in our economy consists of the payment scheme (β, M) determined at $t = 0$, the speculators' demand functions for the two firms' stocks $(m_s(\tilde{v}_S, \tilde{p}_1, \tilde{q}_1), n_s(\tilde{v}_S, \tilde{p}_1, \tilde{q}_1))$ at $t = 1$, the hedgers' demand functions $(m_h(\tilde{z}, \tilde{p}_1, \tilde{q}_1), n_h(\tilde{z}, \tilde{p}_1, \tilde{q}_1))$ at $t = 1$, the two firms' stock price functions $(p_1(\tilde{v}_S, \tilde{z}), q_1(\tilde{v}_S, \tilde{z}))$ at $t = 1$, and the managers' withdrawal strategies

$(a_A(\tilde{p}_1, \tilde{q}_1), a_T(\tilde{p}_1, \tilde{q}_1))$ at $t = 1.5$, such that (i) $(m_s(\tilde{v}_S, \tilde{p}_1, \tilde{q}_1), n_s(\tilde{v}_S, \tilde{p}_1, \tilde{q}_1))$ solve problem (6), and $(m_h(\tilde{z}, \tilde{p}_1, \tilde{q}_1), n_h(\tilde{z}, \tilde{p}_1, \tilde{q}_1))$ solve problem (7); (ii) $p_1(\tilde{v}_S, \tilde{z})$ and $q_1(\tilde{v}_S, \tilde{z})$ clear the market as in equation (8); (iii) withdrawal strategies $a_A(\tilde{p}_1, \tilde{q}_1)$ and $a_T(\tilde{p}_1, \tilde{q}_1)$ form a Nash equilibrium given information in the prices $(\tilde{p}_1, \tilde{q}_1)$; and (iv) (β, M) is determined by the Nash bargaining solution in problem (5).

We solve for the equilibrium via backward induction. First, we characterize the Nash equilibrium of the withdrawal game at $t = 1.5$ for given price functions $p_1(\tilde{v}_S, \tilde{z})$ and $q_1(\tilde{v}_S, \tilde{z})$ and payment scheme (β, M) . Second, we compute the financial market equilibrium at $t = 1$ conditional on (β, M) . Finally, we solve for the optimal payment scheme determined at $t = 0$.

In the withdrawal game at $t = 1.5$, the two firms observe the asset prices $\{\tilde{p}_1, \tilde{q}_1\}$ and use the information contained within them to play a simultaneous withdrawal game. Because the firms' strategies depend on inferring information from these prices, we must specify how the market forms them. Following Banerjee et al. (2025b), we consider a “threshold equilibrium” in the financial market, defined below.

Definition 1. *A threshold equilibrium in the financial market is one in which (i) the stock prices $\tilde{p}_1$ and $\tilde{q}_1$ depend on the synergy $\tilde{v}_S$ through $\tilde{s}_p = \tilde{v}_S - \kappa^{-1}\tilde{z}$, where κ is an endogenous constant, (ii) the stock prices have the form*

$$\tilde{p}_1 = p_1(\tilde{s}_p) = \begin{cases} \alpha_1 + \alpha_2 \tilde{s}_p, & \text{if } \tilde{s}_p \geq \hat{s}, \\ \alpha_0, & \text{if } \tilde{s}_p < \hat{s}, \end{cases} \quad \tilde{q}_1 = q_1(\tilde{s}_p, \tilde{z}) = \begin{cases} \psi_1 + \psi_2 \tilde{s}_p, & \text{if } \tilde{s}_p \geq \hat{s}, \\ \psi_0 - \iota^{-1} \tilde{z}, & \text{if } \tilde{s}_p < \hat{s}, \end{cases} \quad (9)$$

where $\alpha_0, \alpha_1, \alpha_2, \psi_0, \psi_1, \psi_2, \iota$, and $\hat{s}$ are endogenous constants, and (iii) the deal is withdrawn if and only if $\tilde{p}_1 = \alpha_0$.

We determine the coefficient parameters $\alpha_0, \alpha_1, \alpha_2, \psi_0, \psi_1, \psi_2, \iota$, and κ when solving the financial market equilibrium at $t = 1$. The threshold parameter $\hat{s}$, in contrast, is determined by the Nash equilibrium of the withdrawal game at $t = 1.5$.

Note that under the price function (9), the two prices $\{\tilde{p}_1, \tilde{q}_1\}$ reveal the same information

concerning the variable $\tilde{s}_p$. At $t = 1.5$, managers use this inferred information to forecast the synergy $\tilde{v}_S$. In particular, the target's stock price $\tilde{q}_1$ is redundant for forecasting $\tilde{s}_p$ once managers observe the acquirer's stock price $\tilde{p}_1$.

Specifically, when $\tilde{p}_1 = \alpha_0$, managers understand that $\tilde{s}_p < \hat{s}$. At this time, the target's stock price $\tilde{q}_1$ takes the form of $\psi_0 - \iota^{-1}\tilde{z}$ and fully reveals the hedgers' endowment position $\tilde{z}$. However, knowing $\tilde{z}$ is not useful for the firm managers to forecast the synergy $\tilde{v}_S$, since $\tilde{v}_S$ and $\tilde{z}$ are independent. When $\tilde{p}_1 \neq \alpha_0$, either $\tilde{p}_1$ or $\tilde{q}_1$ reveals the signal $\tilde{s}_p$ (as long as $\alpha_2 \neq 0$ or $\psi_2 \neq 0$, which is true in equilibrium), and so again, $\tilde{q}_1$ is redundant for forecasting $\tilde{v}_S$ in the presence of $\tilde{p}_1$.

We do not claim that the target's stock price is always irrelevant for managers to infer information in practice, and this redundancy feature in our model certainly depends on the information structure. However, we find that this feature greatly simplifies our analysis by allowing an analytical characterization of the rational expectations equilibrium in the financial market. More importantly, it captures the essence that managers learn new information from stock prices.

We show that in the Nash equilibrium of the simultaneous withdrawal game, the deal is withdrawn if and only if the signal $\tilde{s}_p$ is sufficiently low; formally, $a(\tilde{p}_1, \tilde{q}_1) = 1$ if and only if $\tilde{s}_p < \hat{s}$ (or equivalently, $a(\tilde{p}_1, \tilde{q}_1) = 1$ if and only if $\tilde{p}_1 = \alpha_0$). In the following section, we characterize this Nash equilibrium of the withdrawal game the $t = 1.5$.

4.1 Nash Equilibrium of the Withdraw Game

The Nash equilibrium is computed in the standard way, by deriving each firm manager's best response to the other's strategy. A firm manager's action is pivotal only when she believes the other firm will continue. If a firm manager believes the other will withdraw, the deal fails irrespective of her own action; in this scenario, we assume the firm manager chooses to continue, as this is the optimal response given an arbitrarily small cost of cancellation.

We construct a Nash equilibrium with the following strategies: one firm manager always chooses to continue, and the other withdraws if and only if $\tilde{p}_1 = \alpha_0$. This construction

proceeds in two steps. First, we show that a firm manager's best response to a rival that always continues is to withdraw based on a threshold for the expected synergy. Second, we verify that a profile in which the firm manager with the lower threshold always continues, while the other follows the threshold strategy, constitutes a mutual best response, thereby verifying the Nash equilibrium.

Specifically, if the acquirer believes that the target chooses to continue, then solving problem (3), the acquirer's optimal withdrawal decision at $t = 1.5$ takes the form

$$a_A = \begin{cases} 0, & \text{if } E[\tilde{v}_S|\tilde{p}_1, \tilde{q}_1] \geq \frac{\bar{v}_A}{1-\beta} - (\bar{v}_A + \bar{v}_T - M), \\ 1, & \text{if } E[\tilde{v}_S|\tilde{p}_1, \tilde{q}_1] < \frac{\bar{v}_A}{1-\beta} - (\bar{v}_A + \bar{v}_T - M). \end{cases} \quad (10)$$

Note that the prices in (9) reveal information about the synergy $\tilde{v}_S$ through variable $\tilde{s}_p$. Let $\hat{s}_A$ denote the level of $\tilde{s}_p$ such that the acquiring firm's manager is indifferent between completing and withdrawing the deal if she observes $\tilde{s}_p$, i.e.,

$$E[\tilde{v}_S|\tilde{s}_p = \hat{s}_A] - \frac{\bar{v}_A}{1-\beta} + (\bar{v}_A + \bar{v}_T - M) = 0. \quad (11)$$

Solving this equation yields the expression for $\hat{s}_A$. Similarly, if the target believes that the acquirer chooses to continue the deal, then solving problem (4), the optimal withdrawal decision of the target at $t = 1.5$ has the form

$$a_T = \begin{cases} 0, & \text{if } E[\tilde{v}_S|\tilde{p}_1, \tilde{q}_1] \geq \frac{\bar{v}_T - M}{\beta} - (\bar{v}_A + \bar{v}_T - M), \\ 1, & \text{if } E[\tilde{v}_S|\tilde{p}_1, \tilde{q}_1] < \frac{\bar{v}_T - M}{\beta} - (\bar{v}_A + \bar{v}_T - M). \end{cases} \quad (12)$$

Let $\hat{s}_T$ denote the level of $\tilde{s}_p$ such that the target firm's manager is indifferent between completing and withdrawing the deal if she observes $\tilde{s}_p$, i.e.,

$$E[\tilde{v}_S|\tilde{s}_p = \hat{s}_T] - \frac{\bar{v}_T - M}{\beta} + (\bar{v}_A + \bar{v}_T - M) = 0. \quad (13)$$

Solving this equation yields the expression for $\hat{s}_T$.

We set the threshold $\hat{s}$ in the price function (9) as:

$$\hat{s} \equiv \max\{\hat{s}_A, \hat{s}_T\}. \quad (14)$$

Now, consider the case in which $\hat{s}_A > \hat{s}_T$, so that $\hat{s} = \hat{s}_A$. We now demonstrate that the following strategy profile constitutes a Nash equilibrium: the target always continues, and the acquirer employs the threshold strategy in (10). First, for the acquirer, the strategy in (10) is a best response to a target that always continues, as established previously. Second, we verify the target's incentives. There are two scenarios to consider: (i) When $\tilde{p}_1 \neq \alpha_0$ (or equivalently, $\tilde{s}_p > \hat{s} = \hat{s}_A$), the acquirer continues. In this case, prices reveal $\tilde{s}_p$, and the target's best response is to continue if and only if $\tilde{s}_p > \hat{s}_T$, as established in strategy (12). This condition holds because $\tilde{s}_p > \hat{s}_A \geq \hat{s}_T$. (ii) When $\tilde{p}_1 = \alpha_0$ (or $\tilde{s}_p < \hat{s} = \hat{s}_A$), the acquirer withdraws. The target's action is then no longer pivotal, and since withdrawing incurs an arbitrarily small cost, its dominant strategy is to continue. As both firms' strategies are mutual best responses, the profile is a Nash equilibrium.

For the case of $\hat{s}_A < \hat{s}_T$, we can apply a similar argument and show that the strategy profile in which the acquirer always continues, while the target adopts the threshold strategy in (12) forms a Nash equilibrium. In either case, the equilibrium withdraw outcome is that the deal is withdrawn if and only if $\tilde{p}_1 = \alpha_0$ (or if and only if $\tilde{s}_p < \hat{s}$).

4.2 Financial Market Equilibrium

We now turn to the financial market equilibrium at date 1. Our objective is to pin down the coefficients of the price function in (9). This is accomplished by computing investors' demand functions and verifying the market-clearing conditions.

Recall that the deal withdrawal outcome at $t = 1.5$, $a(\tilde{p}_1, \tilde{q}_1)$, which results from the Nash equilibrium of the withdrawal game, is determined by the date-1 stock prices $\tilde{p}_1, \tilde{q}_1$. Since traders also observe these prices at $t = 1$, they can perfectly foresee $a(\tilde{p}_1, \tilde{q}_1)$. That

is, from the traders' perspective, the withdrawal outcome $a(\tilde{p}_1, \tilde{q}_1)$ in the stock payoffs $\tilde{p}_2$ and $\tilde{q}_2$ in (1) and (2) is deterministic. This feature is key to allowing us to solve the rational expectations equilibrium in the financial market analytically. If, for instance, firm managers also made decisions based on some private information, then traders would no longer be able to perfectly forecast the withdrawal outcome at date 1.5, which would make the model intractable. Nonetheless, we believe that our simplification captures the essence of our mechanism—that is, managers learning new information from stock prices.

The first-order conditions for problem (6) indicate that a speculator's optimal demands for the stocks must satisfy

$$m_s = \frac{E[\tilde{p}_2|\mathcal{F}_s] - \tilde{p}_1}{\gamma \text{Var}[\tilde{p}_2|\mathcal{F}_s]} - \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_s]}{\text{Var}[\tilde{p}_2|\mathcal{F}_s]} n_s \quad (15)$$

and

$$n_s = \frac{E[\tilde{q}_2|\mathcal{F}_s] - \tilde{q}_1}{\gamma \text{Var}[\tilde{q}_2|\mathcal{F}_s]} - \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_s]}{\text{Var}[\tilde{q}_2|\mathcal{F}_s]} m_s, \quad (16)$$

where $\mathcal{F}_s = \{\tilde{v}_S, \tilde{p}_1, \tilde{q}_1\}$ is the speculator's information set. Similarly, the first-order conditions for problem (6) indicate that a hedger's optimal demands for the stocks should satisfy

$$m_h = \frac{E[\tilde{p}_2|\mathcal{F}_h] - \tilde{p}_1}{\gamma \text{Var}[\tilde{p}_2|\mathcal{F}_h]} - \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_h]}{\text{Var}[\tilde{p}_2|\mathcal{F}_h]} (n_h + \tilde{z}) \quad (17)$$

and

$$n_h = \frac{E[\tilde{q}_2|\mathcal{F}_h] - \tilde{q}_1}{\gamma \text{Var}[\tilde{q}_2|\mathcal{F}_h]} - \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_h]}{\text{Var}[\tilde{q}_2|\mathcal{F}_h]} m_h - \tilde{z}, \quad (18)$$

where $\mathcal{F}_h = \{\tilde{z}, \tilde{p}_1, \tilde{q}_1\}$ is the speculator's information set.

When the investors expect that the deal will be withdrawn, they trade based on their common prior beliefs about $\tilde{v}_A$ and $\tilde{v}_T$. When they expect that the deal will be completed, the speculators also trade based on their private information about $\tilde{v}_S$, and the stock prices reveal the signal $\tilde{s}_p$. Since the hedgers know the realization of $\tilde{z}$, they can perfectly infer $\tilde{v}_S$ from $\tilde{s}_p$ (recall that $\tilde{v}_S = \tilde{s}_p + \kappa^{-1}\tilde{z}$). Therefore, the speculators and hedgers effectively have

the same information set.

Using this fact and substituting the expressions for m_s and m_h in equations (15) and (17) into the market-clearing condition for the acquiring firm's stock $\lambda_s m_s + \lambda_h m_h = 0$, we have

$$\frac{E[\tilde{p}_2|\mathcal{F}_s] - \tilde{p}_1}{\gamma \text{Var}[\tilde{p}_2|\mathcal{F}_s]} - \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_s]}{\text{Var}[\tilde{p}_2|\mathcal{F}_s]} \underbrace{(\lambda_s n_s + \lambda_h n_h)}_{=0} - \lambda_h \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_h]}{\text{Var}[\tilde{p}_2|\mathcal{F}_h]} \tilde{z} = 0.$$

Calculating the conditional moments in the above equation, rearranging terms, and using the market-clearing condition for the target firm's stock $\lambda_s n_s + \lambda_h n_h = 0$, we can derive the expression for the acquiring firm's stock price,

$$\begin{aligned} \tilde{p}_1 = \bar{v}_A + [1 - a(\tilde{p}_1, \tilde{q}_1)] & [(1 - \beta)(\tilde{v}_S - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \tilde{z}) \\ & + (1 - \beta)(\bar{v}_A + \bar{v}_T - M) - \bar{v}_A]. \end{aligned} \quad (19)$$

Similarly, substituting the expressions for n_s and n_h in equations (16) and (18) into the market-clearing condition for the acquiring firm's stock $\lambda_s n_s + \lambda_h n_h = 0$, we have

$$\frac{E[\tilde{q}_2|\mathcal{F}_s] - \tilde{q}_1}{\gamma \text{Var}[\tilde{q}_2|\mathcal{F}_s]} - \frac{\text{Cov}[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_s]}{\text{Var}[\tilde{q}_2|\mathcal{F}_s]} \underbrace{(\lambda_s m_s + \lambda_h m_h)}_{=0} - \lambda_h \tilde{z} = 0,$$

which yields the expression for the target firm's stock price,

$$\begin{aligned} \tilde{q}_1 = \bar{v}_T - \gamma \lambda_h \tau_T^{-1} \tilde{z} + [1 - a(\tilde{p}_1, \tilde{q}_1)] & [\beta(\tilde{v}_S - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \tilde{z}) \\ & + M + \beta(\bar{v}_A + \bar{v}_T - M) - \bar{v}_T + \gamma \lambda_h \tau_T^{-1} \tilde{z}]. \end{aligned} \quad (20)$$

Comparing equations (19) and (20) with the conjectured price functions (9), we can derive the expressions for the endogenous price coefficients α_0 , α_1 , α_2 , ψ_0 , ψ_1 , ψ_2 , ι , and κ . Notably, the endogenous price signal $\tilde{s}_p$ must admit coefficient $\kappa^{-1} = \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1})$, i.e., $\tilde{s}_p = \tilde{v}_S - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \tilde{z}$. We define the precision of signal $\tilde{s}_p$,

$$\tau_p = [\lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1})]^{-2} \tau_z, \quad (21)$$

as “price informativeness.”

The following proposition characterizes the date-1 financial market equilibrium and the date-1.5 withdrawal Nash equilibrium.

Proposition 1 (Financial market equilibrium and withdrawal equilibrium). *Given payment scheme (β, M) , there exists a threshold equilibrium in the date-1 stock market in which the equilibrium stock prices of the acquirer and the target take the form (9), that is,*

$$\tilde{p}_1 = \begin{cases} \alpha_1 + \alpha_2 \tilde{s}_p, & \text{if } \tilde{s}_p \geq \hat{s}, \\ \alpha_0, & \text{if } \tilde{s}_p < \hat{s}, \end{cases} \quad \tilde{q}_1 = \begin{cases} \psi_1 + \psi_2 \tilde{s}_p, & \text{if } \tilde{s}_p \geq \hat{s}, \\ \psi_0 - \iota^{-1} \tilde{z}, & \text{if } \tilde{s}_p < \hat{s}, \end{cases}$$

where $\tilde{s}_p = \tilde{v}_S - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \tilde{z}$, and

$$\begin{aligned} \alpha_0 &= \bar{v}_A, \quad \alpha_1 = (1 - \beta)(\bar{v}_A + \bar{v}_T - M), \quad \alpha_2 = 1 - \beta, \\ \psi_0 &= \bar{v}_T, \quad \psi_1 = M + \beta(\bar{v}_A + \bar{v}_T - M), \quad \psi_2 = \beta, \quad \iota = (\gamma \lambda_h)^{-1} \tau_T, \end{aligned} \tag{22}$$

and $\hat{s} = \max\{\hat{s}_A, \hat{s}_T\}$, where $\hat{s}_A$ and $\hat{s}_T$ can be expressed as

$$\begin{aligned} \hat{s}_A &= \frac{\tau_S + \tau_p}{\tau_p} \left[\frac{\bar{v}_A}{1 - \beta} - \left(\bar{v}_A + \bar{v}_T - M + \frac{\tau_S \bar{v}_S}{\tau_S + \tau_p} \right) \right] - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \bar{z}, \\ \hat{s}_T &= \frac{\tau_S + \tau_p}{\tau_p} \left[\frac{\bar{v}_T - M}{\beta} - \left(\bar{v}_A + \bar{v}_T - M + \frac{\tau_S \bar{v}_S}{\tau_S + \tau_p} \right) \right] - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \bar{z}, \end{aligned} \tag{23}$$

and τ_p is given by equation (21).

At $t = 1.5$, the withdrawal game has a Nash equilibrium characterized as follows: the firm with the lower threshold value, as defined in (23), always chooses to continue, while the other firm withdraws if and only if $\tilde{p}_1 = \alpha_0$. This leads to the following equilibrium outcome:

$$a(\tilde{p}_1, \tilde{q}_1) = \mathbb{I}_{\{\tilde{p}_1 = \alpha_0\}} = \mathbb{I}_{\{\tilde{s}_p < \hat{s}\}},$$

where $\mathbb{I}_{\{\cdot\}}$ is the indicator function.

Proof. See Appendix B. □

Figure 2 plots the price function for the acquirer's stock for parameter configuration of $\bar{v}_A = 5$, $\bar{v}_T = 5$, $\bar{v}_S = 10$, $\bar{z} = 1$, $\tau_A = 1$, $\tau_T = 1$, $\tau_S = 10^{-2}$, $\tau_z = 10^{-4}$, $\lambda_h = 0.5$, $\delta = 0.7$, and $\gamma = 0.2$. At $t = 1.5$, when $\tilde{p}_1 = \alpha_0$, the deal is withdrawn; when $\tilde{p}_1 \neq \alpha_0$, the deal continues.

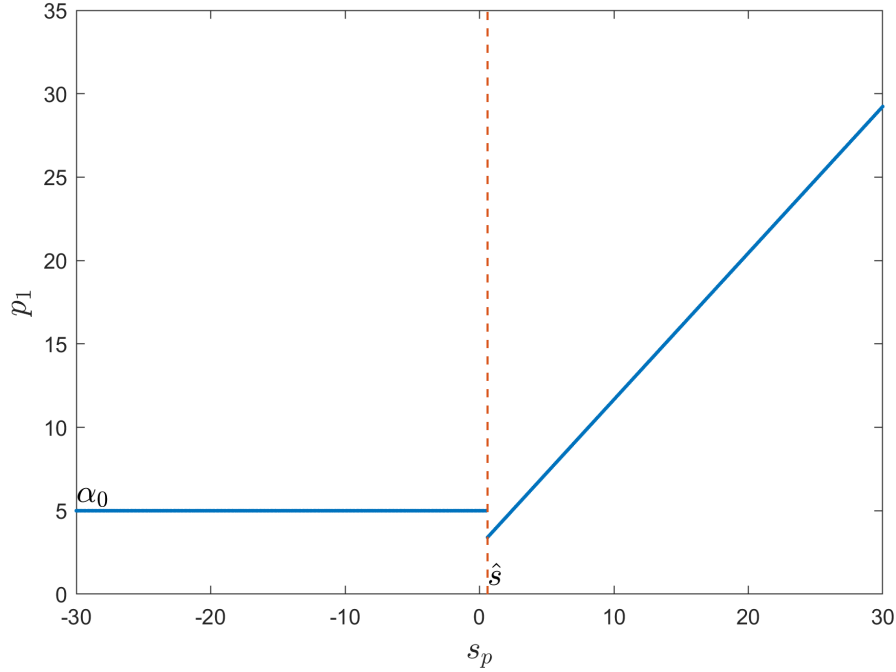


Figure 2: Equilibrium price function. This figure plots the acquiring firm's equilibrium stock price p_1 as a function of s_p . The function is right-continuous at $\hat{s}$. Parameter values: $\bar{v}_A = 5$, $\bar{v}_T = 5$, $\bar{v}_S = 10$, $\bar{z} = 1$, $\tau_A = 1$, $\tau_T = 1$, $\tau_S = 10^{-2}$, $\tau_z = 10^{-4}$, $\lambda_h = 0.5$, $\delta = 0.7$, and $\gamma = 0.2$.

Corollary 1 (Payment method and informativeness). *The price informativeness is decreasing in the use of stock in payment, i.e., $\frac{\partial \tau_p}{\partial \beta} < 0$.*

Corollary 1 shows that the acquiring firm's stock price informativeness is decreasing in the use of stock as payment to the target firm. When the payment method is all-cash (i.e., $\beta = 0$), if the traders expect that the deal will be completed, the stock price fully reveals the traders' private information about the synergy. This result is due to the crucial impact of M&A payment method on traders' trading behavior. When the deal is not withdrawn (i.e., $a(\tilde{p}_1, \tilde{q}_1) = 0$), by equations (15) and (17), the traders' aggregate demand for the acquirer's

stock, $m = \lambda_s m_s + \lambda_h m_h$, can be expressed as

$$m(\tilde{v}_S, \tilde{z}, \tilde{p}_1 \neq \alpha_0) = \frac{(1 - \beta)(\bar{v}_A + \bar{v}_T + \tilde{v}_S - M) - \tilde{p}_1}{\gamma(1 - \beta)^2(\tau_A^{-1} + \tau_T^{-1})} - \frac{\lambda_h \beta}{1 - \beta} \tilde{z}.$$

Therefore, the traders' trading intensities on noise $\tilde{z}$ and information $\tilde{v}_S$ are

$$\left| \frac{\partial m}{\partial \tilde{z}} \right| = \frac{\lambda_h \beta}{1 - \beta} \quad \text{and} \quad \left| \frac{\partial m}{\partial \tilde{v}_S} \right| = \frac{1}{\gamma(1 - \beta)(\tau_A^{-1} + \tau_B^{-1})},$$

respectively. It is obvious that the trading intensity on $\tilde{z}$ is increasing in β . Intuitively, when more stock is used in the payment, the acquiring firm's payoff $\tilde{p}_2$ and the target's payoff $\tilde{q}_2$ becomes more correlated. Therefore, the traders have higher incentives to hedge their random endowments of the target firm's shares, which adds noise to the acquiring firm's stock price and decreases the informativeness.

The traders also trade more aggressively on the information about synergy if more stock is used in M&A payment. The reason is that the risk sharing effect of stock payment decreases the risk of the acquiring firm's payoff. With a lower risk, the risk-averse traders speculate more aggressively on the information. Although both the trading intensities on endowment $\tilde{z}$ and information $\tilde{v}_S$ are increasing in the use of stock in payment (i.e., β), the trading intensity on $\tilde{z}$ increases faster. As a result, the overall effect of β on stock price informativeness is negative.

4.3 Equilibrium Payment Method

In this subsection, we analyze the equilibrium payment method at $t = 0$, which is determined by the Nash bargaining problem (5). We first establish an irrelevance result for a benchmark economy where firm managers do not learn from stock prices, showing that the equilibrium payment method is undetermined as long as cash and stock satisfy a specific condition. We then examine our main economy with managerial learning and show that the payment method is uniquely determined.

An irrelevance result. Let us consider a benchmark economy in which firm managers do not learn from the financial market and the deal is never withdrawn. In this benchmark economy, the “in agreement” expected payoffs to the acquirer and the target are $U_A^N(\beta, M) = (1 - \beta)(\bar{v}_A + \bar{v}_T + \bar{v}_S - M)$ and $U_T^N(\beta, M) = M + \beta(\bar{v}_A + \bar{v}_T + \bar{v}_S - M)$, respectively. The Nash bargaining solution is thus determined by:

$$\max_{(\beta, M)} (U_A^N - \bar{v}_A)^\delta (U_T^N - \bar{v}_T)^{1-\delta}, \text{ s.t. } \beta \in [0, 1), M \geq 0, U_A^N \geq \bar{v}_A, U_T^N \geq \bar{v}_T. \quad (24)$$

Solving this problem, we find that when there is no managerial learning, payment method is irrelevant and cannot be uniquely determined.

Proposition 2 (Payment method without learning). *Assume $\bar{v}_S > 0$. When firm managers do not learn from stock prices and choose not withdrawing the deal, there exist $\hat{\beta} > 0$ and $\hat{M} > 0$ such that any payment scheme $(\beta, M) \in [0, \hat{\beta}] \times [0, \hat{M}]$ satisfying*

$$M = \frac{(1 - \beta)\bar{v}_T + (1 - \beta - \delta)\bar{v}_S - \beta\bar{v}_A}{1 - \beta} \quad (25)$$

is a solution to Problem (24). Moreover, under this solution, firm managers indeed find it optimal not to withdraw.

Proof. See Appendix B. □

If the firm managers do not learn from the financial market, then they make the withdrawal decision based on prior expectation about the synergy. Therefore, if their prior expectation about the synergy is positive (i.e., $\bar{v}_S > 0$), under an optimal payment scheme, the acquiring firm’s manager expects that the surplus from completing the deal is $\delta\bar{v}_S > 0$ and the target firm’s manager expects that the surplus is $(1 - \delta)\bar{v}_S > 0$, so the deal will not be withdrawn at $t = 1.5$. Moreover, any feasible payment scheme (β, M) that satisfies equation (25) can result in an expected surplus of $\delta\bar{v}_S$ for the acquiring firm and $(1 - \delta)\bar{v}_S$ for the target firm if the deal is completed. Intuitively, when there is no market feedback, cash and stock are

equivalent in the payment of a deal, so the payment method is irrelevant to firm values.

Payment methods with market feedback. If the managers learn from stock prices when making withdrawal decisions, the unconditional expectations of payoffs to the acquirer and the target are

$$U_A = (1 - \beta)(\bar{v}_A + \bar{v}_T - M) \left[1 - \Phi \left(\frac{\hat{s} - \bar{v}_S + \kappa^{-1} \bar{z}}{\sqrt{\tau_S^{-1} + \tau_p^{-1}}} \right) \right] + \bar{v}_A \Phi \left(\frac{\hat{s} - \bar{v}_S + \kappa^{-1} \bar{z}}{\sqrt{\tau_S^{-1} + \tau_p^{-1}}} \right) \\ + (1 - \beta) \left[\bar{v}_S - \int_{-\infty}^{+\infty} \frac{v \sqrt{\tau_S}}{\sqrt{2\pi}} e^{-\frac{\tau_S(v - \bar{v}_S)^2}{2}} \Phi \left(\sqrt{\tau_p} (\hat{s} + \kappa^{-1} \bar{z} - v) \right) dv \right], \quad (26)$$

and

$$U_T = [M + \beta(\bar{v}_A + \bar{v}_T - M)] \left[1 - \Phi \left(\frac{\hat{s} - \bar{v}_S + \kappa^{-1} \bar{z}}{\sqrt{\tau_S^{-1} + \tau_p^{-1}}} \right) \right] + \bar{v}_T \Phi \left(\frac{\hat{s} - \bar{v}_S + \kappa^{-1} \bar{z}}{\sqrt{\tau_S^{-1} + \tau_p^{-1}}} \right) \\ + \beta \left[\bar{v}_S - \int_{-\infty}^{+\infty} \frac{v \sqrt{\tau_S}}{\sqrt{2\pi}} e^{-\frac{\tau_S(v - \bar{v}_S)^2}{2}} \Phi \left(\sqrt{\tau_p} (\hat{s} + \kappa^{-1} \bar{z} - v) \right) dv \right], \quad (27)$$

respectively, where $\Phi(\cdot)$ is the cumulative distribution function for a standard normal random variable. Note that $\hat{s}$, κ , and τ_p in the above expressions are functions of β and M . See Appendix B for the derivations of equations (26) and (27). Due to the analytical complexity of the expressions for U_A and U_T , we employ numerical analysis to explore the solutions to problem (5) and underlying intuitions.

In our numerical examples, we set $\bar{v}_A = 5$, $\bar{v}_T = 5$, $\tau_A = 1$, and $\tau_T = 1$. Following the interpretation of [Gârleanu and Pedersen \(2018\)](#), these numbers mean that for both the acquirer and the target, the volatility of standalone value is 20% (i.e., $\sigma_A = \sqrt{\tau_A^{-1}}/\bar{v}_A = 0.2$). Moreover, we set $\bar{z} = 1 > 0$ so that the hedgers tend to hold short positions in the acquirer's stock, consistent with the behavior of merger arbitrageurs in the real world. The traders' absolute risk-aversion coefficient is set to be $\gamma = 2$. Following the interpretation in [Goldstein and Yang \(2022\)](#), this corresponds to a relative risk-aversion coefficient $\gamma_R = 10$ and an expected initial wealth $\bar{z}\bar{v}_T = 5$ for a hedger. For the synergy, we set $\bar{v}_S = 10$ and $\tau_S = 10^{-2}$,

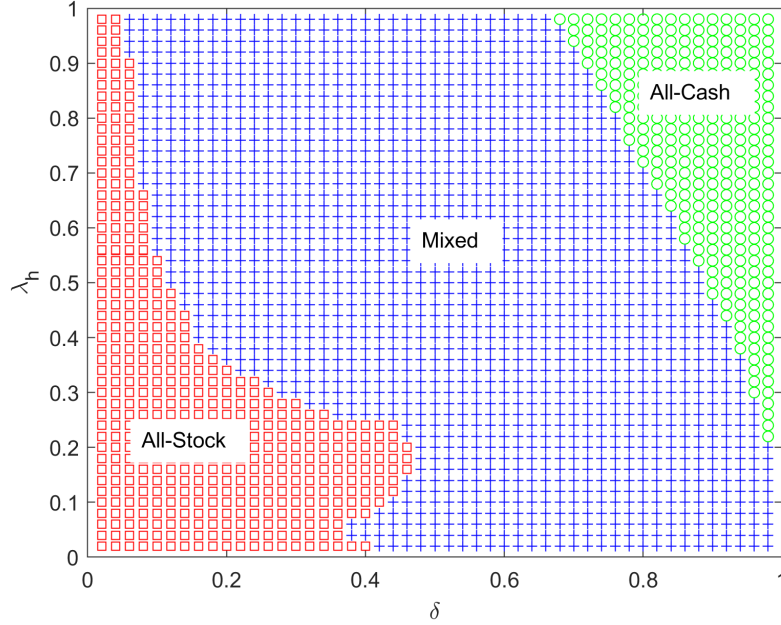


Figure 3: Equilibrium payment method. A red “□” represents all-stock payment ($M = 0$). A blue “+” represents mixed payment ($M > 0$ and $\beta > 0$). A green “o” represents all-cash payment ($\beta = 0$). Parameter values: $\bar{v}_A = 5$, $\bar{v}_T = 5$, $\bar{v}_S = 10$, $\tau_A = 1$, $\bar{z} = 1$, $\tau_T = 1$, $\tau_S = 10^{-2}$, $\tau_z = 10^{-4}$, and $\gamma = 2$.

so the volatility of synergy is 100% (i.e., $\sigma_S = \sqrt{\tau_S^{-1}/\bar{v}_S} = 1$). The high volatility of synergy leads to high incentives for firm managers to learn from stock prices. Finally, the precision of a hedger’s endowment of the target firm’s stock is $\tau_z = 10^{-4}$, so the mass of hedgers λ_h is an important determinant of stock price informativeness. In the following analyses, we allow the mass of hedgers λ_h and the acquiring firm’s bargaining power δ to vary.

We find that, in contrast to the benchmark case, if firm managers learn from stock prices when making withdrawal decisions, then the payment method can be uniquely determined. Figure 3 demonstrates that when feedback effects exist, more cash is used in M&A payments compared with stocks if investors are more risk averse and acquiring firms have higher bargaining power. We further explore the implications of payment methods for managerial learning and the determinants of payment methods in the next section.

5 Payment Methods and Market Feedback

This section examines the interaction between payment methods and market feedback through two exercises. First, we demonstrate that our model rationalizes the key empirical fact from Section 2: the sensitivity of deal withdrawal to stock prices is higher for all-cash deals than for all-equity or mixed-payment deals. Second, we perform a comparative static analysis on the population size of hedgers (who represent merger arbitrageurs) to generate a testable prediction for payment method choice, which we will test in the following section.

5.1 Sensitivity of Withdrawal to Prices

Our empirical observation shows that the sensitivities of withdrawal decisions to market reactions are higher for all-cash deals. To understand this result with our model, we conduct a simple simulation exercise. The parameter values we use are explained in Section 4.3. With these parameters, we simulate a sample of payment schemes, stock prices, and withdrawal decisions. Each observation in the simulated sample is generated by the following steps.

First, we randomly draw a pair (λ_h, δ) from a predetermined joint probability distribution and then solve problem (5) for the equilibrium payment scheme (β, M) . Specifically, λ_h is drawn from a uniform distribution over $(0, 1)$ and δ is drawn from a uniform distribution over $[0.7, 1)$. The selections of λ_h and δ are independent. We use $\tilde{\omega} = \mathbb{I}_{\{\beta=0\}}$ to denote the all-cash deals. Second, based on the exogenous and endogenous parameters, we generate a realization of the stock price $\tilde{p}_1$ and calculate the corresponding withdrawal decision $\tilde{a} = \mathbb{I}_{\{\tilde{p}_1=\alpha_0\}}$. By repeating the above two steps for $N = 7,810$ times, we generate a sample of $(\tilde{a}, \tilde{p}_1, \tilde{\omega})$. Following the approach in Section 2, we estimate the following linear model on the simulated sample:

$$\tilde{a} = b_0 + b_1\tilde{p}_1 + b_2\tilde{\omega}\tilde{p}_1 + b_3\tilde{\omega} + \tilde{\varepsilon}, \quad (28)$$

where b_0 , b_1 , b_2 , and b_3 are deterministic coefficients and $\tilde{\varepsilon}$ is the error term. The estimation results are reported in Table 2.

[Insert Table 2 Here]

Consistent with our empirical observations presented in Table 1, Table 2 shows that an M&A deal is less likely to be withdrawn when the trading price of the acquiring firm's stock is higher. This result is intuitive: a higher stock price signals stronger synergies, reducing the manager's incentive to withdraw. We also find that the magnitude of this negative relationship is greater under all-cash payments than under non-all-cash payments. The reason is that with all-cash payments, the acquirer does not share synergies with the target firm, making its withdrawal decision more sensitive to synergy inferences drawn from the stock price. Moreover, the higher price informativeness induced by all-cash payments increases the importance of price signals in managers' withdrawal decisions compared with their prior beliefs about synergies, strengthening the negative impact of prices on withdrawal decisions.

5.2 Comparative Statics: The Mass of Hedgers

In this subsection, we study the impacts of the mass of hedgers on managers' choices of payment methods. We plot the equilibrium fraction of the merged firm value enjoyed by the target β , the cash paid to the target M , the unconditional deal withdrawal probability $\Pr\{\tilde{p}_1 = \alpha_0\}$, and the ex ante expected deal cost $M + \beta(\bar{v}_A + \bar{v}_T + \bar{v}_S - M)$ as functions of the mass of hedgers λ_h in Figure 4.

The upper left (upper right) panel of Figure 4 shows that β (M) is decreasing (increasing) in λ_h , indicating that more cash is used in payments if more hedgers engage in the stock market. To understand the choice of payment methods, we decompose the acquiring firm's surplus at $t = 0$ as follows:

$$U_A - \bar{v}_A = [(1 - \beta)(\bar{v}_A + \bar{v}_T + \bar{v}_S - M) - \bar{v}_A](1 - \bar{a}) + (1 - \beta)\text{Cov}[\tilde{v}_S, 1 - \tilde{a}], \quad (29)$$

where $\tilde{a} = a(\tilde{p}_1, \tilde{q}_1)$ denotes the withdrawal decision at $t = 1.5$ and $\bar{a} = E[\tilde{a}]$ is the probability

of deal withdrawal. Similarly, the target firm's surplus at $t = 0$ can be decomposed as

$$U_T - \bar{v}_T = [\beta(\bar{v}_A + \bar{v}_T + \bar{v}_S - M) + M - \bar{v}_T](1 - \bar{a}) + \beta Cov[\tilde{v}_S, 1 - \tilde{a}], \quad (30)$$

and the total surplus is $\bar{v}_S(1 - \bar{a}) + Cov[\tilde{v}_S, 1 - \tilde{a}]$. See Appendix B for the derivations of equations (29) and (30). One can see that both the acquirer's and target's surpluses, as well as the total surplus, are positively associated with the ex ante probability of continuation $(1 - \bar{a})$ and the covariance between synergy and continuation $Cov[\tilde{v}_S, 1 - \tilde{a}]$.

When the ex ante probability of continuation $(1 - \bar{a})$ increases, both the acquirer and target are more likely to enjoy the benefit of the synergy, so their expected payoffs increase. A higher $Cov[\tilde{v}_S, 1 - \tilde{a}]$ means the managers' withdrawal decision is more responsive to variation in synergy, indicating a higher decision quality. With a higher decision quality, the expected payoffs also increase. Therefore, both the acquirer and target have incentives to increase the continuation probability and decision quality.

However, when choosing the payment methods, the managers face a tradeoff between decision quality and continuation probability. On one hand, as demonstrated in Corollary 1, when more stock is used in payment, the stock price informativeness will decrease, which negatively affects managerial learning and decreases the decision quality. On the other hand, When more stock is used, the continuation probability (withdrawal probability) tends to increase (decrease). This can be seen by comparing the upper left panel and lower left panel of Figure 4. To understand the intuition, we analyze two extreme cases: all-cash and all-stock. We note that the acquiring firm's manager compares the cost and benefit of M&A when deciding whether to withdraw the deal.³ When the payment method is all-cash, the manager of the acquiring firm will withdraw the deal if and only if

$$\underbrace{E[\tilde{v}_A + \tilde{v}_T + \tilde{v}_S | \tilde{p}_1, \tilde{q}_1]}_{\text{benefit of M\&A}} - \underbrace{M}_{\text{cost of M\&A}} < \bar{v}_A.$$

³Under the chosen parameters described in Subsection 4.3, we always have $\hat{s}_A > \hat{s}_T$, indicating that the withdrawal decisions are effectively made by acquirers. See the lower middle panel of Figure 4.

When the payment method is all-stock, the manager will withdraw the deal if and only if

$$\underbrace{E[\tilde{v}_A + \tilde{v}_T + \tilde{v}_S | \tilde{p}_1, \tilde{q}_1]}_{\text{benefit of M\&A}} - \underbrace{\beta E[\tilde{v}_A + \tilde{v}_T + \tilde{v}_S | \tilde{p}_1, \tilde{q}_1]}_{\text{cost of M\&A}} < \bar{v}_A.$$

With the all-cash payment, the manager will withdraw the deal if she expects that the benefit of the deal is lower than a *fixed* cost. In contrast, with all-stock payment, the cost of the deal is *variable*. If the manager expects that the synergy is lower and thus the benefit of the deal is lower, she also expects a lower cost of the deal. Therefore, the manager is less likely to withdraw the deal with all-stock payment than with all-cash payment. Moreover, by comparing the upper left panel and the lower right panel of Figure 4, one can see that more use of stock also corresponds to a lower expected deal cost. This explains why the unconditional withdrawal probability is decreasing in the use of stock.

The mass of hedgers λ_h only directly affects stock price informativeness, without affecting other variables that may have an effect on payment such as deal quality, firm sizes, and bargaining power. Therefore, the impacts of hedgers on payment methods must be through the managerial learning channel. When the mass of hedgers λ_h is low, the stock price informativeness $\tau_p = [\lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1})]^{-2} \tau_z$ tends to be high, and the marginal effect of a decrease in β on τ_p and decision quality is low. In this case, the managers optimally choose a high stock ratio β and a low cash level M in payment to obtain a low withdrawal probability. As the mass of hedgers λ_h increases, the stock price informativeness τ_p tend to decrease, and the marginal effect of lowering β on τ_p and decision quality increases. Therefore, the managers optimally choose to use more cash and less stock in payment to improve the price informativeness and the quality of withdrawal decision.

Testable hypothesis. As has been explained, the hedgers in our model correspond to merger arbitrageurs in the real world. Based on the results in Proposition 2 and Figure 4, we propose the following testable hypothesis, which will be tested in the next section.

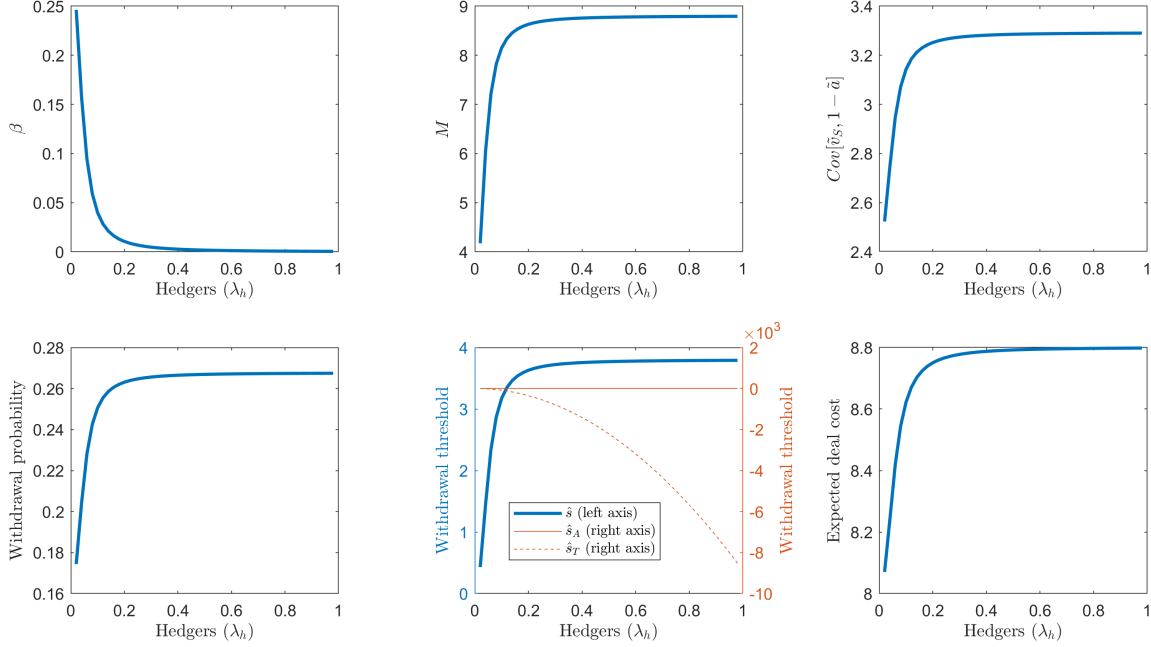


Figure 4: Impacts of the mass of hedgers. This figure plots the equilibrium fraction of the merged firm value enjoyed by the target β , the cash paid to the target M , the unconditional covariance between synergy and deal completion $Cov[\tilde{v}_S, 1 - \tilde{a}]$, the unconditional deal withdrawal probability $\Pr\{\tilde{p}_1 = \alpha_0\}$, the withdrawal thresholds $\hat{s}, \hat{s}_A, \hat{s}_T$, and the ex ante expected deal cost $M + \beta(\bar{v}_A + \bar{v}_T + \bar{v}_S - M)$ as functions of the mass of hedgers λ_h . Parameter values: $\bar{v}_A = 5$, $\bar{v}_T = 5$, $\bar{v}_S = 10$, $\tau_A = 1$, $\tau_T = 1$, $\tau_S = 10^{-2}$, $\tau_z = 10^{-4}$, $\delta = 0.7$, and $\gamma = 2$.

H1: If the managers do not intend to learn from the stock prices when making the deal withdrawal decision, then the mass of merger arbitrageurs has no impact on the choice of payment method. On the contrary, if the managers intend to learn from the stock prices, then they are more likely to choose cash (stock) as the payment method when the mass of merger arbitrageurs increases (decreases).

6 Merger Arbitrageurs

Section 2.2 documents stylized facts on how payment methods influence market feedback. In this section, we examine the reciprocal feedback channel implied by our model, namely, the endogenous financing channel, through which market feedback in turn shapes the choice of M&A payment methods, as established in Hypothesis H1 in Section 5.2.

6.1 Institutional Background of Merger Arbitrageurs

As discussed in Section 3, we interpret the hedgers in our model as merger arbitrageurs in practice. These professional investors establish their positions at the public announcement by buying the target and then shorting the acquirer to hedge the stock component of the payment. The short position offsets the mechanical exposure they will receive when target shares convert into acquirer shares at completion. At closing, they unwind their trades mechanically—delivering the newly received acquirer shares back to lenders—so covering occurs through share delivery rather than open-market buy-to-cover. This institutional structure generates a large and highly predictable short-selling flow in acquirer shares that produce temporary price pressure.

Consistent with this interpretation, [Mitchell et al. \(2004\)](#) show that merger arbitrage generates large, predictable hedging flows: arbitrageurs enter around announcement dates, acquirer short interest rises as they establish the hedge, and return patterns reverse at completion as this order flow unwinds. Evidence on the short-interest dynamics is also provided by [Liu and Wu \(2014\)](#), who document that borrow demand from the hedge leg is a first-order driver of acquirer short interest and temporary pricing. The broader literature further clarifies the sources and scale of this hedging-induced flow. In particular, [Baker and Savaşoğlu \(2002\)](#) mention the existence practical frictions in shorting acquirer shares in stock deals. Interpreting these short-selling frictions as part of the arbitrageurs’ entry cost, [Cornelli and Li \(2002\)](#) imply that tighter or costlier borrowing raises entry cost and lowers arbitrageurs’ participation.

Putting these pieces together, the literature consistently views merger-arbitrage activity as a supply-driven shock to acquirer shares, exerting *downward price pressure* on acquirers’ shares. The magnitude of this pressure naturally depends on both the mass of arbitrageurs seeking to hedge and their *ability to short*, which in practice is largely influenced by the activities of the equity-lending market. In this vein, [Dutordoir et al. \(2022\)](#) show that ex-ante lending supply—and its ETF-instrumented component—systematically affects payment

choice, with firms more likely to choose cash when shorting capacity is abundant and expected downward pressure on the acquirer’s stock price is greater. Their findings motivate our use of lending-market capacity as a proxy for merger arbitrageurs’ shorting strength, which in our framework maps directly into the mass of hedgers (λ_h).

6.2 Acquirers’ Equity Lending Supply and Payment Choice

The model’s comparative statics (Section 5.2) posit that an increase in the mass of hedgers, interpreted in practice as merger arbitrageurs, shifts equilibrium payments toward cash. This occurs because equity payments generate stronger hedge-driven selling pressure and noisier prices, making cash the more attractive option from a learning perspective.

Empirical Design and Markit Securities Lending Data

Dutordoir et al. (2022) show that *ex-ante* lending supply and its ETF-instrumented component predict payment choice. We therefore measure effective hedging strength with a lending-market proxy and interpret higher lending supply increases the effective mass of hedgers, which lowers τ_p and shifts optimal payment toward cash in our framework.

In particular, we use a refined subsample in which merger–arbitrage activity is most plausibly and market feedback is most informative for managers. We begin from the SDC–CRSP–Compustat dataset in Section 2.2 and merge it with daily Markit securities-lending data, which consolidate stock-loan activity from prime brokers, custodial banks, and lending agents.⁴ To ensure that merger arbitrage can be implemented in practice, we restrict deals to publicly listed targets, so arbitrageurs can take the canonical long-target/short-acquirer position. We further restrict the sample to deals with negative acquirer announcement-window returns, thereby focusing on cases in which downward price reactions most plausibly signal market perceptions of value destruction and are therefore most informative for withdrawal

⁴On the daily basis, Markit reports total shares *available to lend*, total *on-loan* balances, indicative *borrow fees* (rebates), and *utilization* rates. These data are widely used to study short-selling frictions and equity-lending market depth. We focus on shares available for lending, because merger arbitrageurs hedge stock deals by shorting the acquirer, and the capacity to short depends primarily on *pre-existing lending supply* rather than contemporaneous borrowing demand.

and payment decisions.⁵ The resulting sample, summarized in Table 3, provides a focused setting to study how ex-ante lending supply and the associated shorting capacity shape cash-versus-equity financing when managers learn from prices.

[Insert Table 3 Here]

With the Markit-merged sample and screening criteria established, we next define the deal-level measure of ex-ante hedging capacity used in the analysis. For each deal, we compute *Lending Supply* (LS) as the acquirer’s equity-lending capacity one trading year (252 trading days) before the announcement date, following Dutordoir et al. (2022). In particular, we sum the total number of acquirer shares available to lend from day $t = -252$ to day $t = 0$ (the announcement day) and scale by the acquirers’ CRSP shares outstanding. This deal-level variable, LS , is merged to the deal dataset and used as our proxy for arbitrageurs’ ex-ante ability to implement the short leg of merger arbitrage.

Empirical Results

Our model implies that when shorting is easy, i.e., when the market can supply borrow at scale, equity financing induces stronger hedge-driven selling pressure and noisier prices, making cash relatively more attractive by virtue of its effect on market feedback. Table 3 tests this mechanism using LS and an instrument based on acquirer *ETF ownership* (ETFs systematically lend). As mentioned above, in relation to our model, variable LS corresponds to the mass λ_h of hedgers.

In Column (1), higher LS predicts a greater likelihood of all-cash payment (0.001, $t = 2.03$). The IV estimates strengthen the interpretation: the first stage is strong, ETF holdings per share predict LS (14.797, $t = 3.23$; Cragg–Donald Wald $F = 32.44$). In the second stage, instrumented lending supply $\widehat{LS}$ raises the odds of choosing all-cash (0.007, $t = 1.87$).

⁵Because the Markit merge and these additional screens substantially reduce the estimation sample, we adopt a 1% cutoff for relative deal size rather than the 10% threshold used in Section 2.2 to retain sufficient variation while still excluding economically negligible transactions. Our main results are qualitatively unchanged when we adopt a 10% threshold.

Translating magnitudes, the OLS estimates imply that a *ten-percentage-point* increase in lending supply raises the probability of an all-cash bid by 1.0% ($= 0.001 \times 10$). These empirical patterns mirror the model’s prediction: active equity-lending markets indicate greater arbitrageurs’ capacity to short the acquirer in stock-financed deals, which lowers signal precision and induces a shift toward cash so as to maintain and enhance the informativeness of prices, consistent with the model’s predicted financing response to hedgers’ driven noise.

6.3 Managerial Learning Traits and Payment Methods

A central empirical concern is that the relation between lending-market activity and payment choice may reflect differences in financing capacity rather than learning. Recent evidence shows that index creation and related index-membership shocks improve firms’ information environments and lower public-debt financing costs, facilitating access to bond markets and raising leverage (Goyal et al., 2025). If equity-lending activity simply reflected cheaper external finance arising from the presence of large index funds—which are also major providers of lendable shares—then firms with greater lending supply might appear more likely to choose cash even in the absence of learning motives, merely because index-driven reductions in borrowing costs make cash financing more affordable.

Our empirical strategy is designed explicitly to rule out this possibility and to isolate the learning channel. In particular, we interact LS with firms’ pre-deal managerial learning traits (*Learner*). We can view this empirical strategy as testing Hypothesis H1 in Section 5.2 as follows. Firm managers feature two types: (i) the rational type, who learn information from stock prices, as in the baseline model; and (ii) the “cursed” type, who ignore the information from stock prices as in the benchmark economy. The second type of managers are similar to the cursed traders in Eyster et al. (2019) who ignore the information in stock prices. Our mechanism operates through the managerial learning channel, and so the prediction is more likely to hold when managers are more likely to be the rational type, as proxied by pre-deal managerial learning traits.

Specifically, we measure a firm’s pre-deal managerial learning traits using the firm-level

learning coefficient ℓ_i , which captures the sensitivity of its future investment to both firm value and stock-price informativeness. Following the literature, we estimate ℓ_i from rolling regressions of investment growth on valuation and informativeness proxies such as $Q \times (1 - R^2)$ constructed over the prior 24 quarters. A higher ℓ_i indicates greater managerial reliance on market signals. To isolate heterogeneity, we define $\text{Learner}_i = \mathbf{1}\{\ell_i > \tilde{\ell}_{0.50}\}$, where $\tilde{\ell}_{0.50}$ is the sample median of ℓ_i .

This heterogeneity result is highly informative. In particular, Table 3 displays the effect of LS on the likelihood of all-cash payment is enhanced among firms with strong ex-ante incentives to learn (e.g., $\text{Learner} \times \widehat{LS} = 0.025$, $t = 4.10$ in Column (5)). Such patterns are difficult to reconcile with a financing-capacity explanation or other alternative mechanisms, which would not naturally generate a learning-dependent shift toward cash. By contrast, the observed heterogeneity follows directly from the mechanism implied by our model. In equilibrium, price informativeness, $\tau_p = \left[\lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \right]^{-2} \tau_z$, declines with the equity share β and with the effective mass of hedgers λ_h . Active lending markets predict greater arbitrageurs' capacity to short acquirer shares in stock deals, which lowers τ_p and weakening learning from prices under equity financing. Consequently, firms that place higher value on market feedback optimally tilt their financing choice toward cash. The empirical patterns align tightly with the model's comparative statics in Section 5.2 and are consistent with a learning-based interpretation of the relation between LS and payment choice.

7 Conclusion

A fundamental premise in financial economics is that market prices contain significant information about asset fundamentals. The feedback effect literature posits that real-economy decision-makers incorporate this information into their decisions. A natural setting for studying market feedback is M&A transactions, where acquiring-firm managers learn from stock prices to determine whether to cancel deals. In practice, acquisitions are paid for with cash, stock, or a combination of the two, and we observe that the propensity to cancel a deal

based on market feedback differs substantially across these payment methods. Specifically, while withdrawal probabilities decrease with stock prices, the sensitivity is steeper for all-cash payments. In this paper, we develop a model to examine the interaction between payment methods and market feedback. Our theory not only explains these differing feedback patterns but also yields unique predictions for how payment method choices depend on financial market characteristics. We test these predictions in a merger-arbitrageur setting and find supporting evidence.

Table 1: All-Cash vs. Non-All-Cash: Summary Statistics and Withdrawal Regressions

This paper presents the results of regressing the *Withdraw* dummy on the acquirer's cumulative abnormal return (CAR). Panel A presents the summary statistics for the main variables in the below regression. Panel B examines the effect of announcement returns ($CAR(-2,+2)$) on withdraw probability. Column (1) employs the full sample; Columns (2)–(3) split by payment method; Column (4) interacts CAR with an All-Cash indicator. Among the 7,810 observations, 2,960 are all-cash deals and 4,850 are non-all-cash deals, of which 500 are all-stock transactions. Controls include firm characteristics (log assets, book-to-market, leverage), deal characteristics, and year and industry fixed effects. Standard errors are two-way clustered by year and industry. *t*-statistics are in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels.

Panel A. Summary Statistics (All-Cash & Non-All-Cash)						
Variables	Obs	Mean	Median	Std. Dev.	P25	P75
Withdrawn	7,810	0.110	0.000	0.313	0.000	0.000
CAR (−2,+2)	7,810	0.015	−0.024	0.090	0.010	0.050
All-Cash	7,810	0.379	0.000	0.485	0.000	1.000
DealSize	7,810	5.180	3.904	1.678	5.014	6.217
Hostile	7,810	0.003	0.000	0.058	0.000	0.000
BM	7,810	0.445	0.267	0.248	0.442	0.626
LogSIZE	7,810	7.279	5.970	1.871	7.191	8.423
Leverage	7,810	0.260	0.068	0.215	0.235	0.404
Panel B. Dependent Variable: Withdraw (=1)						
		Pooled	All-Cash	Non-All-Cash		Pooled × All-Cash
CAR(−2,+2)		−0.107 *** (−4.36)	−0.230 *** (−5.20)	−0.112 *** (−3.67)		−0.098 *** (−3.05)
CAR(−2,+2)×All-Cash		−	−	−		−0.155 *** (−3.82)
All-Cash		−	−	−		0.135 *** (7.91)
<i>Firm & Deal characteristics</i>		Y	Y	Y		Y
<i>YEAR & Ind FE</i>		Y	Y	Y		Y
<i>Clustered</i>		YearInd	YearInd	YearInd		YearInd
Observations		7,810	2,960	4,650		7,810
<i>R</i> ²		0.108	0.146	0.130		0.144

Table 2: M&A Withdrawal Probability and Stock Prices in the Model Economy

This table presents the results of regressing the *Withdraw* dummy ($\tilde{a}$) on the acquirer's trading price ($\tilde{p}_1$) using simulated samples. Panel A presents the baseline result from a sample of $N = 7,810$ observations. Panel B presents the bootstrap result. Specifically, we randomly select 10,000 subsamples with size 3,000 from the full sample used in Panel A. The numbers reported in Panel B are the averages of the numbers from the subsamples. Panel C presents the result from a sample of $N = 10^7$ observations. Column (1) employs the full sample; Columns (2)–(3) split by payment method; Column (4) interacts $\tilde{p}_1$ with an All-Cash indicator. Parameter values: $\bar{v}_A = 5$, $\bar{v}_T = 5$, $\bar{v}_S = 10$, $\bar{z} = 1$, $\tau_A = 1$, $\tau_T = 1$, $\tau_S = 10^{-2}$, $\tau_z = 10^{-4}$, $\gamma = 2$, $\lambda_h \sim U(0, 1)$, and $\delta \sim U[0.7, 1)$.

Dependent: Withdraw ($\tilde{a}$)	All	All-Cash	Non-All-Cash	Interaction
Panel A: Baseline Result				
p_1	-0.0194	-0.0247	-0.0171	-0.0171
$p_1 \times \text{AllCash}$				-0.0076
AllCash				0.0716
Intercept	0.4089	0.4604	0.3888	0.3888
Observations	7,810	3,054	4,756	7,810
Panel B: Bootstrap				
p_1	-0.0195	-0.0247	-0.0173	-0.0173
$p_1 \times \text{AllCash}$				-0.0074
AllCash				0.0701
Intercept	0.4098	0.4605	0.3904	0.3904
Observations	3,000	1,137	1,863	3,000
Panel C: Large Sample				
p_1	-0.0196	-0.0250	-0.0172	-0.0172
$p_1 \times \text{AllCash}$				-0.0078
AllCash				0.0793
Intercept	0.4160	0.4726	0.3934	0.3934
Observations	10,000,000	3,889,273	6,110,727	10,000,000

Table 3: Merger Arbitrageurs, Managerial Learning, and M&A Payment Choice

This table summarizes the estimation sample and reports how acquirors' *payment choice* responds to merger arbitrageurs' activity—proxied by deal-level equity lending supply (LS)—and how the sensitivity varies with managerial learning from prices. *Panel A* provides summary statistics for the variables used in the regressions. *Panel B* reports the baseline and heterogeneous effects using LS (Columns 1–2) and an IV–projection approach in which prior-year firm-level ETF holdings (scaled by shares outstanding) instrument for LS . Column (3) is the *first stage*; the Cragg–Donald Wald F for weak identification equals 32.44, indicating a strong instrument. Columns (4)–(5) replace LS with its fitted component $\widehat{LS}$ ($lsETF$) and then add the interaction with *Learner*. All specifications include year and industry fixed effects and the same firm/deal controls as in Table 1. Standard errors in Columns (1), (2), (4), and (5) are two-way clustered by year and industry; t -statistics are in parentheses. Coefficients on other controls are estimated but omitted for brevity. ***, **, * denote significance at the 1%, 5%, and 10% levels.

<i>Panel A: Summary statistics (estimation sample)</i>						
Variable	N	Mean	SD	P25	Median	P75
LS (Equity Lending Supply)	1345	26.117	11.478	19.716	26.508	32.776
ETF Lending Supply ($\widehat{LS}$)	1345	3.451	1.350	2.825	3.452	4.270
Logarithm of Deal Size (in million)	1345	5.757	1.729	4.602	5.663	6.909
Relative Deal Size	1345	0.180	0.270	0.043	0.079	0.171
Logarithm of Assets	1345	8.254	1.768	7.044	8.150	9.356
Book-to-Market Ratio	1345	0.485	0.322	0.259	0.422	0.652
Return on Assets	1345	0.049	0.069	0.012	0.047	0.081
Leverage	1345	0.217	0.189	0.053	0.183	0.337
<i>Panel B: All-cash regressions and IV estimation</i>						
	<i>Dep. var.: All-cash</i>		<i>Dep. var.: LS</i>	<i>Dep. var.: All-cash</i>		
	(1)	(2)	(3)	(4)	(5)	
	Base	Base $\times$ Learner	First stage	ETF $\rightarrow$ LS	IV $\times$ Learner	
LS	0.001** (2.03)	0.001 (0.55)				
Learner $\times$ LS		0.002** (2.29)				
Learner		-0.049* (-2.01)				0.002 (0.13)
$\widehat{LS}$ (ETF-projected)				0.007* (1.87)	-0.008 (-1.37)	
Learner $\times$ $\widehat{LS}$					0.025*** (4.10)	
<i>First stage (dep. var. = LS)</i>						
Holding (ETF holdings / SO)			14.797*** (3.23)			
Firm & Deal characteristics	Y	Y	–	Y	Y	
YEAR & Ind FE	Y	Y	Y	Y	Y	
Clustered	YearInd	YearInd	–	YearInd	YearInd	
Cragg–Donald Wald F	–	–	32.44	–	–	
Observations	1,345	1,345	1,359	1,345	1,345	
R-squared	0.449	0.450	0.286	0.448	0.449	

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Appendix A

Table A1: Sample Construction and Data-Filtering Steps

This table documents the key data-filtering steps used to construct our sample of domestic mergers and acquisitions (M&A) announced between 2000 and 2022. We begin with SDC domestic M&A deals and match acquiror CUSIPs to CRSP/Eventus, retaining ordinary common-stock acquirors (CRSP share code = 10) for which cumulative abnormal returns (CARs) can be computed. We then restrict to deals with status “Completed” or “Withdrawn,” require non-missing deal values, eliminate duplicate announcements, and correct anomalous completion dates (dropping deals whose effective date precedes the announcement date and shifting same-day completions one trading day forward). Next, we require stock-price availability on both the announcement and effective dates and, when necessary, impute the effective-date price using the mean of the three nearest subsequent prices. These pre-screening steps yield a cleaned market-data sample of 21,174 deals. The rows below report the remaining filtering steps based on accounting information and additional deal and firm-level controls. The final regression sample comprises 7,810 observations.

Data-filtering step	Obs.
Compustat-merged sample (cleaned market-data sample with accounting match)	17,453
Minus: deals with missing AMV (acquiror market value in SDC)	13,392
Add: replace missing AMV with acquiror’s market value at announcement	17,453
Minus: deals with deal value < \$10 million or relative size $\leq 10\%$	7,912
Minus: deals lacking controls for deal and firm characteristics	7,810

Note: Pre-screening steps (not tabulated) include (i) matching SDC domestic M&A deals to CRSP/Eventus and retaining ordinary common-stock acquirors; (ii) restricting to completed or withdrawn deals with non-missing deal values; (iii) removing duplicate announcements; (iv) correcting anomalous completion dates by dropping deals with DATEEFF < DATEANN and shifting DATEEFF forward by one trading day when DATEEFF = DATEANN; and (v) requiring stock prices on both announcement and effective dates, imputing missing completion prices using the average of the three nearest subsequent prices.

Table A2: Variable Definitions

This table defines every variable used in our empirical tests and explains how each is constructed. Deal-level information—such as *All-Cash* dummy, *Withdrawn* dummy, Deal Size, and announcement / completion dates—comes from SDC Platinum. Stock-return measures (*CAR* $(-1,+1)$, *CAR* $(-2,+2)$) are calculated with the market-adjusted model using CRSP/Eventus data over various post-announcement windows. Firm controls (*LogSize*, *BM*) derive from COMPUSTAT, as do financial-statement items. Relative deal size (*Relasize*) is the transaction value divided by the acquirer’s market capitalization at announcement (imputed from CRSP when needed).

Variables	Definitions	Source / Construction
<i>AllCash</i>	Indicator equal to 1 if 100% of the consideration is cash ($PCT_CASH = 100$); 0 otherwise.	<i>SDC</i>
<i>CAR</i> $(-1,+1)$	Cumulative abnormal return over the 3-day window (-1 to +1, inclusive).	<i>Eventus</i>
<i>CAR</i> $(-2,+2)$	Cumulative abnormal return over the 5-day window (-2 to +2, inclusive).	<i>Eventus</i>
<i>Withdrawn</i>	Indicator equal to 1 if deal status is “Withdrawn” (terminated before completion); 0 if “Completed”.	<i>SDC</i>
<i>DATEANN</i>	Calendar date of the first public disclosure of intent to merge/acquire (earliest Rank Date before 2006).	<i>SDC</i>
<i>DATECOMP</i>	Deal-completion date: (i) <i>DATEEFF</i> (legal completion); (ii) <i>DATEWITH</i> (withdrawal); or (iii) <i>DATEUNCON</i> (earliest unconditional date).	<i>SDC</i>
<i>DealSize</i>	Natural log of deal value in millions USD: $\log(DEAL_VALUE)$.	<i>SDC</i>
<i>Relasize</i>	Relative deal size: $DEAL_VALUE/AMV$, where AMV = acquirer market value at announcement (proxied by MV if missing).	<i>SDC + CRSP</i>
<i>AC_HPR</i>	Announcement-to-completion holding-period return: $(P_{END} - P_{ANN})/P_{ANN}$.	<i>SDC + CRSP</i>
<i>Hostile</i>	Indicator equal to 1 if the bid is classified as hostile/unsolicited; 0 otherwise.	<i>SDC</i>
<i>LogSize</i>	Natural log of acquirer total assets ($\log(at)$), winsorised at the 1st/99th percentiles.	<i>Compustat</i>
<i>BM</i>	Book-to-market ratio: seq/at , winsorised at the 1st/99th percentiles.	<i>Compustat</i>
<i>Leverage</i>	Ratio of total debt to total assets.	<i>Compustat</i>
<i>Acquirer Industry</i>	Thomson Financial mid-level industry classification (85 industries, grouped into 14 macro-categories) based on SIC/NAICS codes and company descriptions.	<i>SDC</i>
<i>Lending Supply</i>	Summation the total number of acquirer shares available to lend from day $t = -252$ (day $t = 0$ represents the announcement day) and scale by the acquirers’ CRSP shares outstanding.	<i>Markit</i>

Table A3: All-Cash vs. All-Stock: Summary Statistics and Withdrawal Regressions

This paper presents the results of regressing the *Withdraw* dummy on the acquirers' cumulative abnormal return (CAR). Panel A presents the summary statistics for the main variables in the below regression. Panel B examines the effect of announcement returns ($CAR(-2,+2)$) on withdraw probability. Column (1) employs the full sample; Columns (2)–(3) split by payment method, i.e., All-Cash v.s. All-Stock; Column (4) interacts CAR with an All-Cash indicator. Controls include firm characteristics (log assets, book-to-market, leverage), deal characteristics, and year and industry fixed effects. Standard errors are two-way clustered by year and industry. *t*-statistics are in parentheses. ***, **, * denote significance at the 1%, 5%, 10% levels.

Panel A. Summary Statistics (All-Cash & All-Stock)						
Variables	Obs	Mean	Median	Std. Dev.	P25	P75
Withdrawn	3,460	0.201	0.000	0.400	0.000	0.000
CAR (-2,+2)	3,460	0.017	-0.022	0.092	0.013	0.052
All-Cash	3,460	0.852	1.000	0.356	1.000	1.000
DealSize	3,460	5.520	4.227	1.694	5.525	6.633
Hostile	3,460	0.004	0.000	0.066	0.000	0.000
BM	3,460	0.444	0.256	0.251	0.441	0.635
LogSIZE	3,460	7.503	6.120	1.935	7.413	8.672
Leverage	3,460	0.237	0.054	0.215	0.201	0.366
Panel B. Dependent Variable: Withdraw (=1)						
	Pooled	All-Cash	All-Stock	Pooled × All-Cash		
CAR(-2,+2)	-0.081*** (-3.16)	-0.230*** (-5.22)	-0.118 (-1.26)	-0.065 (-0.68)		
CAR(-2,+2)×All-Cash				-0.188** (-2.17)		
All-Cash				0.014 (0.34)		
Firm characteristics	Y	Y	Y	Y		
Deal characteristics	Y	Y	Y	Y		
Year FE	Y	Y	Y	Y		
Industry FE	Y	Y	Y	Y		
Clustering (Year, Ind.)	Y	Y	Y	Y		
Observations	3,460	2,960	500	3,460		
R ²	0.094	0.146	0.211	0.122		

Appendix B: Proofs and Derivations

Proof of Proposition 1

Proof. Note that the manager's withdrawal decision depends only on the stock prices $\tilde{p}_1$ and $\tilde{q}_1$. Therefore, at $t = 1$, the investors can perfectly foresee the withdrawal decision a , because they can also observe $\tilde{p}_1$ and $\tilde{q}_1$. Given a , using the moment generating function for normal random variables, one can transform a speculator's problem (6) into the following problem:

$$\begin{aligned} \max_{m_s, n_s} \quad & m_s (E[\tilde{p}_2 | \mathcal{F}_s] - \tilde{p}_1) + n_s (E[\tilde{q}_2 | \mathcal{F}_s] - \tilde{q}_1) \\ & - \frac{\gamma}{2} (m_s^2 \text{Var}[\tilde{p}_2 | \mathcal{F}_s] + n_s^2 \text{Var}[\tilde{q}_2 | \mathcal{F}_s] + 2m_s n_s \text{Cov}[\tilde{p}_2, \tilde{q}_2 | \mathcal{F}_s]) , \end{aligned} \quad (\text{B.1})$$

where $\mathcal{F}_s = \{\tilde{v}_s, \tilde{p}_1, \tilde{q}_1\}$ is the speculator's information set. The first-order conditions for this problem are

$$\begin{aligned} E[\tilde{p}_2 | \mathcal{F}_s] - \tilde{p}_1 - \frac{\gamma}{2} (2m_s \text{Var}[\tilde{p}_2 | \mathcal{F}_s] + 2n_s \text{Cov}[\tilde{p}_2, \tilde{q}_2 | \mathcal{F}_s]) &= 0, \\ E[\tilde{q}_2 | \mathcal{F}_s] - \tilde{q}_1 - \frac{\gamma}{2} (2n_s \text{Var}[\tilde{q}_2 | \mathcal{F}_s] + 2m_s \text{Cov}[\tilde{p}_2, \tilde{q}_2 | \mathcal{F}_s]) &= 0, \end{aligned}$$

which yield equations (15) and (16). Similarly, a hedger's problem (7) can be transformed into the following problem:

$$\begin{aligned} \max_{m_h, n_h} \quad & m_h (E[\tilde{p}_2 | \mathcal{F}_h] - \tilde{p}_1) + n_h (E[\tilde{q}_2 | \mathcal{F}_h] - \tilde{q}_1) + \tilde{z} E[\tilde{q}_2 | \mathcal{F}_h] \\ & - \frac{\gamma}{2} (m_h^2 \text{Var}[\tilde{p}_2 | \mathcal{F}_s] + (n_h + \tilde{z})^2 \text{Var}[\tilde{q}_2 | \mathcal{F}_s] + 2m_h (n_h + \tilde{z}) \text{Cov}[\tilde{p}_2, \tilde{q}_2 | \mathcal{F}_h]) , \end{aligned}$$

whose first-order conditions are

$$\begin{aligned} E[\tilde{p}_2 | \mathcal{F}_h] - \tilde{p}_1 - \frac{\gamma}{2} (2m_h \text{Var}[\tilde{p}_2 | \mathcal{F}_h] + 2(n_h + \tilde{z}) \text{Cov}[\tilde{p}_2, \tilde{q}_2 | \mathcal{F}_h]) &= 0, \\ E[\tilde{q}_2 | \mathcal{F}_h] - \tilde{q}_1 - \frac{\gamma}{2} (2(n_h + \tilde{z}) \text{Var}[\tilde{q}_2 | \mathcal{F}_s] + 2m_h \text{Cov}[\tilde{p}_2, \tilde{q}_2 | \mathcal{F}_h]) &= 0, \end{aligned}$$

which yield equations (17) and (18).

In the main text, we have shown that the speculators and hedgers effectively have the same information on $\tilde{v}_S$. By equations (1) and (2), we can calculate that

$$\begin{aligned}\hat{V}_A &\equiv Var[\tilde{p}_2|\mathcal{F}_s] = Var[\tilde{p}_2|\mathcal{F}_h] = (1 - (1 - a)\beta)^2\tau_A^{-1} + (1 - a)^2(1 - \beta)^2\tau_T^{-1}, \\ \hat{V}_T &\equiv Var[\tilde{q}_2|\mathcal{F}_s] = Var[\tilde{q}_2|\mathcal{F}_h] = ((1 - a)\beta)^2\tau_A^{-1} + ((1 - a)\beta + a)^2\tau_T^{-1}, \\ \hat{C}_{AT} &\equiv Cov[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_s] = Cov[\tilde{p}_2, \tilde{q}_2|\mathcal{F}_h] = (1 - a)\beta(1 - \beta)(\tau_A^{-1} + \tau_T^{-1}).\end{aligned}$$

Combining the expressions for (m_s, n_s, m_h, n_h) with the market clearing conditions $\lambda_s m_s + \lambda_h m_h = 1$ and $\lambda_s n_s + \lambda_h n_h = 1$ and rearranging terms, the equilibrium prices of the acquirer and target can be expressed as

$$\tilde{p}_1 = E[\tilde{p}_2|\mathcal{F}_s] - \lambda_h \gamma \hat{C}_{AT} \tilde{z} \quad \text{and} \quad \tilde{q}_1 = E[\tilde{q}_2|\mathcal{F}_s] - \lambda_h \gamma \hat{V}_T \tilde{z}. \quad (\text{B.2})$$

The conditional expectations of $\tilde{p}_2$ and $\tilde{q}_2$ are

$$\begin{aligned}E[\tilde{p}_2|\mathcal{F}_s] &= a\bar{v}_A + (1 - a)(1 - \beta)(\bar{v}_A + \bar{v}_T + \tilde{v}_S - M), \\ E[\tilde{q}_2|\mathcal{F}_s] &= a\bar{v}_T + (1 - a)(M + \beta(\bar{v}_A + \bar{v}_T + \tilde{v}_S - M)).\end{aligned}$$

Substituting the expressions for $\hat{V}_A$, $\hat{V}_T$, $\hat{C}_{AT}$, $E[\tilde{p}_2|\mathcal{F}_s]$, and $E[\tilde{q}_2|\mathcal{F}_s]$ into equation (B.2), we can derive equations (19) and (20).

Comparing equations (19) and (20) with the conjectured price function (9), we can verify our conjecture that both prices reflect the same information content about the synergy, and know that the endogenous price signal $\tilde{s}_p$ must have coefficient $\kappa^{-1} = \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1})$, i.e., $\tilde{s}_p = \tilde{v}_S - \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \tilde{z}$. Other price coefficients can also be derived and are given in equation (22).

If the target chooses not to withdraw the deal (i.e., $a_T = 0$), solving problem (3), the optimal withdrawal decision of the acquirer at $t = 1.5$ has the form in equation (10). Let $\hat{s}_A$ denote the level of $\tilde{s}_p$ such that the acquiring firm's manager is indifferent between completing

and withdrawing the deal if she observes $\tilde{s}_p$, i.e.,

$$E[\tilde{v}_S|\tilde{s}_p = \hat{s}_A] - \frac{\bar{v}_A}{1-\beta} + (\bar{v}_A + \bar{v}_T - M) = 0.$$

Using Bayes' rule, the conditional expectation of $\tilde{v}_S$ can be expressed as

$$E[\tilde{v}_S|\tilde{s}_p = \hat{s}_A] = \frac{\tau_S \bar{v}_S + \tau_p [\hat{s}_A + \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \bar{z}]}{\tau_S + \tau_p},$$

where $\tau_p = [\lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1})]^{-2} \tau_z$. Therefore, the threshold $\hat{s}_A$ satisfies

$$\frac{\tau_S \bar{v}_S + \tau_p [\hat{s}_A + \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1}) \bar{z}]}{\tau_S + \tau_p} - \frac{\bar{v}_A}{1-\beta} + (\bar{v}_A + \bar{v}_T - M) = 0,$$

which yields the expression for $\hat{s}_A$ in equation (23). The expression for $\hat{s}_T$ can be similarly derived. In the main text, we have shown that the deal will be withdrawn if and only if $\tilde{s}_p < \hat{s} \equiv \max\{\hat{s}_A, \hat{s}_T\}$.

Now we verify that individual demands (m_s, n_s, m_h, n_h) satisfying equations (15), (16), (17) and (18) exist and are optimal under the equilibrium prices given by equations (9) and (22). The situation when the deal is withdrawn (i.e., $a = 1$) is trivial. Now we consider the situation in which the deal is continued (i.e., $a = 0$). It can be calculated that under the equilibrium prices, we have $E[\tilde{p}_2|\mathcal{F}_s] - \tilde{p}_1 = (1 - \beta)\kappa^{-1}\tilde{z}$, and $E[\tilde{q}_2|\mathcal{F}_s] - \tilde{q}_1 = \beta\kappa^{-1}\tilde{z}$, where $\kappa^{-1} = \lambda_h \gamma \beta (\tau_A^{-1} + \tau_T^{-1})$. Using these expressions, a speculator's portfolio choice problem (B.1) can be expressed as

$$\max_{m_s, n_s} ((1 - \beta)m_s + \beta n_s) \kappa^{-1} \tilde{z} - \frac{\gamma}{2} (\tau_A^{-1} + \tau_T^{-1}) ((1 - \beta)m_s + \beta n_s)^2.$$

Let $x \equiv (1 - \beta)m_s + \beta n_s$. Then the above problem can be rewritten as

$$\max_x (\kappa^{-1} \tilde{z}) x - \frac{\gamma}{2} (\tau_A^{-1} + \tau_T^{-1}) x^2.$$

It is obvious that the objective function of this problem is concave in x . Therefore, the first-order condition,

$$\kappa^{-1}\tilde{z} - \gamma(\tau_A^{-1} + \tau_T^{-1})x = 0,$$

is not only necessary but also sufficient for optimality. The optimal solution is thus

$$x^* = \frac{\kappa^{-1}\tilde{z}}{\gamma(\tau_A^{-1} + \tau_T^{-1})},$$

so any portfolio (m_s, n_s) that satisfies $(1 - \beta)m_s + \beta n_s = x^*$ is the optimal portfolio for the speculator. Therefore, to prove that a pair (m_s, n_s) satisfying equations (15) and (16) is optimal, it suffices to show that this pair also satisfies $(1 - \beta)m_s + \beta n_s = x^*$. It can be shown that under the equilibrium prices, equation (15) implies

$$m_s = \frac{(1 - \beta)\kappa^{-1}\tilde{z}}{\gamma(1 - \beta)^2(\tau_A^{-1} + \tau_T^{-1})} - \frac{\beta(1 - \beta)(\tau_A^{-1} + \tau_T^{-1})}{(1 - \beta)^2(\tau_A^{-1} + \tau_T^{-1})}n_s,$$

which yields $(1 - \beta)m_s + \beta n_s = x^*$. Equation (16) implies

$$n_s = \frac{\beta\kappa^{-1}\tilde{z}}{\gamma\beta^2(\tau_A^{-1} + \tau_T^{-1})} - \frac{\beta(1 - \beta)(\tau_A^{-1} + \tau_T^{-1})}{\beta^2(\tau_A^{-1} + \tau_T^{-1})}m_s,$$

which also yields $(1 - \beta)m_s + \beta n_s = x^*$. Therefore, under the equilibrium prices, equation (15) and equation (16) are identical, and any (m_s, n_s) satisfying the two equations is an optimal solution to the speculator's problem (6). The optimality of any (m_h, n_h) satisfying equations (17) and (18) can be similarly proved. Note that m_s , n_s , m_h , and n_h cannot be separately determined. □

Proof of Proposition 2

Proof. Conjecture that at $t = 1.5$ the deal is never withdrawn. Then the Nash bargaining problem at $t = 0$ is problem (24).

We first consider the problem without constraints on β and M :

$$\max_{(\beta, M)} (U_A^N - \bar{v}_A)^\delta (U_T^N - \bar{v}_T)^{1-\delta}, \text{ s.t. } U_A^N \geq \bar{v}_A, U_T^N \geq \bar{v}_T, \quad (\text{B.3})$$

where $U_A^N = (1 - \beta)(\bar{v}_A + \bar{v}_T + \bar{v}_S - M)$ and $U_T^N = M + \beta(\bar{v}_A + \bar{v}_T + \bar{v}_S - M)$. Notice that $U_A^N + U_T^N = \bar{v}_A + \bar{v}_T + \bar{v}_S$, so $U_T^N - \bar{v}_T = \bar{v}_S - (U_A^N - \bar{v}_A)$. Therefore, β and M affect the objective function only through U_A^N . Let $x \equiv U_A^N - \bar{v}_A$ and $f(x) \equiv x^\delta (\bar{v}_S - x)^{1-\delta}$. Problem (B.3) can thus be solved with two steps. First, we find the solution x^* to problem $\max_{0 \leq x \leq \bar{v}_S} f(x)$. Second, we find the β^* and M^* that satisfy $U_A^N(\beta^*, M^*) = x^*$.

The first-order condition for problem $\max_{0 \leq x \leq \bar{v}_S} f(x)$ is

$$f'(x) = \delta x^{\delta-1} (\bar{v}_S - x)^{1-\delta} + x^\delta (1 - \delta) (\bar{v}_S - x)^{-\delta} (-1) = 0,$$

whose unique real root is $x^* = \delta \bar{v}_S$. Recall that $\delta \in (0, 1)$, so $x^* \in (0, \bar{v}_S)$. The second-order derivative of f is

$$f''(x) = \delta(\delta - 1)x^{\delta-2}(\bar{v}_S - x)^{-\delta}[\bar{v}_S + x + x^2(\bar{v}_S - x)^{-1}].$$

It is easy to verify that $f''(x^*) < 0$, so $x^* = \delta \bar{v}_S$ is the solution to problem $\max_{0 \leq x \leq \bar{v}_S} f(x)$.

We can see that $U_A^N(\beta, M) = \delta \bar{v}_S$ has infinitely many solutions in $\mathbb{R}^2$. Specifically, it is easy to verify that any $(\beta^*, M^*) \in \mathbb{R}^2$ satisfying equation (25) results in $U_A^N(\beta^*, M^*) = \bar{v}_A + \delta \bar{v}_S > \bar{v}_A$ and $U_T^N(\beta^*, M^*) = \bar{v}_T + (1 - \delta)\bar{v}_S > \bar{v}_T$, so it is a solution to problem (B.3). Notice that equation (25) stipulates a negative relationship between β^* and M^* . When $\beta^* = 0$, equation (25) requires that $M^* = \hat{M} \equiv \bar{v}_T + (1 - \delta)\bar{v}_S$. When $M^* = 0$, equation (25) requires that $\beta^* = \hat{\beta} \equiv [\bar{v}_T + (1 - \delta)\bar{v}_S]/(\bar{v}_A + \bar{v}_T + \bar{v}_S) < 1$.

Denote the feasible set of problem (24) by G and that of problem (B.3) by H . Notice that $G \subseteq H$, and the objective functions of the two problems are the same. Therefore, if some $(\beta^*, M^*) \in G$ is a solution to problem (B.3), then it must be a solution to problem (24).

It can be easily verified that any $(\beta^*, M^*) \in [0, \hat{\beta}] \times [0, \hat{M}]$ satisfying equation (25) is both in G and a solution to problem (B.3) and thus a solution to problem (24).

Recall that an optimal payment scheme (i.e., solution to problem (B.3)) results in a positive expected surplus $\delta \bar{v}_S > 0$ for the acquiring firm and also a positive expected surplus $(1 - \delta) \bar{v}_S > 0$ for the target firm if the deal is completed, so at $t = 1.5$ both firms will choose not to withdraw the deal under the optimal payment scheme. $\square$

Derivations of Equations (26), (27), (29), and (30)

Proof. By equation (1) and the manager's optimal withdrawal decision given in Proposition 1, $U_A \equiv E[\tilde{p}_2]$ can be expressed as

$$E[\tilde{p}_2] = (1 - \beta)(\bar{v}_A + \bar{v}_B - M)(1 - E[\mathbb{I}_{\{\tilde{s}_p < \hat{s}\}}]) + \bar{v}_A E[\mathbb{I}_{\{\tilde{s}_p < \hat{s}\}}] + (1 - \beta)E[\tilde{v}_S \mathbb{I}_{\{\tilde{s}_p \geq \hat{s}\}}]. \quad (\text{B.4})$$

We can calculate that

$$E[\mathbb{I}_{\{\tilde{s}_p < \hat{s}\}}] = \Pr\{\tilde{s}_p < \hat{s}\} = \Phi\left(\frac{\hat{s} - E[\tilde{s}_p]}{\sqrt{\text{Var}[\tilde{s}_p]}}\right) = \Phi\left(\frac{\hat{s} - \bar{v}_S + \kappa^{-1}\bar{z}}{\sqrt{\tau_S^{-1} + \tau_p^{-1}}}\right), \quad (\text{B.5})$$

where $\Phi(\cdot)$ is the cumulative distribution function for a standard normal random variable.

Now for notational convenience, we denote $\tilde{n} \equiv \tilde{s}_p$, $\mu_n \equiv E[\tilde{n}] = \bar{v}_S - \kappa^{-1}\bar{z}$, $\sigma_n^2 \equiv \text{Var}[\tilde{n}] = \tau_S^{-1} + \tau_p^{-1}$, $\sigma_v^2 \equiv \text{Var}[\tilde{v}_S] = \tau_S^{-1}$, and $\rho \equiv \text{Cov}[\tilde{n}, \tilde{v}_S]/(\sigma_v \sigma_n) = \tau_S^{-1}/(\sigma_v \sigma_n)$. Then using the definition of expectation, $E[\tilde{v}_S \mathbb{I}_{\{\tilde{s}_p \geq \hat{s}\}}]$ can be expressed as

$$E[\tilde{v}_S \mathbb{I}_{\{\tilde{s}_p \geq \hat{s}\}}] = \iint_{\mathbb{R}^2} v \mathbb{I}_{\{n \geq \hat{s}\}} h(v, n) dn dv = \int_{-\infty}^{+\infty} v \int_{\hat{s}}^{+\infty} h(v, n) dn dv, \quad (\text{B.6})$$

where $h(v, n)$ is the joint probability density function for $\tilde{v}_S$ and $\tilde{n}$. With the expressions for $h(v, n)$, we have

$$\int_{\hat{s}}^{+\infty} h(v, n) dn = e^{-\frac{1}{2(1-\rho^2)} \frac{(v-\bar{v}_S)^2}{\sigma_v^2}} \int_{\hat{s}}^{+\infty} \frac{1}{2\pi\sigma_v\sigma_n\sqrt{1-\rho^2}} e^{-\frac{1}{2(1-\rho^2)} \left[\frac{(n-\mu_n)^2}{\sigma_n^2} - \frac{2\rho(v-\bar{v}_S)(n-\mu_n)}{\sigma_v\sigma_n} \right]} dn.$$

Notice that

$$\frac{(n - \mu_n)^2}{\sigma_n^2} - \frac{2\rho(v - \bar{v}_S)(n - \mu_n)}{\sigma_v \sigma_n} = \left[\frac{n - \mu_n - \rho\left(\frac{\sigma_n}{\sigma_v}\right)(v - \bar{v}_S)}{\sigma_n} \right]^2 - \left[\frac{\rho(v - \bar{v}_S)}{\sigma_v} \right]^2.$$

Using this expression, we have

$$\int_{\hat{s}}^{+\infty} h(v, n) dn = \frac{1}{\sqrt{2\pi}\sigma_v} e^{-\frac{(v - \bar{v}_S)^2}{2\sigma_v^2}} \int_{\hat{s}}^{+\infty} \frac{1}{\sqrt{2\pi}\sqrt{1 - \rho^2}\sigma_n} e^{-\frac{[n - \mu_n - \rho(\sigma_n/\sigma_v)(v - \bar{v}_S)]^2}{2[\sqrt{1 - \rho^2}\sigma_n]^2}} dn.$$

Notice that

$$\int_{\hat{s}}^{+\infty} \frac{1}{\sqrt{2\pi}\sqrt{1 - \rho^2}\sigma_n} e^{-\frac{[n - \mu_n - \rho(\sigma_n/\sigma_v)(v - \bar{v}_S)]^2}{2[\sqrt{1 - \rho^2}\sigma_n]^2}} dn = 1 - \Phi\left(\frac{\hat{s} - \mu_n - \rho\left(\frac{\sigma_n}{\sigma_v}\right)(v - \bar{v}_S)}{\sigma_n\sqrt{1 - \rho^2}}\right),$$

and $\rho\left(\frac{\sigma_n}{\sigma_v}\right) = 1$, $\sigma_n\sqrt{1 - \rho^2} = \sqrt{\tau_p^{-1}}$. Therefore, we have

$$\int_{\hat{s}}^{+\infty} h(v, n) dn = \frac{1}{\sqrt{2\pi}\sigma_v} e^{-\frac{(v - \bar{v}_S)^2}{2\sigma_v^2}} [1 - \Phi(\sqrt{\tau_p}(\hat{s} + \kappa^{-1}\bar{z} - v))].$$

Substituting the above expression into equation (B.6), we finally have

$$\begin{aligned} E[\tilde{v}_S \mathbb{I}_{\{\tilde{s}_p \geq \hat{s}\}}] &= \int_{-\infty}^{+\infty} \frac{v}{\sqrt{2\pi}\sigma_v} e^{-\frac{(v - \bar{v}_S)^2}{2\sigma_v^2}} [1 - \Phi(\sqrt{\tau_p}(\hat{s} + \kappa^{-1}\bar{z} - v))] dv \\ &= \bar{v}_S - \int_{-\infty}^{+\infty} \frac{v}{\sqrt{2\pi}\sigma_v} e^{-\frac{(v - \bar{v}_S)^2}{2\sigma_v^2}} \Phi(\sqrt{\tau_p}(\hat{s} + \kappa^{-1}\bar{z} - v)) dv. \end{aligned} \tag{B.7}$$

Combining equations (B.7), (B.5), and (B.4) yields equation (26). The derivation of equation (27) is similar.

Now we prove equation (29). Let $1 - \tilde{a} = \mathbb{I}_{\{\tilde{s}_p \geq \hat{s}\}}$. Then equation (B.4) can be rewritten as

$$U_A = (1 - \beta)(\bar{v}_A + \bar{v}_B - M)(1 - E[\tilde{a}]) + \bar{v}_A E[\tilde{a}] + (1 - \beta)E[(1 - \tilde{a})\tilde{v}_S].$$

Notice that $E[(1 - \tilde{a})\tilde{v}_S] = Cov[\tilde{v}_S, 1 - \tilde{a}] + E[1 - \tilde{a}]E[\tilde{v}_S]$, and denote $\bar{a} = E[\tilde{a}]$. Then we

have

$$U_A = (1 - \beta)(\bar{v}_A + \bar{v}_B - M)(1 - \bar{a}) + \bar{a}\bar{v}_A + (1 - \beta)\text{Cov}[\tilde{v}_S, 1 - \tilde{a}] + (1 - \beta)(1 - \bar{a})\bar{v}_S.$$

Subtracting $\bar{v}_A$ from both sides of the above equation and collecting terms, we can derive equation (29). Equation (30) can be similarly derived. Moreover, the covariance between $\tilde{v}_S$ and $1 - \tilde{a}$ can be expressed as

$$\text{Cov}[\tilde{v}_S, 1 - \tilde{a}] = - \int_{-\infty}^{+\infty} \frac{v}{\sqrt{2\pi}\sigma_v} e^{-\frac{(v-\bar{v}_S)^2}{2\sigma_v^2}} \Phi\left(\frac{\hat{s} + \kappa^{-1}\bar{z} - v}{\sqrt{\tau_p^{-1}}}\right) dv + \bar{v}_S \Phi\left(\frac{\hat{s} - \bar{v}_S + \kappa^{-1}\bar{z}}{\sqrt{\tau_S^{-1} + \tau_p^{-1}}}\right).$$

□