Disclosing Share Repurchases More Frequently?*

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Abstract

Corporate signaling theory posits that firms voluntarily disclose share repurchases to signal undervaluation and typically favor frequent disclosure. Yet, a recent SEC proposal mandating daily disclosures elicited significant opposition through litigation by firms. This paper models a firm as an informed trader aiming to maximize long-term per-share value through repurchases. More frequent disclosure reduces information asymmetry, thereby lowering the marginal cost of repurchases and encouraging the firm to buy more shares; however, firms oppose the policy because it also increases the average repurchase price and lowers information advantage. Empirically, we leverage the 2004 Rule 10b-18 amendment mandating quarterly disclosure as an exogenous shock. All U.S. domestic firms are in the treatment group; British and Canadian cross-listed firms serve as the control group since they had been disclosing share repurchases daily and monthly before 2004, respectively. We demonstrate that, relative to the cross-listed U.K./Canada firms, increased disclosure frequency reduces price impact by 6.8 basis points, raises average repurchase prices by 6.78%, decreases earnings announcement cumulative abnormal returns by 0.743%, and leads U.S. domestic firms to increase repurchase volume by 0.299% of total assets. These findings highlight a trade-off for policymakers: more frequent disclosure improves price efficiency but incentivizes more share repurchase.

Keywords: Payout Policy, Share Repurchase, Disclosure, Regulation and Market Efficiency, Information Asymmetry

JEL Codes: G14, G30, G35

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1 Introduction

Exponential growth in share repurchase has raised concern among regulators.[1] In 2023, the U.S. Securities and Exchange Commission (SEC) proposed increasing the disclosure frequency for share repurchases by public firms from quarterly to daily. However, this proposal met strong opposition from listed companies and triggered litigation from the U.S. Chamber of Commerce, ultimately leading to its reversal by the Fifth Circuit Court of Appeals.[2] The court cited "the SEC was unable to quantity most of the economic effects of the proposed amendments." This confrontation between the regulatory objectives and the firms raises two important questions. First, could more frequent disclosure effectively moderate the escalating share repurchase trend? Second, while signaling theory suggests that firms voluntarily disclose share repurchases to signal undervaluation (Vermaelen, 1981) or to indicate improved corporate governance by reducing free cash flow (Jensen, 1986), why do firms oppose more frequent disclosure in practice?

We provide both theoretical and empirical answers to these two questions. Theoretically, we show that more frequent disclosure decreases the marginal cost of share repurchases, inducing firms to purchase more shares; yet firms oppose it because it also raises total costs. We reveal these insights by modeling a firm as an informed trader about its future cash flow, engaging in share repurchases to maximize long-term share value.[3] The firm trades with liquidity traders and competitive market makers. Liquidity traders sell shares to meet exogenous liquidity needs, while market makers can only observe the aggregate order flow rather than distinguishing between orders from the firm and liquidity traders. Therefore, information asymmetry creates a price impact whereby a higher buying volume leads market makers to infer a higher value for the firm, thus driving up the price. As a result, the firm optimally

[1] Share repurchase reaches a record high of $1.1 trillion in 2025.

[2] See The U.S. Court of Appeal, case 23-60255 here.

[3] Brav et al. (2005) reports survey evidence indicating that many managers consider their firm's stock price—specifically, whether the shares are undervalued relative to intrinsic value—an important determinant of repurchase decisions. Consistent with this view, Dittmar (2000), Allen and Michaely (2003), and Bonaimé and Kahle (2024) survey empirical evidence showing that repurchasing shares at undervaluation is a primary motive for share repurchases. Complementing the empirical literature, Bond and Zhong (2016) develops a theoretical model in which privately informed firms issue shares when they are overvalued and repurchase them when they are undervalued.

repurchases small quantities to blend with liquidity sellers, lowering the aggregate order flow and the repurchase price. More frequent disclosure of share repurchases reduces the firm's ability to hide behind the liquidity traders and thereby reveals more information about the firm's intrinsic value. Consequently, the disclosure causes a price jump that raises the overall repurchase price, leaving the firm worse off compared to less frequent disclosure. However, the disclosure also reduces information asymmetry and the price impact for future trading. Thus, the marginal cost of purchasing additional shares falls, incentivizing the firm to buy a larger amount afterward. In summary, our model predicts that more frequent disclosure 1) reduces price impact, 2) boosts repurchase volume, and 3) increases the repurchase price.

Although the court revoked the daily repurchase regulation, we are able to test our model prediction and shed light on the current policy debate using the previous shock on disclosure frequency. In 2004, the SEC amended Rule 10b-18, mandating U.S.-listed firms to disclose average repurchase prices and quantities quarterly. This policy shock, however, does not affect Canadian and British firms cross-listed in the U.S. because they are subject to both U.S. and their home countries' regulations. A UK (Canada) firm has already disclosed its share repurchases on a daily (monthly) basis since 1981 (1989), regardless of whether the repurchase occurs in its home country or in the U.S. market. Therefore, we use Canadian/British–U.S. cross-listed firms as the control group for this policy shock, whereas a matched sample of U.S. domestic firms constitutes the treatment group.

Following this amendment, we observe U.S. domestic firms experiencing a significant decline in price impact compared to UK/Canada cross-listed firms. Specifically, Kyle's Lambda decreases by 4.5 basis points, representing 21.02% of its pre-reform level. Similarly, the five-minute percentage price impact, defined as the change in the five-minute mid-quote price relative to the current mid-quote price, falls by 6.8 basis points, corresponding to 13.33% of pre-shock levels. Collectively, these findings suggest a reduction in information asymmetry in stock prices.

Increased disclosure frequency also prompts firms to raise their repurchase payouts. Quarterly repurchase dollar volume increases by 0.299% of total asset, translating into an average quarterly increase of approximately \$2.25 million per firm. In terms of quantity, treatment firms repurchase 0.218% more of their total outstanding shares quarterly, a 90.8% increase compared to pre-shock averages. We also document a statistically significant shift in payout structures, with U.S. domestic firms increasingly favoring share repurchase over dividend following enhanced disclosure requirements.

Figure 1 plots the comparison of average repurchase payouts between treatment and control firms. Prior to 2004, repurchase payouts for both groups fluctuate around similar average levels. However, after the introduction of more frequent disclosure, U.S. domestic firms substantially increase their repurchase payouts compared to control firms, and this divergence persists in subsequent periods.

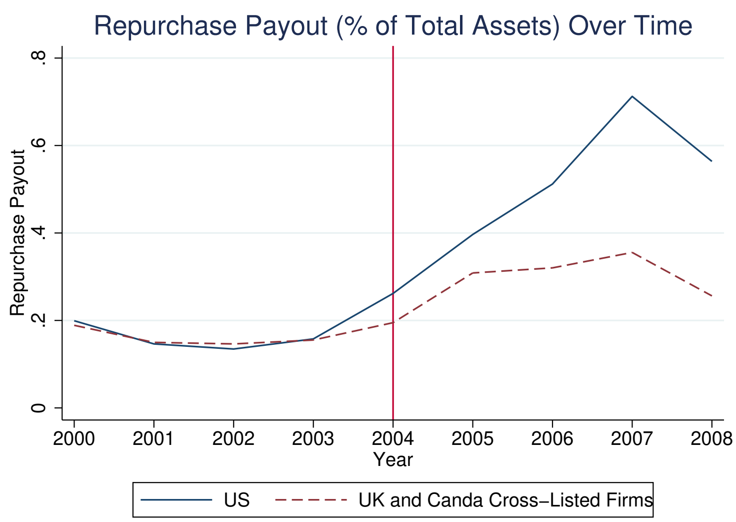

Figure 1: Time-Series of Share Repurchase between Treatment and Control Firms

This figure shows the simple average in annual repurchase dollar volume to total asset values in previous quarter between the treatment firms (U.S. firms) and control firms (UK/Canada-U.S. cross-listed firms).

To test the effect of more frequent disclosure on repurchase price, we first measure the relative repurchase prices as the quarterly average closing prices. We find that relative to control firms, treatment firms face a 6.79% increase in the relative repurchase prices. We further analyze the cumulative abnormal returns (CAR) around earnings announcements. The intuition is that more frequent disclosure allows investors to better anticipate firm earnings, causing earlier price jumps before earnings announcement and thereby reducing the earnings surprise at the announcement date. Each quarter, we calculate the three-day CAR for U.S. domestic firms and UK/Canada-US cross-listed firms. Empirically, we find that U.S. domestic firms experience a significant decline of 0.688% in their three-day CAR around quarterly earnings announcements following increased disclosure frequency. This effect is even stronger among firms reporting positive earnings, where the CAR decreases by 0.992%. Collectively, our findings suggest that the observed increase in repurchase dollar volume is driven by both higher repurchase prices and a greater number of shares repurchased.

This paper contributes to the market microstructure literature by modeling firms themselves as informed traders in the open market. Given their inherent informational advantage about their own operations and prospects, firms naturally qualify as informed traders in their stocks. Distinct from standard frameworks, in which informed traders' profits do not influence underlying firm value (e.g., Kyle, 1985; Glosten and Milgrom, 1985), the trading and disclosure decisions made by firms directly affect their intrinsic valuation for remaining shareholders. This direct impact complicates the derivations of rational expectation equilibrium: market makers must now infer the asset's expected value by accounting not only for the distribution of future operational cash flows but also for the firm's potential trading gains. Consequently, the firm's best response becomes nonlinear in its private signal, thereby invalidating the convenient additivity properties derived from assuming normally distributed asset values. We use a simple model to resolve this problem.

Modeling a firm as informed trader, we also contributes to the corporate finance literature by providing a new perspective of how information asymmetry affects payout policy. Seminal work by Miller and Modigliani (1961) shows that in the absence of information asymmetry, payout policy is irrelevant to a firm's value. Existing studies incorporating information asymmetry into share repurchase suggest that firms repurchase shares to signal undervaluation (Vermaelen, 1981; Ofer and Thakor, 1987) or to enhance corporate governance by reducing free cash flow (Jensen, 1986). However, empirical evidence supporting these theories remains limited (Farre-Mensa et al., 2014; Bonaimé and Kahle, 2024). Furthermore, both signaling and free cash flow channels imply voluntary disclosure, but firms rarely disclose more about share repurchase than what regulations ask. Firms have even collectively contested daily disclosure requirements through litigation against the SEC.[4] Our paper rationalizes this puzzle: firms repurchase their shares at undervalued prices to enhance long-term shareholder value. In this framework, more frequent, mandatory ex-post disclosure of repurchase activities diminishes firms' informational advantage, thereby explaining their resistance to such disclosure.

One important line of research in behavioral corporate finance studies how managers lower the overall cost of capital for ongoing investors by issuing overpriced securities and repurchasing underpriced ones (e.g., Baker and Wurgler, 2002). However, theoretical models in this literature, such as Stein et al. (1996), typically assume an exogenous price impact to prevent managers from buying back the entire firm when it is undervalued. We contribute to the literature by endogenizing such price impact and showing how this price impact affects corporate decisions. We show firms buy undervalued stocks, but the endogenous price impact prevents them from buying a large amount. Disclosure reduces the endogenous price impact, thereby increasing share repurchases.

The paper proceeds as follows. Section 2 provides the theoretical framework modeling a firm as informed trader and corresponding empirical predictions. Section 3 presents our empirical strategy including the institutional background, data source, and identification methods. Section 4 reports our empirical results that verify our model predictions and a battery of placebo tests. Section 5 concludes the paper.

2 Theory and Empirical Predictions

This section first establishes the trading game in which a firm's privately informed manager is trading with competitive market makers and liquidity liquidity traders. We derive two equilibria under less and more frequent disclosures and compare equilibrium outcomes. This comparison yields three testable empirical predictions. All proofs are designated to the

[4] Although EPS manipulation (e.g., Kahle, 2002; Almeida et al., 2016) may help explain firms' resistance to more frequent disclosure, this channel offers no explicit predictions about how disclosure frequency affects repurchase volume, repurchase price, or the degree of information asymmetry—patterns we document in this paper.

Appendix C.

2.1 Trading Game

Times and Traders. The economy unfolds over four dates $t \in \{0, 1, 2, 3\}$. Participants comprise an informed manager of an all-equity firm, liquidity traders, and competitive market makers. The firm owns a risky project that will ultimately pay a cash flow $A \in \{A_H, A_L\}$. At $t = 0$, nature draws A_H or A_L with equal probability 1/2 and privately reveals the realization to the manager, granting the manager an informational advantage over outside investors. For convenience, we set $A_H = 1$ and $A_L = 0$, so a positive realization represents an "earnings surprise." The firm has normalized one share outstanding. Trading in the firm's stock takes place in two rounds, at $t = 1$ and $t = 2$. At $t = 3$, the cash flow from the project is publicly disclosed in the financial report, the firm liquidates by paying remaining cash as dividends, and trading ceases. Intertemporal discount rate is zero.

Trading. In each round the firm could repurchase $q_t = 0$ (no repurchase), x (small), or $2x$ (large) shares. We also pose a regulatory assumption that $x \in (0, \frac{1}{4})$ to ensure the remaining share outstanding is strictly positive after buying $2x$ in both periods. Liquidity traders facing exogenous liquidity shocks, submit a net order $u_t \in \{-x, 0\}$ with equal probability 1/2.[5] Hence x can be interpreted as the scale of noise-trading volume.[6] Market makers observe only the aggregate order flow $z_t = q_t + u_t$ and, given the history up to t, set the price equal to the expected fundamental value of the firm. Figure 2 summarizes the information structure.

Disclosure Structures. We consider two disclosure structures: (1) a less frequent disclosure: the firm only discloses the share repurchase price and quantity at $t = 3$ along with the financial reports, which resembles the SEC's current quarterly share repurchase disclosure in the 10-Q file; (2) a more frequent disclosure: the firm discloses the share repurchase price

[5] Allowing liquidity traders to buy or sell a different amount leaves all insights unchanged but complicating states.

[6] An alternative interpretation for liquidity traders is that they are investors who disagree with the manager's investment decisions (Huang and Thakor, 2013).

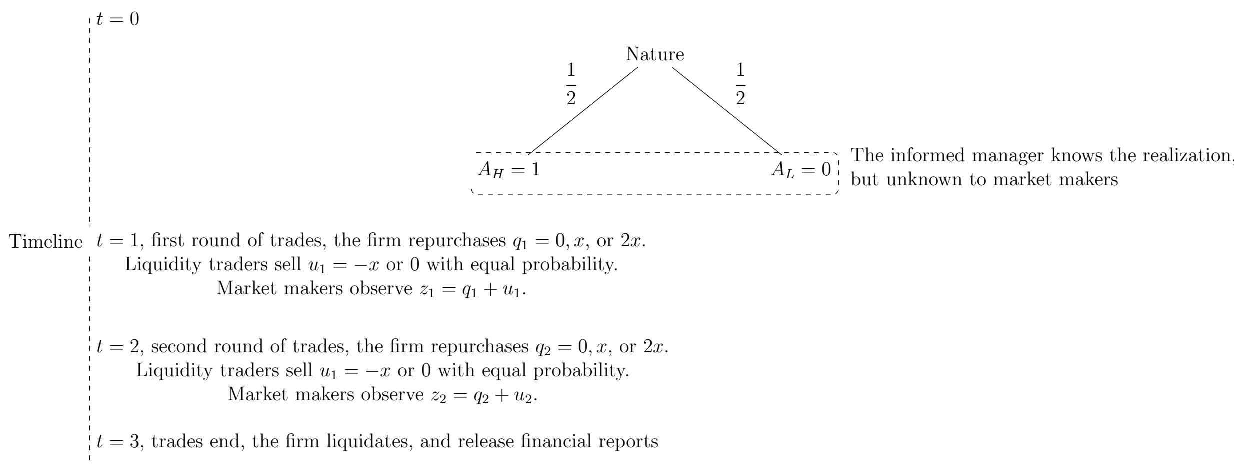

Figure 2: The Information Structure

and quantity at the end of $t = 1$ and at $t = 3$, which captures the idea of a more frequent share repurchase disclosure in the SEC's proposed rule.

The Manager's Objective. The objective of the manager is to maximize the firm value for remaining shareholders at time $t = 3$, based on her private signal $\mathbf{s}$. Denoting q_t as the shares repurchased at time t with price p_t, we could express the firm's objective function as follows mathematically:

$$\max_{q_1, q_2 \in \{0, x, 2x\}} \mathbf{E}\left[V_3\left(q_1, q_2\right)\right] = \frac{\overbrace{A}^{\text{cash flow}} - \overbrace{\left(p_1 q_1 + p_2 q_2\right)}^{\text{Cash Spent on Repurchase}}}{\underbrace{1 - \left(q_1 + q_2\right)}_{\text{Reduction in Outstanding Shares}}} \tag{2.1}$$

Equation 2.1 is consistent with the idea that the informed manager maximizes long-term value for passive shareholders, an approach that shares similar intuition with Myers and Majluf (1984); Bond and Zhong (2016). Another interpretation is that the manager owns stock in the firm and therefore maximizing the long-term stock price is incentive compatible for her.[7] Repurchasing undervalued stocks in the open market increases the share value for remaining shareholders. Because the firm's terminal value also depends

[7] Since the manager's incentives are fully aligned with long-term value maximization, we refer to the decision-maker as the firm for the remainder of the analysis.

on shares repurchased, its optimal strategy is no longer linear in its private signal A, unlike in standard trading models. Similarly, market makers' pricing rule is also not linear because price includes the expectation of the firm's operational cash flow A and the repurchased quantity. Therefore, the workhorse model of Rational Expectations Equilibrium, the linear-normal framework, no longer works for our model. We resolve this problem by discretizing q_t, A, and u_t. To accommodate additional motives for share repurchases, we assume the firm prefers share repurchases over cash dividends and randomizes the repurchase quantity (with a probability of $\rho \in (0,1)$ on repurchasing x and $1-\rho$ on repurchasing $2x$) in situations where payout policy is irrelevant to long-term value.[8]

Market Efficiency. Competitive market makers set the price as the expected values of terminal share price, conditional on the trading histories $\mathcal{Z}_t$ and the disclosure structure $\mathbf{D}$. In the following sections, we consider two disclosure structures: less frequent and more frequent disclosure. Specifically,

$$\begin{aligned}
p_1 &= \mathbf{E}[V_3|z_1] \quad \text{Under less frequent disclosure} \\
p_2 &= \mathbf{E}[V_3|z_2, z_1] \quad \text{Under less frequent disclosure} \\
p_1 &= \mathbf{E}[V_3|z_1] \quad \text{Under more frequent disclosure} \\
p_2 &= \mathbf{E}[V_3|z_2, z_1, \boldsymbol{q_1}] \quad \text{Under more frequent disclosure}
\end{aligned} \tag{2.2}$$

where $\boldsymbol{q_1}$ indicates the disclosed trading quantity by the firm under more frequent disclosure.

2.2 Equilibrium

We solve the model as a Rational Expectations Equilibrium (REE) à la Grossman and Stiglitz (1980). First, characterized by equation 2.2, competitive market makers set the price as the conditional expectation of the firm's value at time $t=3$ given the firm's optimal strategy.

[8]Repurchases offer lower commitment than dividends (Allen and Michaely, 2003), tax advantages (Jacob and Jacob, 2013), leverage adjustment (Hovakimian et al., 2001), mitigation of option-related dilution (Kahle, 2002), a vehicle for distributing excess cash (Grullon and Michaely, 2002), and many other benefits to firms. This assumption also helps us pin down a unique equilibrium.

Second, the firm maximizes its expected value at time $t = 3$ as in equation (2.1) given the market makers' pricing rules. We derive separate REE solutions for less and more frequent disclosure regimes and compare them to generate empirical predictions.

Intuitively, to avoid full revelation of its private information, the firm would not repurchase a large fraction of shares in the first trading round under either disclosure structures. Under less frequent disclosure, it will continue to repurchase small to conceal its identity in the second period. Under more frequent disclosure, however, it will repurchase large in the second trading round because its private information is revealed through the disclosure and marginal cost of repurchasing share is reduced to zero.[9] We discuss two equilibria in following sections.

2.2.1 Equilibrium under less Frequent Disclosure

Under less frequent disclosure, the firm only discloses its share repurchase activities along with the announcement of realized cash flow at time $t = 3$. Market makers do not know the firm's submitted orders when setting prices. This information structure reflects current share repurchase regulations, where firms report repurchases only in their quarterly 10-Q filings. We first derive the equilibrium under less frequent disclosure in the following proposition.

Proposition 1 (Equilibrium under less Frequent Disclosure) *The equilibrium under less frequent disclosure consists of market makers' pricing rules in both periods and the informed manager's best strategy.*

[9] Our stylized model simplifies the price impact after disclosure to zero. A more complex information structure with multiple states can have non-zero price impact after disclosure. But the insight stays the same: more frequent disclosure reduces information asymmetry in firm's value, thus lowering price impact.

1. *Market makers' pricing rules:*

$$p_1 = E[V_3|z_1] = \begin{cases} 0 & z_1 = -x \\ \dfrac{1}{2-x} & z_1 = 0 \\ 1 & z_1 = x \\ 1 & z_1 = 2x \end{cases}$$

$$p_2 = \mathbf{E}[V_3|z_1, z_2] = \begin{array}{c|cccc} & & z_1 & & \\ z_2 & -x & 0 & x & 2x \\ \hline -x & 0 & 0 & 1 & 1 \\ 0 & \dfrac{1}{2-x} & \dfrac{1-p_1(0)\,x}{2-3x} & 1 & 1 \\ x & 1 & \dfrac{1-p_1(0)\,x}{1-x} & 1 & 1 \\ 2x & 1 & \dfrac{1-p_1(0)\,x}{1-x} & 1 & 1 \end{array}$$

where z_1 and z_2 are the aggregate order flows observed by the market makers at $t = 1, 2$.

2. *The firm's best strategy:*

   (a) *If $A = A_H$, repurchases $q_1 = x$ from the market at $t = 1$;*

      i. *If $z_1 = 0$, repurchases $q_2 = x$ from the market at $t = 2$;*

      ii. *If $z_1 = x$, repurchases x with probability $\rho \in (0, 1)$ and $2x$ with probability $1 - \rho$, yielding an expected repurchase amount of $\mathbf{E}[q_2|z_1] = (2 - \rho)x$ at $t = 2$.*

   (b) *If $A = A_L$, does not repurchase.*

Proof: See Appendix C.

Intuitively, when market makers see zero aggregate order flow in the first trading round, they cannot determine whether the firm has submitted any orders nor infer the realization of cash flow. If the aggregate flow observed is x or $2x$ in the first round, market makers can infer that the firm has the high cash flow. Therefore, this is a "credible threat" to the firm in the equilibrium that prevents it repurchasing a large fraction of shares in the first trading round. In sum, there is the only non-trivial state in which the first-period aggregate order flow is zero ($z_1 = 0$) and the firm can mix itself with liquidity traders.

Note that, the denominator of $p_1(0) = \frac{1}{2-x}$ reflects market makers' adjustment of share repurchase affecting outstanding shares, hence the per-share value. Repurchasing x shares reduces the share outstanding to $1 - x$, and the firm's value becomes $\frac{1-p_1(0)x}{1-x}$. Since market makers cannot distinguish if the firm buys back shares, they set the price as $p_1(0) = \frac{1}{2}\frac{1-p_1(0)x}{1-x} + \frac{1}{2} \cdot 0$ given their prior beliefs on the distribution of $A = \{0, 1\}$ with equal probability. Thus, our framework nests the classic informed trading model, in which the informed trader is an outsider, as a special case: when we shut down share repurchase by setting $x = 0$, the first-period price collapses to $p_1(0) = \frac{1}{2}$.

Market makers then set prices as the expected repurchase-adjusted value per share, conditional on observed order flows. In the second period, they incorporate both past and current order flows when setting prices. For illustration, Figure 3 shows the pricing rules at $t = 1$ and $t = 2$ when $z_1 = 0$ as this is the only non-trivial state. The upward-sloping pricing functions indicate adverse selection risk, as the higher observed quantities suggest a higher likelihood of informed trading, leading to higher prices. Furthermore, second-period prices are higher than those in the first period, reflecting the adjustment made by the market makers as they consider the effects of share repurchases on the firm's value.

We now discuss the firm's best strategy given these pricing rules. Intuitively, when there is no disclosure after the first trading round, the firm prefers a small repurchase to conceal its identity under $A = A_H$. If it repurchases x shares in the first period, there is a half chance that its trade will be pooled with those of liquidity traders, resulting in an aggregate order flow of zero. In this situation, market makers set the price lower than the firm's share value, allowing the firm to benefit remaining shareholders through the repurchase. By contrast, if the firm repurchases $2x$ shares in the first period, it will reveal its identity to market makers with certainty, prompting them to set a price that renders the share repurchase unprofitable.

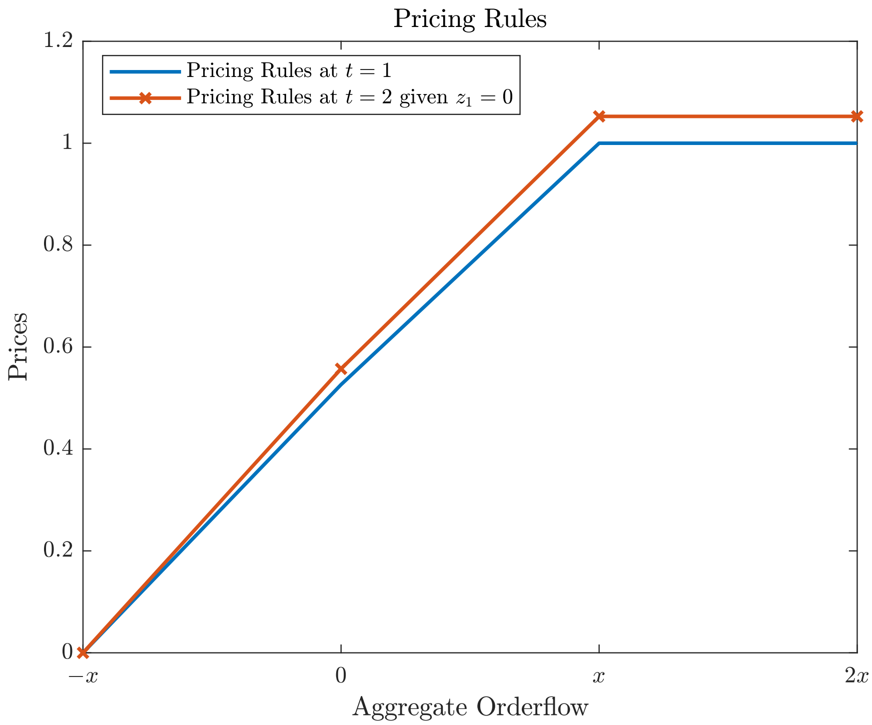

Figure 3: Pricing Rules at $t = 1$ and $t = 2$ given $z_1 = 0$. We choose $x = 0.1$.

Lastly, if the firm does not repurchase in the first period, it would lose the opportunity of increasing the share value, which is suboptimal.

If the aggregate order flow at $t = 1$ is zero ($z_1 = 0$), market makers cannot distinguish whether there was informed trading and therefore retain their prior beliefs about the distribution of firm's future cash flow. In this case, a small repurchase strictly dominates a large one because the firm can again conceal her identity and earn profits again in the second trading round. However, if the market makers observe an aggregate order flow of x at $t = 1$, they infer the presence of informed trading and update their beliefs about the firm's future cash flow. Consequently, the information asymmetry disappears and the price impact reduces to zero. In response, the firm repurchases a lager amount.

2.2.2 Equilibrium under more Frequent Disclosure

We now consider the equilibrium in which the firm discloses its share repurchase quantity after the first trading round. This structure reflects a more frequent disclosure of share repurchase, as in the SEC's proposed rules. In the first period, the pricing rules are the same as in the case of non-disclosure. In the second period, the market makers would update their beliefs about the firm's future cash flow based on the disclosed information. Intuitively, if the firm disclosed its first-round trading quantity as x, the market makers would infer that the cash flow is A_H. Thus, more frequent disclosure reduces the information asymmetry between the firm and market makers. Given the change in these pricing rules, the firm also changes its best strategy. We summarize the equilibrium under more frequent disclosure in the following proposition.

Proposition 2 (Equilibrium under more Frequent Disclosure) *The equilibrium under more frequent disclosure consists of market makers' pricing rules in both periods and the firm's best strategy.*

1. *Market makers' pricing rules:*

$$p_1 = \mathbf{E}[V_3|z_1] = \begin{cases} 0 & z_1 = -x \\ \dfrac{1}{2-x} & z_1 = 0 \\ 1 & z_1 = x \\ 1 & z_1 = 2x \end{cases}$$

$p_2 = E[V_3|z_1, z_2, q_1] =$

Disclosure	$\boldsymbol{q_1 = 0}$		$\boldsymbol{q_1 = x}$		$\boldsymbol{q_1 = 2x}$	
$z_2 \backslash z_1$	$-x$	0	0	x	x	$2x$
$-x$	0	0	$\frac{1-p_1(0)x}{1-x}$	1	1	1
0	$\frac{1}{2-x}$	$\frac{1}{2-x}$	$\frac{1-p_1(0)x}{1-x}$	1	1	1
x	1	1	$\frac{1-p_1(0)x}{1-x}$	1	1	1
$2x$	1	1	$\frac{1-p_1(0)x}{1-x}$	1	1	1

where z_1, and z_2 are the aggregate order flows observed by the market makers at $t = 1, 2$ and q_1 the disclosed amount of repurchased shares in the first round.

2. *The firm's best strategy:*

   (a) *If $A = A_H$, repurchases $q_1 = x$ at $t = 1$. At $t = 2$, repurchases x with probability $\rho \in (0, 1)$ and $2x$ with probability $1 - \rho$, yielding an expected repurchase amount of $\mathbf{E}[q_2] = (2 - \rho)x$ at $t = 2$, regardless of the first-period aggregate order flow z_1.*

   (b) *If $A = A_L$: does not repurchase.*

Proof: See Appendix C.

Compared with the pricing rules in Proposition 1, those in Proposition 2 show that more frequent disclosure diminishes information asymmetry about the firm's cash flow and its value. When the first-period aggregate order flow is zero, disclosing the informed-trading quantity fully reveals the firm's private information. Market makers can then infer the realized cash flow and the firm's value, producing a price jump in the second period. Anticipating this repricing, the manager changes its trading strategy.

Comparing to the manager's best strategy under less frequent disclosure, the firm ends up repurchasing larger quantity under more frequent disclosure.[10] When the aggregate order flow is zero in the first period, disclosure still reveals the firm's private information. In our model, disclosure eliminates information asymmetry and the price impact of share repurchase is reduced to zero. This result shares the same intuition with Miller and Modigliani (1961) as when there were no information asymmetry, share repurchase would not affect stock price. Since the price impact measures the marginal cost of share repurchase, the reduction in marginal cost induces the firm to repurchase more. However, the firm still dislikes a more frequent disclosure because it has to pay a higher repurchase price, which results in a lower final share value.

2.3 Empirical Predictions

Now, we compare the equilibrium outcomes specified in Propositions 1 and 2. We crystallize three empirical predictions regarding how the more frequent disclosure affects price impact, repurchase price, and repurchase volume.

2.3.1 Price Impact

The first prediction is about price impact. After making a more frequent disclosure, the price impact of the firm's stock reduces along with the reduction in information asymmetry. We can easily derive this result by comparing the pricing rules in Propositions 1 and 2.

[10]Not repurchasing in the first period and then repurchasing x in the second period also gives firm the same value. However, it will end up repurchase x shares, less than this case of $x + bx + (1-b)2x = (3-b)x$ shares. As we have assumed, the firm would prefer share repurchase over cash dividend when payout policy is irrelevant to the firm's value. Another way to rule out this strategy is to assume an non-zero intertemporal discount rate, which does not affect the main results but complicates the model.

Prediction 1 *Disclosing share repurchases more frequently activities decreases the stock's price impact.*

We illustrate Prediction 1 in Figure 4. We plot the second-period pricing rules given first-period aggregate order flow is zero ($z_1 = 0$). It is of interest because when z_1 is x or $2x$, market makers can infer the firm's cash flow even without disclosure. The blue solid line is the pricing rules in the second period under less frequent disclosure, and the red line with the cross mark is the pricing rules under more frequent disclosure given the firm disclosed its trading quantity as $q_1 = x$ and $z_1 = 0$. After the disclosure, the price "jumps" and the price impact of repurchasing large becomes zero. In other words, the expected price impact from repurchasing small to larger shares ($\frac{1}{2}\left[p_2(x) + p_2(2x)\right] - \frac{1}{2}\left[p_2(0) + p_2(x)\right]$) decreases.

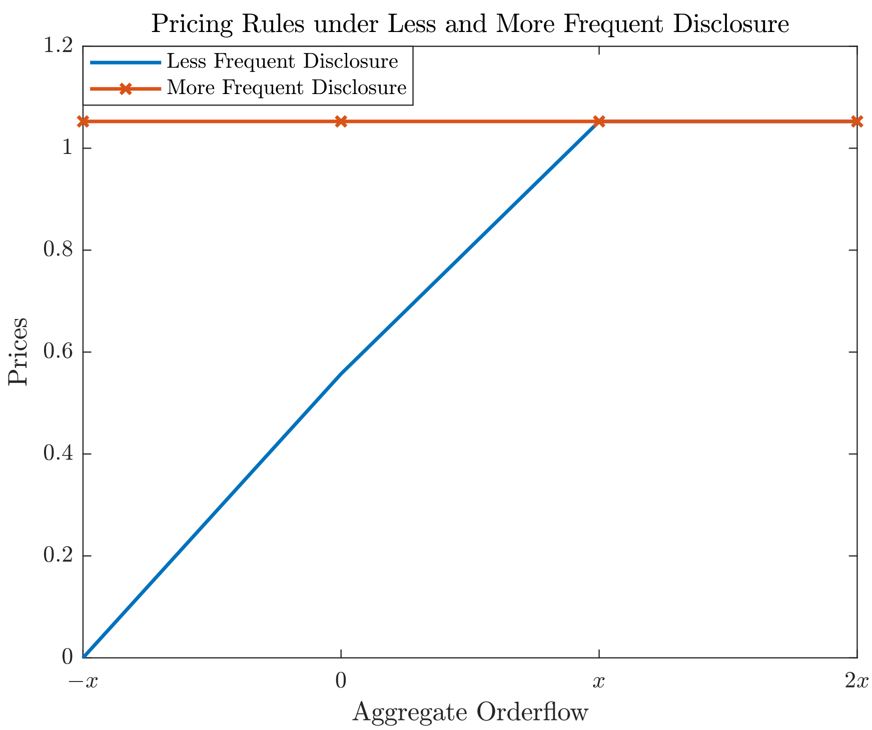

Figure 4: Equilibrium Pricing Rule at $t = 2$ Given $z_1 = 0$ (and $q_1 = x$) under less (more) Frequent Disclosure. We take $x = 0.1$.

2.3.2 Repurchase Price

The next prediction is that, under more frequent disclosure, the firm faces a higher repurchase price, as also reflected in the price jump shown in Figure 4. This mechanism provides a rational explanation for why firms may oppose more frequent disclosure requirements. We summarize this prediction as follows.

Prediction 2 *Disclosing share repurchase activities more frequently increases the average share repurchase price and thus lowers the abnormal return around earnings announcement.*

The intuition is that the disclosure of share repurchase reveals the cash flow ($A = A_H$), first-period cash spent on repurchase ($x \cdot p_1(z_1)$), and the reduction in share outstanding ($1 - x$). Market makers therefore adjust the price upward to reflect the increased termination value resulting from first-period repurchases, as the price jumps in Figure 4. For instance, if the firm disclosed its first-period trading quantity as $q_1 = x$ and the second-period aggregate order flow is $z_2 = x$, market makers would infer $A = 1$ and set the price by solving $p_2(x) = \frac{1-p_1(z_1)x-p_2(x)\cdot 2x}{1-3x} > 1$. Therefore, the firm opposes more frequent disclosure because it is worse off under the higher second-period repurchase price. Figure 5 intuitively shows the time $t = 3$ expected per-share value under less and more frequent disclosure in dashed red and solid black lines, respectively. Under more frequent disclosure, the expected per-share value is strictly lower than the less frequent disclosure situation. Note that if $x > 0$, the terminal share value at $t = 3$ exceeds $A_H = 1$ because the firm can still buy back a small number of undervalued shares in the first period, thereby raising the value of the remaining shares. Finally, if the liquidity traders sell more shares as the x increases, the firm can repurchase more undervalued shares, thus increasing the terminal share value and producing the upward-sloping curves.

Furthermore, under more frequent disclosure, firms experience lower abnormal returns around earnings announcements. The intuition is that under more frequent disclosure, a previous price jump prior to the earnings announcement reflects the good news about future

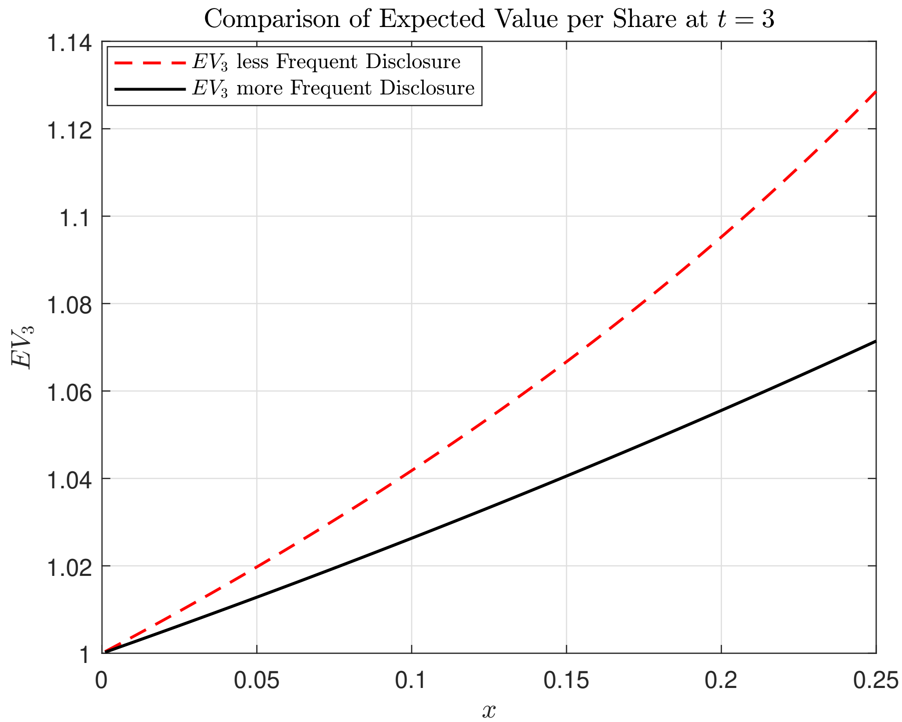

Figure 5: Comparison of Expected Value per Share under Less and More Frequent Disclosure

earnings. Therefore, the stock price at the earnings announcement day, which is time $t = 3$ in our model, would exhibit a lower price jump and thereby a lower abnormal return. In Table 1, we provide a non-trivial numerical example. Under less frequent disclosure, the manager can hide her information and trade $q_2 = x$ in the second period without moving the price to the fundamental value. Consequently, we observe a positive abnormal return at time $t = 3$. In contrast, more frequent disclosure reflects the good news about earnings, eliminating information asymmetry and causing early price jumps. As a result, we find a zero abnormal return at $t = 3$. Finally, if the firm bad news with $A = A_L$, the manager would not conduct share repurchases, and therefore we would observe zero abnormal return in either disclosure frequency.

	Disclosure Frequency	
	Less Frequent Disclosure	More Frequent Disclosure
$\mathbf{E}[q_2]$	x	$(2-\rho)x$
$\mathbf{E}(p_2)$	$\frac{1}{2}[p_2(0)+p_2(x)]$	$\frac{2}{2-x}$
p_3	$\frac{1-p_1(0)x-\mathbf{E}(p_2)\cdot x}{1-2x}$	$\frac{2}{2-x}$
Abnormal Return at Earnings Announcement: $p_3-\mathbf{E}(p_2)$	0.2786	0

Table 1: Numerical Example of Abnormal Return at the Earnings Announcement given $z_1 = 0$ and $A = A_H = 1$. We take $x = 0.1$.

2.3.3 Repurchase Activity

The last prediction from our model is that the firm repurchases more share under more frequent disclosure. As stated by Propositions 1 and 2, given the lower price impact under a more frequent disclosure, the optimal strategy for the firm is to repurchase larger shares, $2x$, in the second trading round. We compare the firm's optimal strategy under $A = A_H$ in Table 2. Under more frequent disclosure requirement, the firm's expected trading quantity is $(3-\rho)x$, which is larger than $\frac{5-\rho}{2}x$, the expected quantity under less frequent disclosure.[11] A more general intuition is that more frequent disclosure reduces price impact, or the marginal cost of repurchasing additional shares, as shown in Figure 4. The reduction in the marginal cost induces firms to repurchase more shares, given many other benefits of share repurchases. In other words, the lower marginal cost following the more frequent disclosure makes firms less constrained in share repurchase.

As also shown in Figure 4, the repurchase price also increases following more frequent disclosure. Since both the repurchase price and the repurchase quantity increase, we predict that the repurchase volume, calculated as the product of the repurchase price and quantity, also

[11] Note that $\frac{5-\rho}{2}x = x + \frac{1}{2}[x + (2-\rho)x]$ and $(3-\rho)x = x + \frac{1}{2}[(2-\rho)x + (2-\rho)x]$. $(3-\rho)x - \frac{5-\rho}{2}x = \frac{1-\rho}{2}x > 0$ as $\rho \in (0,1)$.

	Disclosure Frequency	
	Less Frequent	More Frequent
q_1	x	x
q_2		
$z_1 = 0$:	x	$(2-\rho)x$
$z_1 = x$:	$(2-\rho)x$	$(2-\rho)x$
$q_1 + \mathbf{E}[q_2]$	$\frac{(5-\rho)x}{2}$	$(3-\rho)x$

Table 2: Comparison of Expected Repurchase Quantity under Less and More Frequent Disclosure Given $A = A_H$

increases. We summarize the prediction on repurchase activity in the following proposition.

Prediction 3 *More frequent disclosure of repurchase activity increases both the number of shares repurchased and the total dollar volume of repurchases.*

In the next section, we provide empirical tests on predictions 1, 2 and 3. Overall, our predictions imply that requiring a more frequent disclosure of share repurchase reduces information asymmetry in the stock, decreases price impact and results in a "price jump". The firm responds to such market reaction by repurchasing more shares but still dislike more frequent disclosure. We summarize our model predictions in the following Table 3.

Table 3: Summary of Model Predictions and Intuitions

Predictions	Measures	Change	Intuitions
1	Price Impact	↓	Less information asymmetry.
2.1	Repurchase Price	↑	Price Jumps
2.2	Abnormal Return around Earnings Announcement	↓	More frequent disclosure reflects good news on earnings earlier.
3	Repurchase Payout	↑	Marginal cost of share repurchase (the price impact) is lower.

3 Empirical Strategy

In this section, we test the model's predictions by exploiting a policy change in the US, which requires US firms to disclose their share repurchase activities more frequently.[12] In December 2003, SEC Rule 10b-18 was amended such that, effective on March 15, 2004, US-listed firms must explicitly disclose their monthly share repurchase activities, including the number of shares repurchased and the average repurchase price, on a quarterly basis (i.e., in the 10-Q filings and decomposed into each month within that quarter).

The amendment of Rule 10b-18 is an exogenous shock to the disclosure frequency of US-listed public firms. As a result, US-listed firms must disclose their share repurchase activities more frequently. On the other hand, firms cross-listed in both UK and US have been disclosing their share repurchase activities in both UK and US stock exchanges on a daily basis since 1981 as required by the UK listing rules. (BOE, 1998). Firms cross-listed in Canada and US have been disclosing their share repurchase activities in both Canada and US markets on a monthly basis since 1985 (Ikenberry et al., 2000). The amendment of Rule 10b-18 did not alter these cross-listed firms' disclosure frequency because they had already been disclosing more frequently than required by the amended rule 10b-18.

We thus conduct a difference-in-differences (DiD) analysis, using firms that are listed only in US as treatment firms and US-UK/Canada cross-listed firms as control firms. To enhance the comparability of the treatment and control firms, we match each the treatment and control firms based on firm characteristics relevant for share repurchases and stock liquidity.

3.1 Institutional Backgrounds

The Amendment of Rule 10b-18. The SEC Rule 10b-18 was amended on December 17, 2003. The amendment requires that, starting from March 15, 2004, firms must disclose the

[12]Prior to March 2004, Rule 10b-18 only required US firms to disclose their share repurchase indirectly in cash flow statement under the item "Net dispositions (repurchase) of treasury shares" without specifying repurchase price or quantity; nor distinguishing the effects of share issuance or exercises of stock options Bonaimé (2015).

following information every quarter in their 10-Q filings regarding their share repurchases in each of the three months within the quarter: the number of shares repurchased, the average repurchase price per share, and the remaining shares authorized from the repurchase plan that could be repurchased in the future. The amendment aims to enhance the transparency of firm share repurchase activities with more frequent disclosure.

Before the amendment, U.S. public did not disclose repurchase quantity or price explicitly. The SEC Rule 10b-18 only required that public firms disclosed their net repurchase dollar volume in cash flow statement. This limited information made it difficult for investors and market makers to know precisely the number of shares repurchased in each month/quarter and the repurchase price. Investors and market makers had to rely on indirect information to infer the number of shares repurchased in each quarter and the repurchase price. The indirect information includes the number of shares outstanding, the number of treasury stocks in 10-Q filings, and the amount of money spent on share repurchases in 10-Q filings (Stephens and Weisbach, 1998; Guay and Harford, 2000; Fama and French, 2001). However, estimates of the number of shares repurchased and the average repurchase price in each quarter based on the indirect information are often inaccurate. They could be affected by simultaneous stock issuance, exercise of executive stock options, and the firm's accounting method. Some firms simply retire repurchased shares, while others hold them as treasury stocks (Banyi et al., 2008; Bonaimé, 2015). In our empirical analysis, we directly calculate share repurchase dollar volume as the product of average repurchase price and repurchase quantity after the amendment. Before the amendment, we follow the traditions in the literature (Dittmar and Dittmar, 2008; Ma, 2019) to estimate the dollar volume of share repurchase.[13]

In sum, since the implementation of more frequent disclosure in March 2004, investors and market makers have been able to observe the exact number of shares repurchased and the average repurchase price for each month. Prior to this amendment, they could only infer these values on a quarterly basis, and such estimates were often imprecise. These noisy estimates

[13]In Appendix B.4, we report results using the estimate constructed from cash flow statement both before and after 2004 and find similar results. We obtain similar results.

are consistent with our model assumption that, under less frequent disclosure, market makers only know the distribution of the firm's project cash flow and can thus infer the first-period repurchase quantity only imprecisely. In contrast, more frequent disclosure allows market participants to observe the actual repurchase quantities and prices. Accordingly, we expect the SEC's amendment to Rule 10b-18 to affect firms' repurchase volume, repurchase price, and the resulting price impact, as predicted by our model.[14]

Disclosure of Share Repurchases in UK and Canada. The Financial Conduct Authority (FCA) requires that firms list in the UK must disclose their share repurchase activities daily since 1981. Required information in the disclosure includes the number of shares repurchased on the day, the average repurchase price per share, and the total amount of money spent on share repurchases on the day. The summary of repurchase activities from the last business day must be disclosed to the public through Regulatory News Service (RNS) announcement system no later than 9:30 am of the following day. Compared to less frequent disclosure, the daily disclosure of share repurchase activities in the UK is expected to enhance information transparency, allowing investors and market makers to assess the information content of share repurchases (BOE, 1998; Andriosopoulos and Lasfer, 2015). Figure 6 provides an example of a UK-US cross-listed firm, with US NYSE ticker "CRH", disclosing its share repurchase in last trading day (Feb 22, 2024) on the next business day (Feb 23, 2024). It disclosed its trading venue, numbers of share repurchased, and trading price. Interestingly, the firm executed numerous small-quantity repurchases, including several odd-lot trades, within a single day, indicating an effort to minimize price impact.[15] This observation is consistent with our model that the firm tries to mix with liquidity traders to reduce the price impact and increase the firm's value from trading profit.

In Canada, the Toronto Stock Exchange (TSE) provides a monthly summary detailing the status of all authorized repurchase programs (legally defined as "Normal Course Issuer Bids"), including the program size, termination date, the number of shares purchased in the previous

[14]Although investors were getting noisy information prior to 2004, we take the noisy estimates of share repurchases as dependent variables. As discussed in Wooldridge (2010), if the measurement error in the dependent variable is random and independent of regressors, our OLS estimators would remain consistent.

[15]For more discussions, see, for example, O'Hara et al. (2014); Bartlett et al. (2024, 2025).

23rd February 2024

CRH plc Transaction in Own Shares

CRH plc ("**CRH**") announces that on 22nd February 2024, it acquired the following number of its ordinary shares (the "**ordinary shares**") in the United States from CRH's broker Citigroup Global Markets Inc. The ordinary shares acquired (by way of redemption) will be cancelled.

Aggregate number of ordinary shares acquired	Daily volume weighted average price paid	Daily highest price paid per share	Daily lowest price per share	Trading Venue
81,500	**$78.1010**	**$78.48**	**$77.56**	**See attached schedule**

Trading venue	Currency	Volume Weighted Average Price	Aggregated volume
See attached schedule	USD	$78.1010	81,500

Number of Shares	Price Per Share (USD)	Trade Time	Trading Venue	TransactionID
100	$ 77.56	09:30:01 AM	NYSE	24053G200ez2
100	$ 77.71	09:30:29 AM	NYSE	24053G200hs1
100	$ 77.72	09:30:30 AM	NYSE	24053G200hsy
99	$ 77.72	09:30:30 AM	NYSE	24053G200ht0
98	$ 77.73	09:30:53 AM	NYSE	24053G200igp
1	$ 77.73	09:30:53 AM	NYSE	24053G200igr
2	$ 77.73	09:30:53 AM	NYSE	24053G200igt
12	$ 77.79	09:31:20 AM	NYSE	24053G200j62
36	$ 77.79	09:31:20 AM	NYSE	24053G200j64
100	$ 77.79	09:31:20 AM	NYSE	24053G200j6a
88	$ 77.79	09:31:20 AM	NYSE	24053G200j6c
200	$ 77.76	09:31:20 AM	NYSE	24053G200j6r
100	$ 77.84	09:32:00 AM	NYSE	24053G200k9x
13	$ 77.92	09:32:18 AM	NYSE	24053G200kyk
87	$ 77.92	09:32:18 AM	NYSE	24053G200kym
100	$ 77.92	09:32:18 AM	NYSE	24053G200kyo

Figure 6: Example of an UK-US Cross-listed Firm Daily Repurchase Disclosure

month (across all exchanges), and the cumulative shares repurchased to date under each program (Ikenberry et al., 2000). Figure 7 provides a snapshot of monthly disclosure of share repurchase of all Canadian firms published by the TSE on October 01, 2024. The disclosure table includes the stock symbol, stock name, expiry date of repurchase program, the program size, the number of shares repurchased in the previous months (including those repurchased in U.S. exchanges), and the total shares repurchased to date in the program.

UK–U.S. cross-listed firms have reported repurchases daily since 1981 under UK rules, and Canada–U.S. cross-listed firms have reported monthly since 1985 under Canadian regulations. The 2004 SEC amendment therefore left their disclosure frequency unchanged while raising it only for firms listed solely in the United States.

Normal Course Issuer Bids

Symbol	Stock Name	Expiry Date Of Notice	Approximate # of Subject	Purchases in Month	Purchases to Date
AAV	Advantage Energy Ltd.	May 13, 2025	13,835,841	0	0
ACO.X	ATCO Ltd.	March 12, 2025	1,994,677	0	0
ACQ	AutoCanada Inc.	March 10, 2025	1,329,106	0	460,942
ACX	ACT Energy Technologies Ltd.	July 28, 2025	1,902,008	0	0
ADEN	ADENTRA Inc.	December 31, 2024	1,702,309	0	0
ADN	Acadian Timber Corp.	February 13, 2025	862,739	0	0
ADW.A	Andrew Peller Limited/Andrew Pelle	July 17, 2025	1,000,000	0	35,300
AEM	Agnico Eagle Mines Limited	May 03, 2025	24,961,914	0	763,043
AFN	Ag Growth International Inc.	May 30, 2025	1,886,167	0	0
AG	First Majestic Silver Corp.	September 11, 2025	10,000,000	0	0
AGF.B	AGF Management Limited	February 07, 2025	4,735,269	0	710,000
AGI	Alamos Gold Inc.	December 23, 2024	34,485,405	0	0
AI	Atrium Mortgage Investment Corpor	June 23, 2025	4,232,634	0	0
AIF	Altus Group Limited	February 07, 2025	1,376,034	0	144,200
AIM	Aimia Inc.	June 05, 2025	700,962	0	1,912,200
ALC	Algoma Central Corporation	March 20, 2025	1,975,857	0	0
ALS	Altius Minerals Corporation	August 21, 2025	1,865,313	0	0
ALYA	Alithya Group inc.	September 19, 2024	2,411,570	0	566,749
AND	Andlauer Healthcare Group Inc.	July 01, 2025	1,770,429	0	155,534
AOI	Africa Oil Corp.	December 05, 2024	38,654,702	0	21,932,232
AP.UN	Allied Properties Real Estate Investr	February 25, 2025	12,629,698	0	1,260
ARE	Aecon Group Inc.	August 18, 2025	3,126,306	0	52,800
ARG	Amerigo Resources Ltd.	December 01, 2024	10,900,000	0	0
ARX	ARC Resources Ltd.	September 05, 2025	59,404,376	0	0
ASTL	Algoma Steel Group Inc.	September 03, 2025	5,206,153	0	0
ASTL.WT	Algoma Steel Group Inc.	September 03, 2025	1,208,950	0	0
ATD	Alimentation Couche-Tard Inc.	April 30, 2025	78,083,521	0	0
ATH	Athabasca Oil Corporation	March 17, 2025	55,423,786	0	27,791,500
ATRL	AtkinsRéalis Group Inc.	March 07, 2025	1,500,000	0	442,687
ATS	ATS Corporation	December 14, 2024	8,044,818	0	1,021,187
ATZ	Aritzia Inc.	January 21, 2025	3,515,740	0	0
AX.PR.E	Artis Real Estate Investment Trust	December 18, 2024	324,300	0	286,900
AX.PR.I	Artis Real Estate Investment Trust	December 18, 2024	457,554	0	234,500
AX.UN	Artis Real Estate Investment Trust	December 18, 2024	7,021,296	0	4,113,624
BAM	Brookfield Asset Management Ltd.	January 10, 2025	34,605,494	0	0
BBD.B	Bombardier Inc.	April 02, 2025	1,750,000	0	0
BBU.UN	Brookfield Business Partners L.P.	August 18, 2025	3,714,088	0	0
BBUC	Brookfield Business Corporation	August 18, 2025	3,647,722	0	0
BCE.PR.A	BCE Inc.	November 08, 2024	1,160,466	0	392,430
BCE.PR.B	BCE Inc.	November 08, 2024	705,563	0	587,200
BCE.PR.C	BCE Inc.	November 08, 2024	650,577	0	170,900
BCE.PR.D	BCE Inc.	November 08, 2024	1,267,112	0	738,788
BCE.PR.E	BCE Inc.	November 08, 2024	609,791	0	179,400
BCE.PR.F	BCE Inc.	November 08, 2024	914,538	0	89,200
BCE.PR.G	BCE Inc.	November 08, 2024	863,693	0	143,400
BCE.PR.H	BCE Inc.	November 08, 2024	487,837	0	164,300
BCE.PR.I	BCE Inc.	November 08, 2024	936,254	0	201,400
BCE.PR.J	BCE Inc.	November 08, 2024	427,996	0	331,400
BCE.PR.K	BCE Inc.	November 08, 2024	2,245,531	0	890,200
BCE.PR.L	BCE Inc.	November 08, 2024	176,118	0	29,300
BCE.PR.M	BCE Inc.	November 08, 2024	1,025,397	0	263,500
BCE.PR.N	BCE Inc.	November 08, 2024	104,232	0	29,800
BCE.PR.Q	BCE Inc.	November 08, 2024	841,041	0	233,500
BCE.PR.R	BCE Inc.	November 08, 2024	789,480	0	271,700
BCE.PR.S	BCE Inc.	November 08, 2024	206,496	0	50,500
BCE.PR.T	BCE Inc.	November 08, 2024	535,483	0	153,800
BCE.PR.Y	BCE Inc.	November 08, 2024	666,705	0	558,700
BCE.PR.Z	BCE Inc.	November 08, 2024	278,569	0	119,867
BDGI	Badger Infrastructure Solutions Ltd.	August 25, 2025	861,836	0	9,800
BDI	Black Diamond Group Limited	May 09, 2025	4,542,945	0	150,000
BEI.UN	Boardwalk Real Estate Investment T	November 21, 2024	3,696,000	0	0
BEP.PR.G	Brookfield Renewable Partners L.P.	December 17, 2024	700,000	0	0
BEP.PR.M	Brookfield Renewable Partners L.P.	December 17, 2024	1,000,000	0	0

Figure 7: Example of Monthly Disclosure of Share Repurchase in Canada

3.2 Data and Matching Sample

We retrieve quarterly data of firm fundamentals from the Compustat database. The "fic" item in Compustat identifies the country in which the company is incorporated or legally registered. There are also firms that are legally registered in other countries but cross-listed in the UK/Canada and US. We therefore refer to the ADR databases provided by J.P. Morgan, the Bank of New York, Deutsche Bank, and the Citi Bank to additionally identify cross-listed firms. Finally, we manually check all the Canadian and British firms listed in the US in the DataStream database to ensure that they are also cross-listed in the UK and Canada. We retrieve microstructure-level variables from WRDS intraday indicator database. Daily closing prices and daily return are retrieved from the CRSP database.

To ensure comparability between treatment and control groups, we build a matched sample using propensity scores. Each covariate is measured as the firm's average quarterly value from 2000 through 2003 Q4 to reduce noise. Because the number of UK- or Canada–U.S.

cross-listed firms is small, each is matched with five U.S. domestic firms.

We use the following covariates in firm's fundamentals to estimate the propensity score following Fama and French (2001); Hillert et al. (2016); Li et al. (2024): (1) firm size, measured by the natural logarithm of total asset; (2) Tobin's Q, which is the ratio of the firm's market value to its book value of asset in the last quarter; (3) Profitability, which is the ratio of the firm's income before extraordinary items plus depreciation and amortization to its book value of asset in the last year; (4) leverage ratio, calculated as the long-term and short-term debt divided by lagged total assets; and (5) repurchase payout, which is the ratio of the firm's dollar volume of share repurchases to its book value of asset in the last quarter. We additionally match on two liquidity measures: (1) Kyle's lambda, estimated from the intraday regression that regresses the log change in the mid-quote onto the square root of the absolute difference in buy and sell volume and (2) five-minute percentage price impact is the difference between the current mid-quote price and the mid-quote price five-minute later, scaled by the current mid-quote price. We estimate each firm's propensity score using the probit regression, where the dependent variable is an indicator for the firm being cross-listed in a Canadian/British exchange and the explanatory variables are the aforementioned covariates. For each firm cross-listed in Canada/UK, we identify five firms that are listed in only the US with the closest propensity scores. The matched sample consists of 827 firms, of which 164 (19.83%) are control firms and 663 (80.17%) are treatment firms. Among the control firms, 23 of them are UK-US cross-listed and 141 of them are Canada-US cross-listed. In Appendix B.1, we report the matching regression results.

Table 4 reports summary statistics for the seven covariates used in propensity-score matching. In the unmatched sample, treatment firms are smaller, repurchase more, and exhibit higher Kyle's Lambda than controls, which underscores the need for matching. After matching, none of the fundamentals, including size, Tobin's Q, profitability, leverage, five-minute price impact, Kyle's Lambda, or repurchase payout, differs significantly between treatment and control firms, confirming that the two groups are now well balanced in terms of firm characteristics, liquidity, and payout behavior. Appendix Table B.2 presents balance test for the full set of control variables used in the regression analysis.

Table 4: Summary Statistics for Treatment and Control Groups before the Reform

This table presents the comparison of seven matching covariates between treatment firms (listed in U.S. stock exchanges only) and control firms (crossed-listed in U.S. and Canada/UK). We also test whether the mean of each variable is the same for the treatment versus control firms, and report the t-statistics. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

		Mean		t-test	
Variable	(Un)Matched	Treatment	Control	t	$p > \|t\|$
Matching Covariates					
Size	U	5.902	7.140	−9.46	0.000***
	M	6.624	6.694	−0.28	0.777
Tobin's Q	U	2.060	2.219	−1.20	0.229
	M	2.203	2.118	0.41	0.683
Profitability	U	0.003	0.010	−1.87	0.062*
	M	0.007	0.009	−0.36	0.721
Leverage (%)	U	21.883	21.251	0.39	0.699
	M	20.499	21.448	−0.45	0.654
Five-minute Price Impact (%)	U	0.498	0.486	0.40	0.688
	M	0.510	0.492	0.34	0.734
Kyle's Lambda	U	0.225	0.187	1.86	0.063*
	M	0.214	0.194	0.61	0.545
Repurchase Payout	U	0.193	0.108	2.59	0.010**
	M	0.128	0.141	−0.40	0.691

3.3 Difference-in-Difference Regression

We employ the difference-in-differences (DiD) analysis to estimate the effects of the mandatory quarterly disclosure of share repurchases on price impact and repurchase activity. In particular, we estimate the following DiD regression:

$$Y_{i,t} = \beta_0 + \beta_1 \left(Treat_i \times Post_t\right) + \beta \mathbf{X}_{i,t} + v_i + \eta_t + \varepsilon_{i,t} \tag{3.1}$$

where $Y_{i,t}$ is the outcome variable, including price impact measures, repurchase dollar volume, repurchase quantity, payout structure, dividend payout, relative repurchase price, and three-day cumulative abnormal return around quarter earnings announcement for firm i in quarter t. $Treat_i$ equals one for firms that are only listed in U.S. stock exchanges and equals zero for firms that are cross-listed in the U.S. and Canada/UK. $Post_t$ equals 1 if the period is after March 15, 2004 (inclusive), and 0 otherwise. Starting from March 15, 2004, all US-listed firms are required to disclose their number of shares repurchased and the average repurchase price every quarter. The coefficient on the interaction term $Treat_i \times Post_t$ captures the average treatment effect of a more frequent disclosure of share repurchase on price impact and repurchase activity. $\mathbf{X}_{i,t}$ is a vector of control variables. Following Fama and French (2001); Li et al. (2024), we control for five firm fundamentals that might affect share repurchase: size, Tobin's Q, Profitability, leverage ratio, and cash holdings. As discussed in Hillert et al. (2016), microstructure-level variables may also affect share repurchase and price impact, we therefore further control for microstructure-level variables, including lagged average volatility, lagged average trading volume, and lagged numbers of trades. Lastly, v_i is the firm fixed effects, and η_t is the year-quarter fixed effects. We also cluster the standard error at the firm level. We provide detailed variable constructions in Appendix A. Our data over the period from 2000 to 2008, that is, 16 quarters before March 15, 2004 and 20 quarters thereafter.

Table 5 presents summary statistics for the dependent and control variables in our analysis. The dependent variables include measures of price impact, repurchase activity, relative repurchase price, and abnormal return around earnings announcement. The five-minute percentage price impact averages 0.337%, and Kyle's Lambda, an alternative measure of price impact, has a mean of 0.114. Specifically, the average repurchase payout in dollar volume across the sample is 0.310% of lagged total asset value. Repurchase quantity averages 0.320% of lagged total share outstanding. The dividend payout ratio is relatively low compared to repurchase payout, averaging 0.175% of lagged total asset value. The payout structure shows a mean of 1.171, indicating firms prefer share repurchase over cash dividend in our sample. The mean of earnings announcement (three-day) CAR is 0.435% and the mean relative repurchase price is 109.7%. Both dependent and control variables illustrate substantial cross-sectional variation, indicating the representativeness of firm characteristics and payout decisions in our sample.

Table 5: Summary Statistics

This table reports summary statistics for the variables used in the quarterly regression analysis. SD denotes the standard deviation, and Q1 and Q3 are the first and third quartiles. The five-minute percentage price impact is the difference between the mid-quote five minutes later and the current mid-quote, scaled by the current mid-quote. Kyle's lambda is the coefficient from an intraday regression whose dependent variable is the log change in the mid-quote over 300 seconds and whose regressor is the signed squared volume imbalance between buy and sell orders. Repurchase payout is a firm's quarterly repurchase dollar volume scaled by its lagged total assets, whereas dividend payout is annual cash dividends scaled by lagged total assets. Repurchase quantity is the percentage of shares repurchased during the quarter relative to lagged shares outstanding. Payout structure is defined as (repurchase payout + 1)/(dividend payout + 1). Relative repurchase price equals the estimated repurchase price scaled by the average daily price in the quarter. Earnings Announcement CAR is the cumulative abnormal return in the (-1,1) event window, in which the abnormal return is the raw return minus value-weighted market return. Size is the natural logarithm of total assets; Tobin's Q is the ratio of market value of assets to their book value at the prior fiscal year-end; Profitability is income before extraordinary items plus depreciation and amortization scaled by lagged total assets; the leverage ratio is current liabilities plus long-term debt scaled by lagged total assets; and cash holdings are cash and equivalents scaled by lagged total assets. Volatility is quote-based intraday volatility. All measures are averaged to the quarter level, and volume is total trade volume during market hours.

VARIABLES	(1) N	(2) Mean	(3) SD	(4) Q1	(5) Median	(6) Q3
Dependent Variables						
Five-minute Price Impact (%)	18,460	0.337	0.436	0.0819	0.185	0.410
Kyle's Lambda	18,460	0.114	0.268	0.0103	0.0296	0.0971
Repurchase Payout	18,460	0.310	1.053	0	0	0.00170
Repurchase Quantity	18,460	0.320	0.922	0	0	0.00756
Dividend Payout	18,460	0.175	0.423	0	0	0.152
Payout Structure	18,460	1.171	0.932	0.932	1	1
Relative Price (%)	18,460	109.7	58.92	100	100	100
Earnings Announcement CAR (%)	18,266	0.435	9.198	-3.489	0.213	4.140
Control Variables						
Treat	18,460	0.820	0.384	1	1	1
Post	18,460	0.513	0.500	0	1	1
Size	18,460	6.857	2.170	5.241	6.813	8.439
Profitability	18,460	0.0115	0.0487	0.00317	0.0165	0.0313
Tobin's Q	18,460	2.146	2.100	1.101	1.427	2.260
Leverage (%)	18,460	20.50	21.18	1.987	17.17	31.44
Cash Holdings	18,460	0.184	0.227	0.0262	0.0793	0.260
Volatility	18,460	0.186	0.739	0.000867	0.00504	0.0477
Log Number of Trades	18,460	10.04	2.205	8.401	10.26	11.68
Log Volume	18,460	16.20	2.147	14.69	16.40	17.84

4 Empirical Results

In this section, we present the empirical results testing the model's predictions for price impact, repurchase price, and repurchase activity.

4.1 Price Impact

Prediction 1 indicates that price impact decreases under more frequent disclosure of share repurchase activities. To test this prediction, we consider two commonly-used price impact measures: five-minute percentage price impact and Kyle's Lambda (Hasbrouck, 2009; Goyenko et al., 2009; Almeida et al., 2016; Boehmer et al., 2018). Five-minute percentage price impact is a proxy for the informed traders' trading profits, and a lower five-minute percentage price impact implies less information asymmetry in stocks. Kyle's lambda measures estimated change in the log mid-quote price triggered by one unit of signed square-root net dollar order flow over five minutes. A lower Kyle's lambda means larger order imbalances move prices less, indicating higher price resilience and lower price impact. Our daily price impact measures are downloaded from WRDS intraday indicator dataset. We then take quarterly average of them as dependent variables in regression 3.1.

Table 6 presents the regression estimates. The coefficients on $Treat \times Post$ are negative and statistically significant for both the five-minute percentage price impact and Kyle's Lambda. This indicates that, relative to the control firms, the treatment firms experienced a decline in price impact after they were required to disclose their share repurchase activities on a quarterly basis since March 2004.

Column (1) reports the results for five-minute percentage price impact. The coefficient on $Treat \times Post$ is –0.068 and significant at the 1 percent level. This estimate indicates that, relative to the control firms, the price impact for treated firms fell by 6.8 basis points after March 2004, which is a 13.33 percent decline compared with their pre-shock average (0.068/0.510 from Table 4). Column (2) reports results for Kyle's Lambda. The coefficient is –0.045 and is also significant at the 1 percent level, implying that a one-unit increase in the squared root of net buy/sell volume moves the average treatment firm's mid-quote by 4.5 basis points less than before the disclosure change. This represents a 21.02 percent reduction relative to the pre-shock benchmark (0.045 / 0.214 from Table 4). Together, these findings confirm Prediction 1: more frequent disclosure lowers stock-price impact and decreases information asymmetry in treatment stocks. In Table B.4 of Appendix B.4, we

Table 6: More Frequent Disclosure of Share Repurchases and Price Impact

This table reports the results of the DiD regression $\text{PriceImpact}_{i,t} = \beta_0 + \beta_1 (Treat_i \times Post_t) + \beta \mathbf{X}_{i,t} + v_i + \eta_t + \varepsilon_{i,m,t}$. Price impact measures include the five-minute percentage price impact and Kyle's lambda. *Treat* takes the value of 1 if the firm is listed in U.S.-only and 0 if it is cross-listed in the U.S. and Canada/UK. *Post* takes the value of 1 if it is after 2004 Q1 (inclusive) and 0 otherwise. The control variables are firm size, Profitability, Tobin's Q, leverage ratio, cash holdings, lagged quarterly average volatility, the lagged natural logarithm of trading volume in the quarter, and the lagged natural logarithm of the number of trades in the quarter. We estimate the regression using firm-quarter observations from 2000 to 2008. All variables are winsorized at the 1% and 99% levels. Firm-clustered standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

VARIABLES	(1) Five-minute Price Impact (%)	(2) Kyle's Lambda
Treat*Post	**-0.068***** **(0.020)**	**-0.045***** **(0.016)**
Size	-0.043*** (0.014)	-0.028** (0.012)
Tobin's Q	-0.016*** (0.003)	-0.017*** (0.003)
Profitability	-0.544*** (0.096)	-0.388*** (0.087)
Leverage (%)	0.001*** (0.000)	0.001*** (0.000)
Cash Holdings	-0.027 (0.031)	-0.011 (0.024)
$\ln(\text{Volume})_{t-1}$	0.004 (0.013)	-0.012 (0.010)
Volatility_{t-1}	0.103*** (0.013)	0.086*** (0.012)
$\ln(\text{Number of Trades})_{t-1}$	-0.094*** (0.013)	-0.016 (0.010)
Constant	1.533*** (0.159)	0.682*** (0.123)
Observations	16,828	16,828
Adj. R-squared	0.702	0.521
Year-Quarter FE	YES	YES
Country FE	YES	YES

report the results on alternative measures of five-minute price impact and Kyle's lambda and document similar results.

To check whether the parallel-trends assumption is violated in our diff-in-diff analysis, we estimate dynamic treatment effects diff-in-diff regressions by replacing the interaction variable $Treat * Post$ with the interactions between $Treat$ and indicators for each quarter from 2000 Q1 to 2008 Q4. We replace all quarters before 2002 Q1 and after 2008 Q1 as "-8" and "16", respectively. Figure 8 plot the coefficients on the interaction variables between $Treat$ and the quarter indicators and the 95% confidence intervals of the coefficients for both price impact measures.

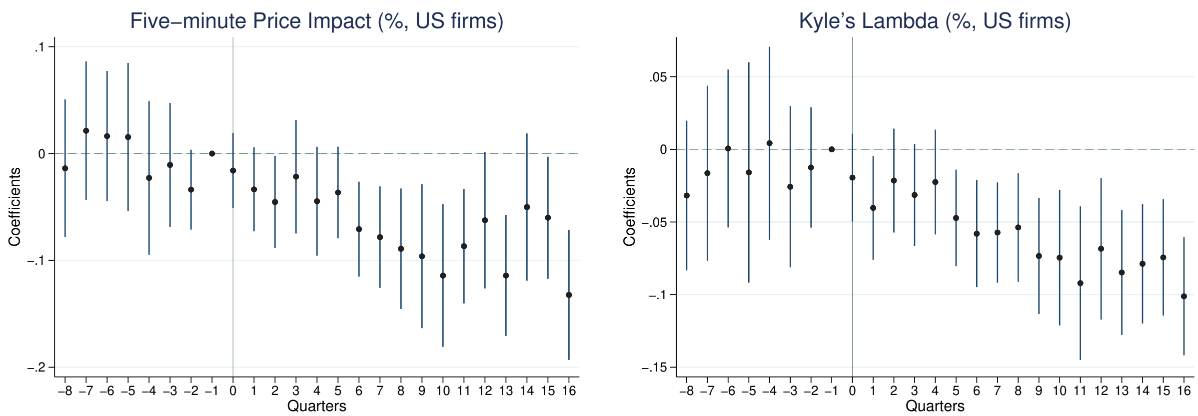

Figure 8: Dynamic Treatment Effects of More Frequent Disclosure of Share Repurchases on Stock Price Impact Measures

We estimate dynamic treatment effects diff-in-diff regressions by replacing the interaction variable $Treat * Post$ in model 3.1 with the interactions between $Treat$ and each of the indicators for each quarter from 2000 Q1 to 2008 Q4. We drop the quarter -1 to avoid collinearity. This figure plots the coefficients on the interaction variables between $Treat$ and the quarter indicators and the 95% confidence intervals of the coefficients. The horizontal red line shows the pre-treatment average treatment effects. We collapse observations before 2002 Q1 and after 2008 Q1 as -8 and 16, respectively.

Figure 8 shows no violation of the parallel-trends assumption. The coefficients on the interactions variables are always statistically insignificant for the quarters before the treatment (i.e., quarter 0 in the plots). After the treatment, both price impact measures exhibit gradual decreasing trends as the policy gradually taking into effects.[16] Coefficients on five-minute

[16]Although firms were required to disclose share repurchases in their 10-Q filings starting in March 2004, some did not fully comply with the new disclosure format until 2005. Others retroactively reported their 2004 repurchase details in their 2005 10-Q filings. These practices suggest that investors may not have had

percentage price impact and Kyle's lambda are statistically significantly negative in most of the post-shock quarters. In sum, the parallel-trends assumption is not violated in our analysis. In section 4.4, we further discuss our additional approach to test the parallel trend assumption through fake time test and fake treatment test.

4.2 Repurchase Price

Prediction 2 of the model states that the repurchase price is higher under more frequent disclosure due to reduced information asymmetry. To test this prediction, we first construct the measure of relative repurchase price as the ratio of the firm's estimated repurchase price in a quarter to the average daily closing price in that quarter. We estimate the repurchase price as the (net) repurchase dollar volume in cash flow statement divided by the decrease in share outstanding. If there was no decrease in shares outstanding in a given quarter (when firms did not repurchase shares), we assign a relative repurchase price of 100%, that is, we assume firms share the same valuation of their stocks with the market when they do not repurchase shares.

We provide additional test to Prediction 2 by analyzing the three-day cumulative abnormal return (CAR) around the earnings announcement event window [-1,+1] for each firm-quarter. If more frequent disclosure induces price jumps to incorporate earnings information in advance, we should observe a lower CAR for treatment firms. Moreover, since share repurchase disclosures primarily signal positive private information, we expect the decline in CAR to be more pronounced among firms reporting positive earnings.[17]

Column (1) of Table 7 reports the results on the relative repurchase price. The coefficient on $Treat * Post$ is 6.786 and is statistically significant at the 5% level. That is, compared to the control firms, the treatment firms' relative repurchase price increases by 6.786 percentage point after they are required to disclose their share repurchase activities every quarter. Note

complete and timely access to repurchase price and quantity information for all firms until 2005.

[17]We define CAR as the three-day cumulative difference between the raw stock return and the market return. In Appendix B.4, we also provide results on CAPM-, Fama-French-three-factor-, and Carhart-four-factor-adjusted CARs, which are consistent with Table 7.

that before the shock, the average relative repurchase price is 104.94%, thus, more frequent disclosure increases relative repurchase price by $6.786\%/104.94\% \approx 6.47\%$.

Column (2) of Table 7 presents results on the CAR for the full sample. We find a statistically and economically significant decline in cumulative abnormal returns (CAR) for treatment firms following the shift to more frequent disclosure. The coefficient on the interaction term $Treat \times Post$ is -0.743, significant at the 5% level, indicating a 0.743 percentage point decrease in CAR for U.S. domestic firms relative to UK/Canada cross-listed firms. Column (3) reports results for the subsample of firms with positive earnings, where the effect is even stronger: treatment firms experience a 1.343 percentage point drop in CAR, significant at the 1% level. This finding is consistent with our model's intuition that firms repurchase shares when they have good news. Under more frequent disclosure, investors can better infer the firm's cash flow, leading to a price jump that reflects the positive news prior to the earnings announcement. As a result, the announcement contains less surprise, and CAR declines. Column (4) shows no significant effect for firms with negative earnings, in line with the model's prediction that firms do not repurchase shares in the absence of good news, so disclosure conveys little additional information. In sum, these findings support model prediction 3: more frequent disclosure reveals positive private information through repurchase activity, causes earlier price jumps, and thus reduces the abnormal return at the time of the earnings announcement.

4.3 Repurchase Activity

Prediction 3 of the model states that treatment firms will repurchase a higher number of shares and increase repurchase dollar volume after they must disclose their repurchase activities more frequently. We test this prediction using the following dependent variables in regression 3.1: repurchase payout, repurchase quantity, and payout structure. Repurchase payout is the ratio of the firm's quarterly repurchase dollar volume scaled by its total asset at the end of the the last quarter. Before 2004, we estimate the repurchase dollar volume from the cash flow statement following the common practice (e.g., Dittmar and Dittmar, 2008;

Table 7: More Frequent Disclosure of Share Repurchases and Repurchase Price

This table reports the results of the DiD regression $Y_{i,t} = \beta_0 + \beta_1 (Treat_i \times Post_t) + \beta \mathbf{X}_{i,t} + v_i + \eta_t + \varepsilon_{i,m,t}$, in which $Y_{i,t}$ includes the relative repurchase price and the three-day Cumulative abnormal return (CAR). The relative repurchase price is the estimated repurchase price divided by average dialy closing prices. The CAR is the sum of daily abnormal returns around the [-1,1] windows of earnings announcement for each firm-quarter. Abnormal return is calculated as the difference between the raw return and the value-weighted market return. We calculate the CAR for each firm in each quarter. Control variables are the same in Table 6. We estimate the regressions using firm-quarter observations from 2000 to 2008. All control variables and relative repurchase price are winsorized at 1% and 99% level. Firm-clustered standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

VARIABLES	(1) Relative Repurchase Price (%)	(2) CAR[-1,1] Whole Sample	(3) CAR[-1,1] Positive Earnings	(4) CAR[-1,1] Negative Earnings
Treat*Post	**6.786****	**-0.743****	**-1.343*****	**0.431**
	(2.957)	**(0.334)**	**(0.366)**	**(0.889)**
Size	5.049***	-0.920***	-0.673**	-0.730
	(1.756)	(0.254)	(0.307)	(0.537)
Tobin's Q	0.136	-0.456***	-0.891***	-0.365**
	(0.375)	(0.091)	(0.141)	(0.148)
Profitability	-10.874	21.670***	67.481***	3.080
	(16.024)	(3.106)	(9.175)	(3.877)
Leverage (%)	-0.080*	0.012*	0.013	0.008
	(0.048)	(0.007)	(0.008)	(0.014)
Cash Holdings	-4.777	2.276***	2.119*	1.677
	(7.122)	(0.878)	(1.144)	(1.554)
$\ln(\text{Volume})_{t-1}$	0.790	0.353	0.524*	0.587
	(2.223)	(0.264)	(0.293)	(0.632)
$(\text{Volatility})_{t-1}$	2.002***	0.192	0.732***	-0.281
	(0.706)	(0.178)	(0.237)	(0.241)
$\ln(\text{Number of Trades})_{t-1}$	-2.111	-0.842***	-1.054***	-1.277**
	(2.183)	(0.266)	(0.310)	(0.613)
Constant	83.044***	9.854***	7.964**	6.501
	(22.902)	(2.857)	(3.144)	(6.064)
Observations	16,590	16,590	12,300	4,163
Adjusted R-squared	0.121	0.026	0.054	-0.000
Year-Quarter FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES

Ma, 2019); after 2004, we measure the dollar volume as the product of repurchase price and repurchase quantity. Repurchase quantity measures the percentage of repurchased shares to the lagged total outstanding shares. Before 2004, we estimate the repurchase quantity as the decrease in outstanding shares in a given quarter and we replace the increase in share outstanding as zero (no repurchase). This construction follows the discussion by Banyi et al. (2008) on how to estimate repurchased quantity prior to 2004.[18] Payout structure equals (repurchase payouts +1) / (dividend payouts +1) following Li et al. (2024). It takes the value of one when the firm does not distribute cash to shareholders through dividends or share repurchases. It is greater than one when the firm returns more cash to shareholders through repurchases than dividends, and smaller than one when the opposite is true. Finally, we also consider the dividend payout, measured by the dollar volume of cash dividend to lagged total asset values.

Column (1) of Table 8 reports the result on repurchase payout, in which the coefficient on $Treat * Post$ is 0.299 and is statistically significant at the 1% level. That is, compared to the control variables, the treatment firms increase their share repurchases by 0.299% quarterly under more frequent disclosure of their share repurchase activities, which is around 2.25 million dollar calculated as the pre-shock average asset size in treatment firms.[19] Since the pre-shock average repurchase payout in treatment firms is 0.13%, more frequent disclosure increases the repurchase payout in treatment firms by around 230% (0.299/0.13).

To rule out the mechanical effect that the increase in share repurchase is simply driven by the increase in repurchase price, column (2) further reports the results on repurchase quantity. The coefficient on $Treat * Post$ is 0.218 and is statistically significant at the 1% level. That is, compared to the control firms, the treated firms repurchase 0.218% more of total outstanding shares after they are required to disclose their share repurchase activities every quarter. Since before the policy change, treatment firms repurchase around 0.240% of total outstanding shares each quarter, the more frequent disclosure increases the repurchasing quantity by

[18] In Appendix B.4, we also provide the results using alternative measures of repurchase payout and repurchase quantity discussed by (Banyi et al., 2008). The results are consistent with those in Table 8.

[19] The average asset size in treatment firms before the shock is $e^{6.624} \approx 753$ million as in Table 4 and $0.299\% * 753 \approx 2.25$.

around 90.8% (0.218/0.240) in treatment firms. In other words, both the repurchase price and the repurchase quantity increase following the more frequent disclosure, and the rise in repurchase dollar volume cannot be attributed solely to the mechanical effect of higher prices.[20]

The coefficient on $Treat * Post$ is 0.252 and is statistically significant at the 1% level in column (3), where the dependent variable is payout structure. This result implies that the treatment firms prefer share repurchase and rely more on share repurchase in their payout policies after being required to disclose their repurchase activities more frequently. Lastly, we do not find significant change in dividend payout following the more frequent disclosure between treatment and control firms in column (4), which makes sense because of the sticky dividend (Lintner, 1956). Therefore, the change in payout structure is mainly due to the increase in repurchase payout. Overall, our results support the model prediction 2.

We estimate dynamic treatment effects to test for parallel-trend assumption. In our estimation, we replace the interaction variable $Treat * Post$ with the interactions between $Treat$ and indicators for each quarter from 2000 to 2008. We use the full sample and collapse the quarters before 2002 Q1 and 2008 Q1 in the "-8" and "16" quarter, respectively. Figure 9 plots the coefficients on the interaction variables between $Treat$ and the year indicators and the 95% confidence intervals of the coefficients. We also plot the average pre-shock treatment effects as the horizontal red line. The dependent variable is repurchase payout, repurchase quantity, and payout structure. The coefficient on the interaction variable between $Treat$ and the quarter indicator is economically small and statistically insignificant before the treatment time of 2004 Q1, and becomes positive and significant over of the post-shock quarters. Comparing to the before-shock treatment effects shown in the red line, we can observe clear policy effects with upwards increasing trend, reflecting that the more frequent disclosure gradually takes into effects on repurchase payout. This trend is consistent with the decreasing trend in price impact as we show in Figure 8. In short, we observe no evi-

[20] These results also help rule out the alternative explanation that firms oppose more frequent disclosure merely because it enables investors to better detect earnings per share (EPS) manipulation by managers (Kahle, 2002; Almeida et al., 2016). If this were the case, we would *not* expect to see an increase in repurchase quantity, as managers aiming to inflate EPS would have little incentive to increase repurchase quantities beyond what is necessary to meet the EPS target.

Table 8: More Frequent Disclosure of Share Repurchases and Repurchase Activity

This table reports the results of the DiD regression Repurchase Activity$_{i,t}$ $= \beta_0 + \beta_1 (Treat_i \times Post_t) + \beta \mathbf{X}_{i,t} + v_i + \eta_t + \varepsilon_{i,m,t}$. The repurchase activity measures are repurchase payout, repurchase quantity, payout structure, and dividend payout. Repurchase payout is the repurchase dollar volume divided lagged total asset. Repurchase quantity is calculated as the percentage of shares repurchased to the lagged shares outstanding. Payout structure is (Repurchase Payout+1)/(Dividend Payout+1). Dividend payout is cash dividend volume divided by lagged total asset values. Control variables are the same in Table 6. We estimate the regressions using firm-quarter observations from 2000 to 2008. All variables are winsorized at the 1% and 99% levels. Firm-clustered standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

VARIABLES	(1) Repurchase Payout	(2) Repurchase Quantity	(3) Payout Structure	(4) Dividend Payout
Treat*Post	**0.299*** **	**0.218*** **	**0.252*** **	**-0.033**
	(0.071)	**(0.048)**	**(0.066)**	**(0.040)**
Size	-0.038	-0.046	-0.012	-0.036**
	(0.042)	(0.033)	(0.039)	(0.015)
Tobin's Q	-0.042***	-0.045***	-0.038***	0.004
	(0.013)	(0.007)	(0.012)	(0.003)
Profitability	0.504*	0.014	0.410	0.135*
	(0.298)	(0.251)	(0.275)	(0.079)
Leverage (%)	-0.000	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Cash Holdings	-0.267*	-0.219**	-0.240*	-0.049
	(0.156)	(0.104)	(0.141)	(0.037)
ln(Volume)$_{t-1}$	0.050	0.075**	0.063	-0.030***
	(0.043)	(0.035)	(0.039)	(0.010)
(Volatility)$_{t-1}$	0.009	-0.001	0.009	-0.008
	(0.010)	(0.011)	(0.009)	(0.006)
ln(Number of Trades)$_{t-1}$	-0.051	-0.087***	-0.068	0.033***
	(0.046)	(0.033)	(0.042)	(0.010)
Constant	0.279	0.344	0.946**	0.582***
	(0.451)	(0.380)	(0.417)	(0.126)
Observations	16,828	16,828	16,828	16,828
Adjusted R-squared	0.252	0.190	0.264	0.728
Year-Quarter FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES

dence that the parallel-trends assumption is violated. In section 4.4, we further discuss our additional approach to test the parallel trend assumption through fake time test and fake treatment test.

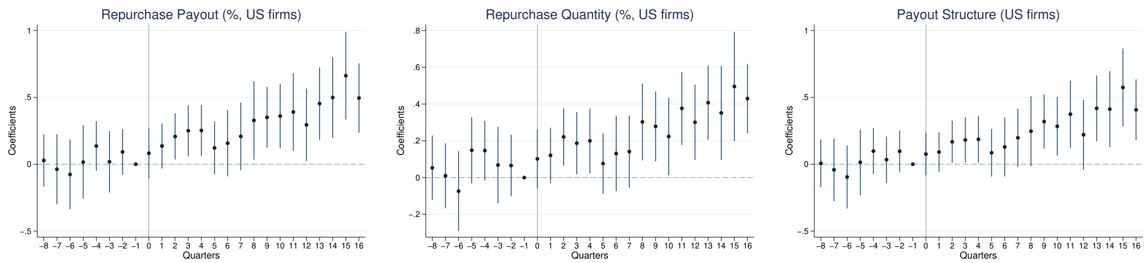

Figure 9: Dynamic Treatment Effects of More Frequent Disclosure of Share Repurchases on Repurchase Payout

We estimate dynamic treatment effects diff-in-diff regressions by replacing the interaction variable $Treat * Post$ in model 3.1 with the interactions between $Treat$ and each of the indicators for each quarter from 2000 Q1 to 2008 Q4. We drop the quarter -1 to avoid collinearity. This figure plots the coefficients on the interaction variables between $Treat$ and the quarter indicators and the 95% confidence intervals of the coefficients. The horizontal red line shows the pre-treatment average treatment effects. We collapse observations before 2002 Q1 and after 2008 Q1 as -8 and 16, respectively.

4.4 Placebo Tests

In this section, we following the literature advances in difference-in-difference analysis by conducting fake treatment-time (Spencer, 2022) and fake treatment-firm (Bloom et al., 2019) tests to check if the documented treatment effects are due to the more frequent disclosure of share repurchase.

In the fake treatment-time placebo test, we change the treatment time from one quarter to twelve quarters before the actual treatment time, and re-estimate the treatment effects in model 3.1. We report our placebo test results on Appendix B.2. Figures B.1, B.2, B.3, B.4, B.5, and B.6 present the results on Kyle's lambda, five-minute percentage price impact, repurchase payout, repurchase quantity, relative repurchase price, and three-day CAR around earnings announcement, respectively. These results show that, before the more frequent disclosure requirement in 2004 first quarter, there are no significant treatment effects in price impact measures, three-day CAR around earnings announcement, repurchase quantity or repurchase payout between treatment and control firms. These results suggest that, before the treatment time, both control and treatment firms are similar in price impact and repurchase activities and no violation of parallel trend assumptions.

In Appendix B.3, we report the results on the fake treatment-firm placebo test. We keep the same treatment-control ratio by randomly assigning 19.83% of the firms to be treatment and the rest of 80.17% firms to be control. The portions are the same as our main sample. We then estimate the regression model 3.1 with the same control variables to obtain the treatment effects. We repeat this procedure with 500 times. We plot the distribution of the treatment effects on Kyle's lambda, five-minute percentage price impact, repurchase payout, repurchase quantity, relative repurchase price, and three-day CAR around earnings announcement with the actual estimators in Figures B.7, B.8, B.9, B.10, B.11, B.12, respectively. These results show that, the actual estimators in all of our main outcome variables are statistically distinct from the distribution of fake treatment firm estimators, suggesting that our results are not driven by unobserved confounding factors. In sum, all of our empirical results show that the treatment effects reported in Tables 6 and 8 are the result of this change in disclosure frequency.

5 Conclusions

Our paper addresses a paradox in payout policy: while classic frameworks such as Modigliani-Miller, signaling, or agency theories suggest that firms should either support or remain indifferent to the disclosure of share repurchases, in practice, firms have strongly opposed recent regulatory changes mandating more frequent disclosure—even suing the SEC. We propose a novel framework to reconcile this tension by modeling the firm as an informed trader in its own stock. Infrequent disclosure enables the firm to blend in with liquidity traders and acquire shares at a lower price. In contrast, more frequent mandatory disclosure makes repurchases more visible, prompting price jumps that raise the total cost of repurchases. At the same time, disclosure reduces information asymmetry and the price impact of buying larger quantities, thereby lowering the marginal cost and encouraging more repurchases. This trade-off between higher total cost and lower marginal cost explains why firms resist daily disclosure, even if it ultimately leads them to repurchase more shares.

We empirically validate this model using the prior shift in U.S. disclosure requirements. Compared to Canadian and U.K. cross-listed firms already subject to higher disclosure frequencies, U.S. domestic firms experience a 13–21 percent decline in two standard measures of price impact, a doubling of shares repurchased per quarter, a 6.786 percent increase in average repurchase prices, and a 0.743% decrease in cumulative abnormal returns around quarterly earnings announcement. Dollar repurchase volume rise by $2.25 million per firm per quarter, and payout policies tilt further toward buybacks and away from dividends.

Our study contributes to the market microstructure literature by introducing the first model in which the informed trader is the firm. We also contribute to corporate finance by identifying a previously unmodeled incentive for repurchases. Endogenizing the price impact of share repurchase provides micro-foundations for assumptions typically taken as exogenous in the behavioral corporate finance literature. Future research can build on this framework to further integrate insights across market microstructure and corporate finance. Such developments would be relevant not only for academic understanding but also for policy design. At a minimum, our findings suggest that policies aimed at curbing share repurchases through enhanced disclosure may not achieve their intended effect: while disclosure reduces information asymmetry, it ultimately leads firms to repurchase more, not less.

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A Variable Definitions

VARIABLES	Definition	Data Source
Dependent Variable		
Repurchase Payout	Average repurchase price ($prcraq_t$) times repurchased shares ($cshopq_t$) divided by lagged total assets (atq_{t-1}). Before 2004, we estimate share repurchase following Dittmar and Dittmar (2008) as the purchase of common and preferred stock ($prstky_t$, adjusted to quarter level) less any decrease in preferred stock ($pstkrq_t - pstkrq_{t-1}$).	Compustat
Repurchase Quantity	The percentage of number of shares repurchased to the lagged outstanding shares ($cshopq_t/cshoq_{t-1}$). Before 2004, we estimate the repurchased shares as the change in share outstanding ($cshoq_{t-1} - cshoq_t$, note that repurchase means decrease in share outstanding). We replace the increase in share outstanding as zero (no repurchase). This approach follows the discussion in Banyi et al. (2008) to estimate repurchased quantity before 2004.	Compustat
Dividend Payout	Cash dividend divided (dy_t, adjusted to quarter level) by lagged total assets (atq_{t-1}).	Compustat
Payout Structure	$\dfrac{\text{Repurchase Payout} + 1}{\text{Dividend Payout} + 1}$	Compustat

Kyle's Lambda	λ estimated from the intraday regression: $\ln(\frac{M_{i,t}}{M_{i,t-300}}) = \alpha + \lambda \times Sign(\sum_{t-300}^{t}(BuyDollar - SellDollar)) \times \sqrt{\lvert \sum_{t-300}^{t}(BuyDollar - SellDollar)\rvert} + \varepsilon$, where $M_{i,t}$ is the bid-ask mid-quote price for stock i at second t. We average at the quarter level.	TAQ & WRDS IID
Five-Minute Percentage Price Impact	$\frac{1}{N}\sum_{k=1}^{N} PI_k$ and $PI_k = \frac{\lvert M_{k+300,i} - M_{k,i}\rvert}{M_{k,i}}$ in which $M_{k,i}$ is the kth mid-quote price for stock i and N is the total number of trades in a trading day. We average at the quarter level.	TAQ & WRDS IID
Relative Repurchase Price (%)	Estimated Share Repurchases ($prstky_t$, adjusted to quarter level, less any decrease in preferred stock, $pstkrq_t - pstkrq_{t-1}$) divided by estimated repurchase quantity ($cshoq_{t-1} - cshoq_t$).	Compustat & CRSP
Three-Day Cumulative Abnormal Return around Earnings Announcement	$CAR_{i,t} = \sum_{\tau=-1}^{+1}(R_{i,\tau} - R_{m,\tau})$ for stock i in earnings announcement date τ at quarter t. $R_{i,\tau}$ and $R_{m,\tau}$ are stock return and market return at day τ, respectively. Earnings announcement date is identified using "rdq" in Compustat.	Compustat & CRSP
Control Variables		
Treat	Equals 1 if US domestic firms and 0 if UK-US or Canada-US cross-listed firms.	Compustat, Citi, JP Morgan, and DB ADR databases, and Datastream

Post	Equals 1 after 2004 first quarter and 0 otherwise.	2004 SEC Rule 10b-18 Amendment
Size	Logarithmic value of total asset, adjusted to USD ($\ln(atq * currtrq)$)	Compustat
Profitability	Income before depriciation and amortization divided by lagged total asset ($(ibq + dpq)/L.atq$).	0.0451
Tobin's Q	Market value of equity plus market value of debt divided by lagged asset value ($(prccq * cshoq + atq - ceqq)/L.atq$)	Compustat
Leverage (%)	Long-term debt plus short-term liabilities divided by lagged total assets ($100 * (dlttq + dlcq)/L.atq$)	Compustat
Cash Holdings	Cash divided by lagged total asset ($chq/L.atq$)	Compustat
Volatility	NBBO quote-based volatility, calculated as $\frac{\sum_{t=1}^{T}(Ret_{i,t}-\bar{Ret}_{i,t})^2}{T-1}$ where $Ret_{i,t}$ is the quote-based return as $\ln(M_{i,t}/M_{i,t-1})$ and t indexes for a second. We average daily volatility to quarterly level.	TAQ & WRDS IID
ln(Numbers of Trades)	Log Numbers of Trades	TAQ & WRDS IID

ln(Volume)	Log Total Trade Volume during Market Hours	TAQ & WRDS IID

B Supplementary Empirical Results

B.1 Additional Results on Propensity Score Matching

In Table B.1, we report our probit regression results when doing the one-to-five propensity score matching. In Table B.2, we further report the balance test before the policy shock for all variables used in our regression model.

Table B.1: Probit Regression Results: Propensity Score Matching

	Coefficient	Std. Error
Size	0.172***	(0.025)
Profitability	1.332	(0.945)
Tobin's Q	0.065***	(0.020)
Leverage (%)	−0.004**	(0.002)
Repurchase Payout	−0.276***	(0.102)
Five-minute Price Impact (%)	0.773***	(0.189)
Kyle's Lambda	−0.661**	(0.284)
Constant	−3.124***	(0.212)
Observations	4,587	
Log Likelihood	−680.71	
LR χ^2	66.41	
Pseudo R^2	0.047	

Table B.2: Summary Statistics for all Variables in Treatment and Control Groups before the Reform

This table presents the mean of all variables used in our analysis for treatment firms (listed in U.S. stock exchanges only) and control firms (crossed-listed in U.S. and Canada/UK) in two samples: the unmatched sample of all firms and the sample of treatment/control firms matched based on propensity score. We also test whether the mean of each variable is the same for the treatment versus control firms, and report the t-statistics. U = Unmatched, M = Matched. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

		Mean		t-test	
Variable	**Sample**	**Treatment**	**Control**	t	$p > \|t\|$
Matching Covariates					
Size	U	5.9019	7.1396	9.46	0.000***
	M	6.6241	6.6936	0.28	0.777
Tobin's Q	U	2.0599	2.2190	1.20	0.229
	M	2.2034	2.1180	-0.41	0.683
Profitability	U	0.00320	0.00969	1.87	0.062*
	M	0.00729	0.00891	0.36	0.721
Leverage (%)	U	21.883	21.251	-0.39	0.699
	M	20.499	21.448	0.45	0.654
Percentage Price Impact	U	0.49803	0.48611	-0.40	0.688
	M	0.51039	0.49196	-0.34	0.734
Kyle's Lambda	U	0.22545	0.18729	-1.86	0.063*
	M	0.21417	0.19403	-0.61	0.545
Repurchase Payout	U	0.19338	0.10797	-2.59	0.010**
	M	0.12756	0.14119	0.40	0.691
Other Control Variables					
Cash Holdings	U	0.18718	0.16003	-1.66	0.098*
	M	0.18469	0.15575	-1.28	0.201
Volatility	U	0.46517	0.50898	0.73	0.463
	M	0.41215	0.52897	1.18	0.241
Log Number of Trades	U	8.4303	8.3128	-0.90	0.368
	M	9.0547	8.3952	-3.09	0.002***
Log Volume	U	15.060	15.079	0.14	0.887
	M	15.676	15.198	-2.03	0.043**

B.2 Placebo Tests by Shifting Back Treatment Time

In this section, we conduct the fake treatment time by re-estimating the regression model 3.1. We replace the $Post$ indicator to -1,-2,...,-12 quarters can plot the estimated coefficients on $Treat * Post$ in the following figures with 95% confident intervals.

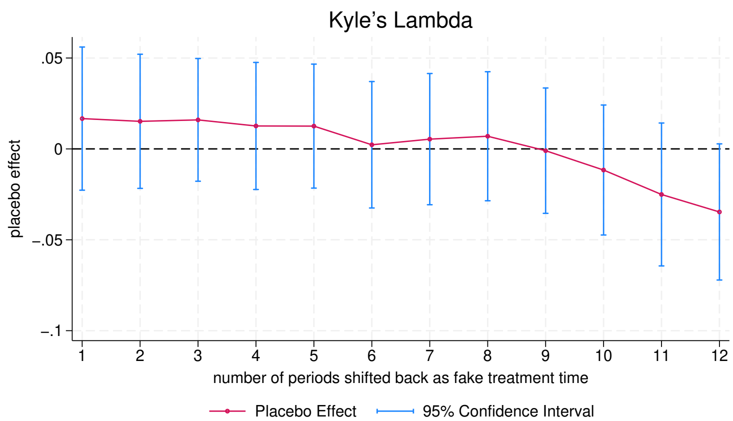

Figure B.1: Coefficients on Kyle's Lambda under Fake Treatment Time

We estimate the treatment effects of diff-in-diff regressions in model 3.1 by changing the treatment time from one to twelve quarters before the actual treatment time. This Figure reports the coefficients on $Treat * Post$ in which $Post$ is shifted backwards from one to twelve quarters.

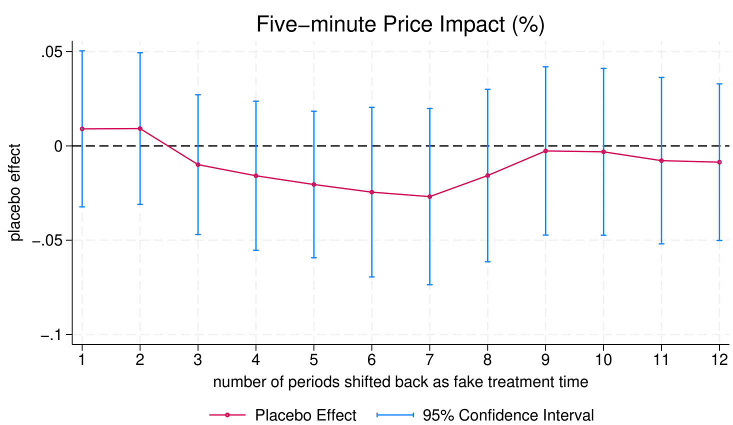

Figure B.2: Coefficients on Five-minute Percentage Price Impact under Fake Treatment Time

We estimate the treatment effects of diff-in-diff regressions in model 3.1 by changing the treatment time from one to twelve quarters before the actual treatment time. This Figure reports the coefficients on $Treat * Post$ in which $Post$ is shifted backwards from one to twelve quarters.

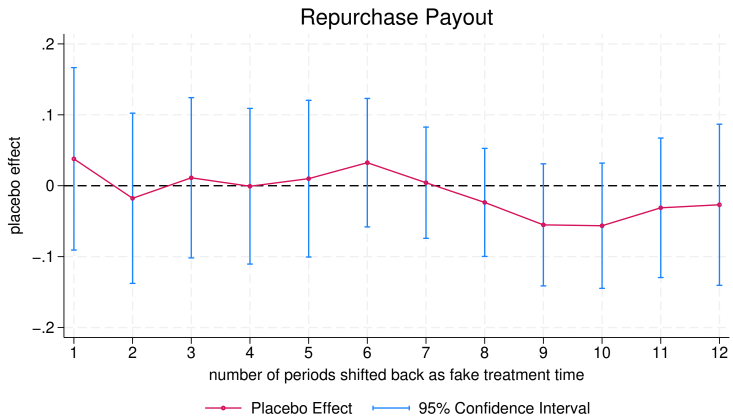

Figure B.3: Coefficients on Repurchase Payout under Fake Treatment Time

We estimate the treatment effects of diff-in-diff regressions in model 3.1 by changing the treatment time from one to twelve quarters before the actual treatment time. This Figure reports the coefficients on $Treat * Post$ in which $Post$ is shifted backwards from one to twelve quarters.

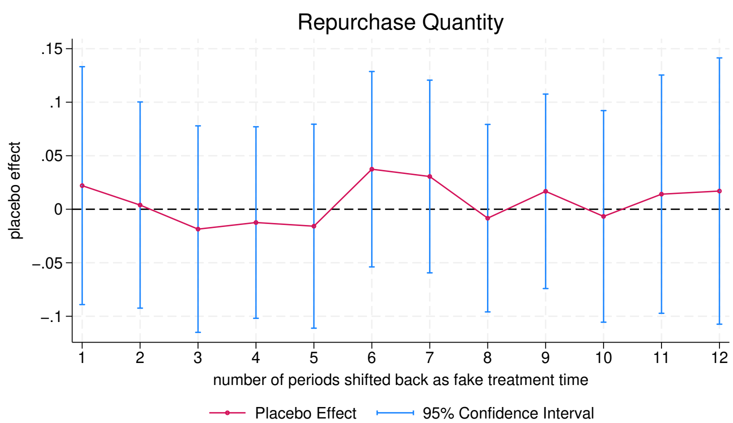

Figure B.4: Coefficients on Repurchase Quantity under Fake Treatment Time

We estimate the treatment effects of diff-in-diff regressions in model 3.1 by changing the treatment time from one to twelve quarters before the actual treatment time. This Figure reports the coefficients on $Treat * Post$ in which $Post$ is shifted backwards from one to twelve quarters.

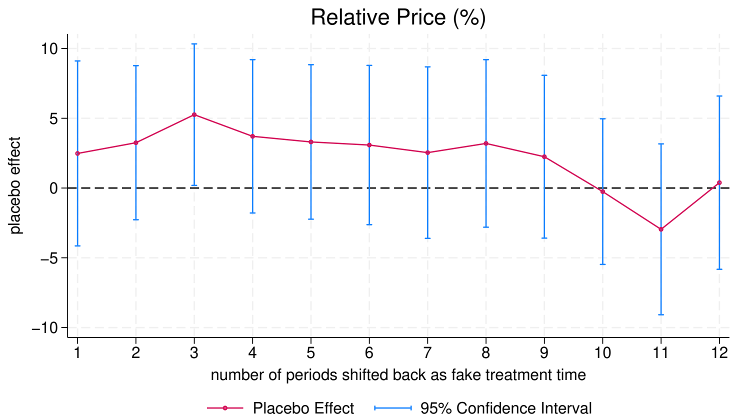

Figure B.5: Coefficients on Relative Repurchase Price (%) under Fake Treatment Time

We estimate the treatment effects of diff-in-diff regressions in model 3.1 by changing the treatment time from one to twelve quarters before the actual treatment time. This Figure reports the coefficients on $Treat * Post$ in which $Post$ is shifted backwards from one to twelve quarters.

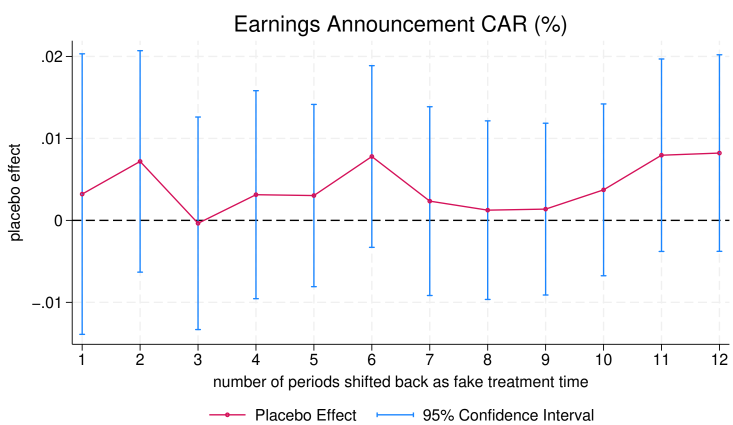

Figure B.6: Coefficients on Earnings Announcement CAR [-1,1] under Fake Treatment Time

We estimate the treatment effects of diff-in-diff regressions in model 3.1 by changing the treatment time from one to twelve quarters before the actual treatment time. This Figure reports the coefficients on $Treat * Post$ in which $Post$ is shifted backwards from one to twelve quarters.

B.3 Placebo Tests by Randomly Replacing Treatment Firms

In this section, we perform the fake treatment test by randomly assign treatment and control firms in our sample. In each random assignment, we keep the same treatment ratio of 81.15% and control ratio of 18.85% as in our original sample. Effectively, we generate fake $Treat$ variable. Then, we re-estimate regression model 3.1 and repeat 500 times. We plot the bootstrap distributions of coefficients on $Treat * Post$ in following figures. We also plot our actual estimators in the vertical solid line. If our estimator is statistically significantly different from the bootstrap distribution, we can conclude that our treatment effects are not driven by other unobserved confounding factors.

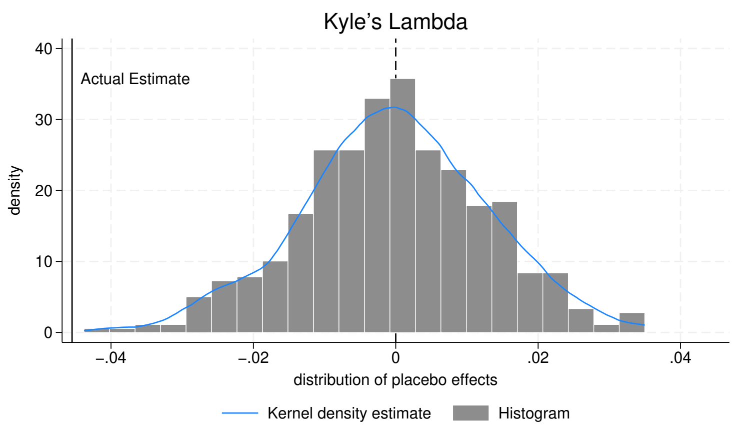

Figure B.7: Placebo Tests on Kyle's Lambda by Randomly Assigning Treatment Firms with 500 Repetition

This figure shows the distribution of coefficient on $Treat * Post$ from 500 repetition. It also shows the smoothed kernel density estimation for the histogram. In each repetition, we randomly select 19.83% of the firms in our sample to be treatment and the rest of the 80.17% is control. In each repetition, we estimate the regression model 3.1 with the same control variables. The solid vertical line is the actual estimator obtained from our main regressions.

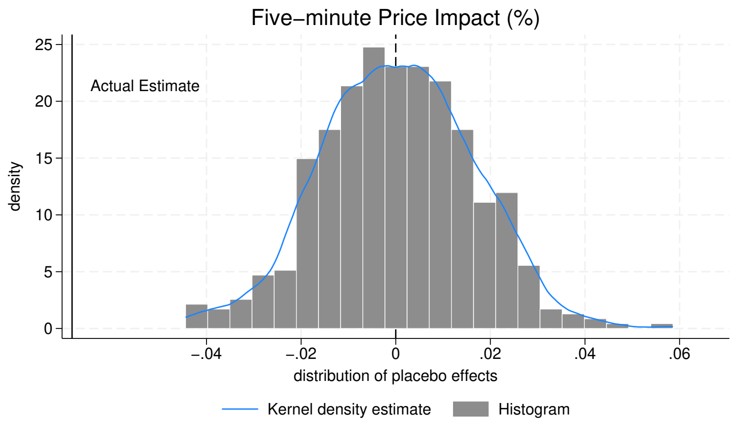

Figure B.8: Placebo Tests on Five-minute Percentage Price Impact by Randomly Assigning Treatment Firms with 500 Repetition

This figure shows the distribution of coefficient on $Treat * Post$ from 500 repetition. It also shows the smoothed kernel density estimation for the histogram. In each repetition, we randomly select 19.83% of the firms in our sample to be treatment and the rest of the 80.17% is control. In each repetition, we estimate the regression model 3.1 with the same control variables. The solid vertical line is the actual estimator obtained from our main regressions.

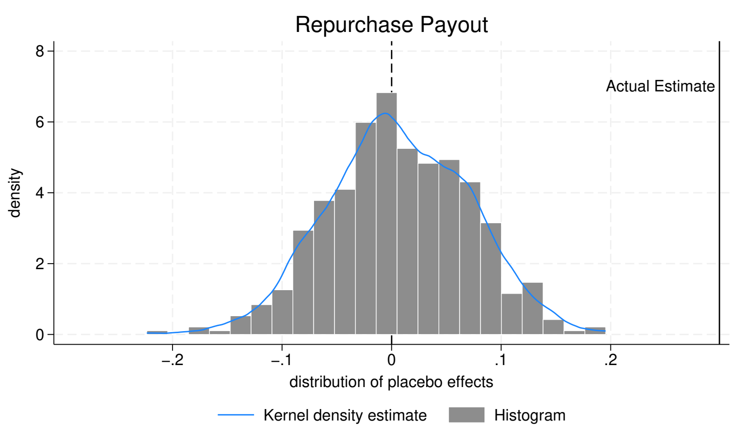

Figure B.9: Placebo Tests on Repurchase Payout by Randomly Assigning Treatment Firms with 500 Repetition

This figure shows the distribution of coefficient on $Treat * Post$ from 500 repetition. It also shows the smoothed kernel density estimation for the histogram. In each repetition, we randomly select 19.83% of the firms in our sample to be treatment and the rest of the 80.17% is control. In each repetition, we estimate the regression model 3.1 with the same control variables. The solid vertical line is the actual estimator obtained from our main regressions.

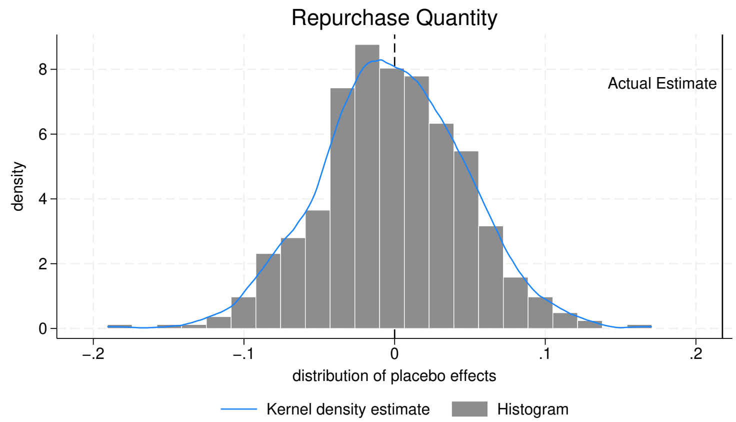

Figure B.10: Placebo Tests on Repurchase Quantity by Randomly Assigning Treatment Firms with 500 Repetition

This figure shows the distribution of coefficient on $Treat * Post$ from 500 repetition. It also shows the smoothed kernel density estimation for the histogram. In each repetition, we randomly select 19.83% of the firms in our sample to be treatment and the rest of the 80.17% is control. In each repetition, we estimate the regression model 3.1 with the same control variables. The solid vertical line is the actual estimator obtained from our main regressions.

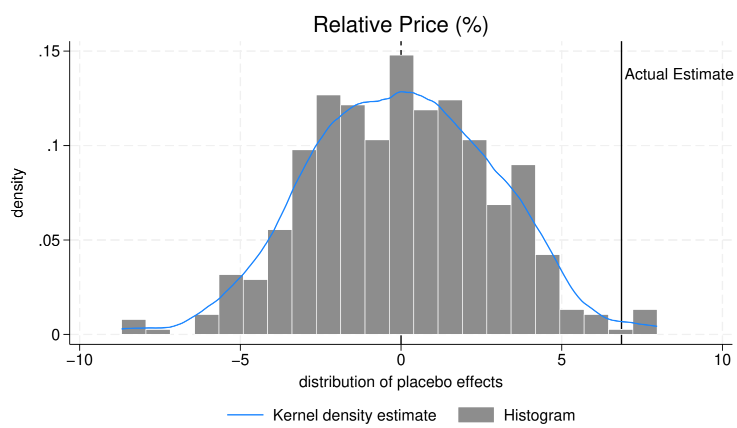

Figure B.11: Placebo Tests on Relative Repurchase Price by Randomly Assigning Treatment Firms with 500 Repetition

This figure shows the distribution of coefficient on $Treat * Post$ from 500 repetition. It also shows the smoothed kernel density estimation for the histogram. In each repetition, we randomly select 19.83% of the firms in our sample to be treatment and the rest of the 80.17% is control. In each repetition, we estimate the regression model 3.1 with the same control variables. The solid vertical line is the actual estimator obtained from our main regressions.

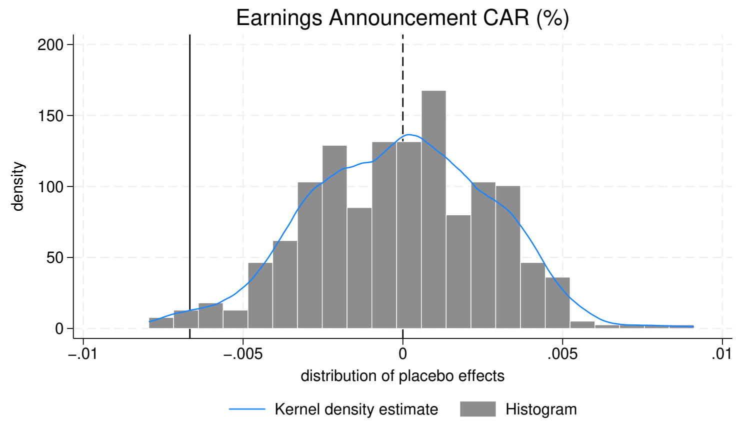

Figure B.12: Placebo Tests on Earnings Announcement CAR[-1,1] by Randomly Assigning Treatment Firms with 500 Repetition

This figure shows the distribution of coefficient on $Treat * Post$ from 500 repetition. It also shows the smoothed kernel density estimation for the histogram. In each repetition, we randomly select 19.83% of the firms in our sample to be treatment and the rest of the 80.17% is control. In each repetition, we estimate the regression model 3.1 with the same control variables. The solid vertical line is the actual estimator obtained from our main regressions.

B.4 Robustness: Alternative Measures

In this section, we provide robustness tests on alternative measures of price impact and repurchase activity. In our main analysis, we calculate the five-minute price impact (%) as a simple average over intraday permanent price impact. To address the concern that larger trades may move prices more, we use share-weighted five-minute price impact, which assigns greater weight to trades with larger share volumes. Table B.3 shows that the mean share-weighted five-minute price impact is 3.81%, approximately ten times larger than the simple-weighted measure. This finding suggests that many intraday trades in our sample are small.

We find similar results in Column (1) of Table B.4: after more frequent disclosure of share repurchases, share-weighted five-minute price impact statistically significantly drops by 0.814%, or 12.90% of the pre-treatment sample mean. This decline is consistent with the 13% reduction found in our main analysis.

Next, we examine an alternative measure of Kyle's lambda. In our main analysis, we estimate Kyle's lambda from an intraday regression of the log change in the mid-quote onto the square root of the absolute difference in buy and sell volume *with* an intercept. The alternative measure excludes the intercept, implicitly assuming that zero order flow does not move the mid-point. This alternative measure has a mean of 0.119, similar to the baseline measure of 0.114. Column (2) of Table B.4 shows that after more frequent disclosure, treatment firms statistically significantly reduce Kyle's lambda (without intercept) by 0.048, comparable to the baseline coefficient of 0.045 in Table 6.

Then, we consider alternative measures of repurchase payout. In our baseline regressions, we measure repurchase payout after 2004 as the product of disclosed repurchase price and quantity scaled by lagged total asset value. For the pre-2004 period, we measure repurchase payout as the estimated dollar volume of share repurchases from the cash flow statement divided by lagged total assets, a common practice in the empirical corporate finance literature (e.g., Dittmar and Dittmar, 2008; Ma, 2019). The alternative measure uses the estimated dollar volume from the cash flow statement for the entire sample period. Table B.3 shows that this alternative measure has a higher mean of 0.326% and a higher standard deviation of 1.080, suggesting noisier estimates. Column (3) in Table B.4 shows that after more frequent disclosure, treatment firms increase the alternative measure of repurchase payout by 0.240%, similar to our baseline estimate of 0.299. Both estimates are statistically significant at the 1% level.

Finally, we consider an alternative measure of repurchase quantity, as suggested by Banyi et al. (2008): the estimated dollar volume of share repurchases from the cash flow statement divided by the average daily closing price. Table B.3 shows that this alternative measure has a lower mean of 0.292% but a higher standard deviation of 0.931. Column (4) in Table B.4 shows that after more frequent disclosure, treatment firms repurchase 0.196% more shares outstanding per quarter, similar to our baseline estimate of 0.218. Both estimates are statistically significant at the 1% level.

Overall, these findings suggest that although measurement errors in share repurchases may exist before 2004, our main results remain robust. As discussed in Wooldridge (2010), if the measurement error in the dependent variable is random and independent of the regressors, OLS estimators remain consistent. However, investors still face information asymmetry when relying on noisy information to infer firms' earnings prospects.[21]

Table B.3: Summary Statistics of Alternative Measures

This table reports summary statistics for the variables of price impact, repurchase activities, and cumulative abnormal return. SD denotes the standard deviation, and Q1 and Q3 are the first and third quartiles. The five-minute percentage price impact is the difference between the mid-quote five minutes later and the current mid-quote, scaled by the current mid-quote and weighted by number of shares per trade. Kyle's lambda is the coefficient from an intraday regression without intercept whose dependent variable is the log change in the mid-quote over 300 seconds and whose regressor is the signed squared volume imbalance between buy and sell orders. Repurchase payout is a firm's quarterly repurchase dollar volume estimated from cash flow statement, scaled by its lagged total assets. Repurchase quantity is the percentage of shares repurchased during the quarter relative to lagged shares outstanding. Shares repurchased is calculated as the estimated repurchase dollar volume divided by average daily closing price in the given quarter. Earnings Announcement CAR is the cumulative abnormal return in the (-1,1) event window, in which the abnormal return is the return adjusted by CAPM, Fama-French three-factor, and Carhar-four factor. All measures are averaged to the quarter level.

	N	Mean	SD	Q1	Median	Q3
Alternative Price Impact Measures						
Five-minute Price Impact (Baseline %)	18,460	0.337	0.436	0.0819	0.185	0.410
Five-minute Price Impact (Share-weighted, %)	18,460	0.381	0.438	0.454	2.442	5.004
Kyle's Lambda (Baseline)	18,460	0.114	0.268	0.0103	0.0296	0.0971
Kyle's Lambda (Alternative)	18,460	0.119	0.281	0.0106	0.0301	0.0986
Alternative Repurchase Measures						
Repurchase Payout (Baseline)	18,460	0.310	1.053	0	0	0.00170
Repurchase Payout (Alternative)	18,460	0.326	1.080	0	0	0.00516
Repurchase Quantity (Baseline)	18,460	0.320	0.922	0	0	0.00756
Repurchase Quantity (Alternative)	18,460	0.292	0.931	0	0	0.00339
Alternative CAR Measures						
CAR (Market Model, Baseline)	18,266	0.435	9.198	-3.489	0.213	4.140
CAR (CAPM)	18,266	0.208	9.181	-3.615	0.0649	3.903
CAR (Fama-French 3-Factor)	18,266	0.179	9.175	-3.690	0.0591	3.909
CAR (Carhart 4-Factor)	18,266	0.195	9.217	-3.676	0.0735	3.918

We also consider alternative measures of cumulative abnormal returns around earnings announcements. In our baseline specification, we measure CAR as the cumulative raw difference

[21] As shown in our model, when market makers know only the distribution of earnings, they set an upward-sloping pricing rule.

Table B.4: Robustness: Alternative Measures on Liquidity and Repurchase Activities

This table reports the results of the DiD regression PriceImpact/Repurchase$_{i,t} = \beta_0 + \beta_1 \left(Treat_i \times Post_t\right) + \beta \mathbf{X}_{i,t} + v_i + \eta_t + \varepsilon_{i,m,t}$. Price impact measures include the share-weighted five-minute percentage price impact and Kyle's lambda without intercept. Repurchase measures include alternative repurchase payout estimated from the cash flow statement and alternative repurchase quantity calculated by estimated repurchase dollar volume from cash flow statement divided by average daily closing prices, following Banyi et al. (2008). *Treat* takes the value of 1 if the firm is listed in U.S.-only and 0 if it is cross-listed in the U.S. and Canada/UK. *Post* takes the value of 1 if it is after 2004 Q1 (inclusive) and 0 otherwise. The control variables are firm size, Profitability, Tobin's Q, leverage ratio, cash holdings, lagged quarterly average volatility, the lagged natural logarithm of trading volume in the quarter, and the lagged natural logarithm of the number of trades in the quarter. We estimate the regression using firm-quarter observations from 2000 to 2008. All variables are winsorized at the 1% and 99% levels. Firm-clustered standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
VARIABLES	Price Impact (%)	Kyle's Lambda	Repurchase Payout	Repurchase Quantity
Treat*Post	**-0.814*** **	**-0.049*** **	**0.240*** **	**0.196*** **
	(0.275)	**(0.016)**	**(0.076)**	**(0.049)**
Size	-0.015	-0.027**	-0.054	-0.027
	(0.185)	(0.012)	(0.043)	(0.038)
Tobin's Q	0.568***	-0.018***	-0.045***	-0.039***
	(0.064)	(0.003)	(0.013)	(0.007)
Profitability	0.519	-0.413***	0.737***	-0.238
	(0.904)	(0.087)	(0.284)	(0.290)
Leverage (%)	0.002	0.001***	-0.000	-0.000
	(0.004)	(0.000)	(0.001)	(0.001)
Cash Holdings	-1.000**	-0.001	-0.253	-0.124
	(0.447)	(0.025)	(0.158)	(0.116)
ln(Volume)$_{t-1}$	-2.138***	-0.014	0.040	0.075**
	(0.193)	(0.010)	(0.043)	(0.038)
(Volatility)$_{t-1}$	-0.261***	0.090***	0.010	0.020
	(0.075)	(0.013)	(0.010)	(0.013)
ln(Number of Trades)$_{t-1}$	1.558***	-0.018*	-0.034	-0.076**
	(0.185)	(0.010)	(0.046)	(0.037)
Constant	22.012***	0.724***	0.434	0.053
	(1.787)	(0.126)	(0.455)	(0.431)
Observations	16,828	16,828	16,828	16,828
Adjusted R-squared	0.608	0.509	0.250	0.190
Year-Quarter FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

between stock returns and the market return. We consider three alternative risk adjustment models: the CAPM CAR, the Fama-French three-factor (FF3) CAR, and the Carhart four-factor CAR. Table B.3 shows that the means of CAPM-, FF3-, and Carhart four-factor adjusted CAR are 0.208%, 0.179%, and 0.195%, respectively.

Table B.5 presents robustness tests using these alternative CAR measures. Across all three measures, we find results consistent with our baseline estimates. For the full sample, the coefficients on the interaction term $Treat \times Post$ are -0.655% (CAPM), -0.628% (FF3), and -0.673% (Carhart), all comparable to our baseline estimate of -0.743%. For the subsample of firms with positive earnings, the effects are stronger and statistically significant at the 1% level: treatment firms experience drops of 1.168 percentage points (CAPM), 1.204 percentage points (FF3), and 1.227 percentage points (Carhart), consistent with our baseline estimate of 1.344 percentage points. These findings confirm that more frequent disclosure enables investors to better infer positive cash flow news through repurchase activity, leading to earlier price jumps and reduced surprise at earnings announcements. For firms with negative earnings, none of the alternative measures show significant effects, mirroring our baseline finding. Overall, these results demonstrate that our main findings are robust across different risk adjustment models.

Table B.5: Alternative CAR Measures

This table reports the results of the DiD regression $\text{CAR}_{i,t} = \beta_0 + \beta_1 (Treat_i \times Post_t) + \beta \mathbf{X}_{i,t} + v_i + \eta_t + \varepsilon_{i,m,t}$. CAR includes the CAPM-, Fama-French three-factor, and Carhart-four-factor-adjusted CARs. *Treat* takes the value of 1 if the firm is listed in U.S.-only and 0 if it is cross-listed in the U.S. and Canada/UK. *Post* takes the value of 1 if it is after 2004 Q1 (inclusive) and 0 otherwise. The control variables are firm size, Profitability, Tobin's Q, leverage ratio, cash holdings, lagged quarterly average volatility, the lagged natural logarithm of trading volume in the quarter, and the lagged natural logarithm of the number of trades in the quarter. We estimate the regression using firm-quarter observations from 2000 to 2008. All control variables are winsorized at the 1% and 99% levels. Firm-clustered standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	CAPM CAR[-1,1]			FF3 CAR[-1,1]			Carhart 4-Factor CAR[-1,1]		
VARIABLES	Whole Sample	Positive Earnings	Negative Earnings	Whole Sample	Positive Earnings	Negative Earnings	Whole Sample	Positive Earnings	Negative Earnings
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat*Post	**-0.655****	**-1.168*****	**0.448**	**-0.628***	**-1.204*****	**0.568**	**-0.673****	**-1.227*****	**0.442**
	(0.327)	**(0.353)**	**(0.878)**	**(0.329)**	**(0.358)**	**(0.898)**	**(0.335)**	**(0.359)**	**(0.899)**
Size	-0.808***	-0.507*	-0.732	-0.780***	-0.416	-0.773	-0.761***	-0.392	-0.780
	(0.285)	(0.304)	(1.041)	(0.285)	(0.313)	(1.054)	(0.289)	(0.310)	(1.064)
Tobin's Q	0.185*	0.093	0.319	0.163	0.048	0.286	0.152	0.040	0.278
	(0.100)	(0.105)	(0.263)	(0.102)	(0.107)	(0.264)	(0.103)	(0.105)	(0.268)
Profitability	7.167***	9.372***	1.850	7.160***	9.387***	1.854	7.183***	9.518***	1.686
	(1.797)	(1.830)	(5.251)	(1.815)	(1.845)	(5.318)	(1.850)	(1.848)	(5.423)
Leverage (%)	0.022**	0.019*	0.019	0.021**	0.018*	0.018	0.021**	0.019*	0.017
	(0.009)	(0.010)	(0.025)	(0.009)	(0.010)	(0.025)	(0.009)	(0.010)	(0.026)
Cash Holdings	2.074**	1.669*	2.303	2.187**	1.806*	2.333	2.205**	1.810*	2.407
	(0.959)	(1.006)	(3.045)	(0.966)	(1.013)	(3.099)	(0.977)	(1.013)	(3.154)
$\ln(\text{Volume})_{t-1}$	0.088	-0.220	1.026*	0.047	-0.231	1.034*	0.077	-0.192	1.114*
	(0.243)	(0.252)	(0.611)	(0.243)	(0.252)	(0.611)	(0.253)	(0.282)	(0.619)
$(\text{Volatility})_{t-1}$	0.037	0.649***	-0.432*	-0.031	0.604***	-0.488*	-0.019	0.639***	-0.496*
	(0.178)	(0.227)	(0.254)	(0.182)	(0.229)	(0.260)	(0.187)	(0.223)	(0.279)
$\ln(\text{Number of Trades})_{t-1}$	-0.725***	-0.949***	-0.975	-0.769***	-0.942***	-1.087*	-0.788***	-1.017***	-0.973
	(0.257)	(0.302)	(0.592)	(0.255)	(0.304)	(0.593)	(0.256)	(0.300)	(0.603)
Constant	10.022***	6.911**	8.776	10.278***	7.178**	8.202	9.434***	6.329**	7.498
	(2.782)	(3.119)	(5.944)	(2.781)	(3.131)	(6.048)	(2.812)	(3.107)	(6.089)
Observations	16,590	12,300	4,163	16,590	12,300	4,163	16,590	12,300	4,163
Adjusted R-squared	0.024	0.051	-0.003	0.023	0.049	-0.007	0.022	0.050	-0.009
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

C Proofs of Propositions

C.1 Proofs of Proposition 1

We begin by assuming the firm's best strategy in proposition 1 were true to establish the pricing rules under the less frequent disclosure. Then, we verify this strategy is optimal under the derived pricing rules. This assume-and-verify technique is similar to Kyle (1985) but we also rule out all possible derivations to ensure the uniqueness of our equilibrium.

Liquidity traders may submit 0 or $-x$ and the firm may submit $0, x, 2x$ in the first period. So, market makers may face four possible aggregate order flows: $z_1 = -x, 0, x, 2x$ and set the price based on equation 2.2. We discuss the prices case by case. Specifically, market makers' pricing rules can be expressed using the law of total probability:

$$\begin{aligned} p_t &= E[P_3|\mathcal{Z}_t] \\ &= P(A_H|\mathcal{Z}_t) \cdot E[P_3|\mathcal{Z}_t, A_H] + P(A_L|\mathcal{Z}_t) \cdot E[P_3|\mathcal{Z}_t, A_L] \end{aligned} \tag{C.1}$$

where $\mathcal{Z}_t$ is the order flow history. They know the distribution of the project's cash flow $P(A_H) = P(A_L) = \frac{1}{2}$. Now, applying equation C.1, we can calculate the pricing rules case by case. In the first period, the pricing rules are as follows:

- $z_1 = -x$

  $$p_1(-x) = 0$$

  When $z_1 = -x$, it means that only liquidity traders trade $-x$ and the firm does not buy. Given the firm's optimal strategy, it implies that the cash flow $A = A_L = 0$.

- $z_1 = 0$

  $$\begin{aligned} p_1(0) &= \frac{1}{2} \cdot \frac{1 - p_1(0)x}{1 - x} + \frac{1}{2} \cdot 0 \\ \implies p_1(0) &= \frac{1}{2 - x} \end{aligned}$$

  When $z_1 = 0$, with probability $1/2$, the cash flow is $A = A_H = 1$ and in this case, the firm repurchases x while the liquidity trader trade $-x$. With probability $1/2$, the cash flow is $A =_L = 0$ and in this case, the firm does not repurchase but the liquidity trader trade 0. In a traditional trading model like Kyle (1985), we would have that $p_1(0) = \frac{1}{2} \cdot 1 + \frac{1}{2} \cdot 0 = \frac{1}{2}$. We can derive the same result by taking $x = 0$. Thus, our model incorporates main results from previous theory in informed trading.

- $z_1 = x$. When $z_1 = x$ or $z_1 = 2x$, the market makers can infer that the firm is repurchasing shares. Given the firm's trading strategy, market makers can infer that the cash flow is $A_H = 1$. So, they set the price directly as the following expected value:

$$
\begin{aligned}
p_1(x) &= 1 \times \frac{1 - p_1(x)x}{1 - x} \\
\Longrightarrow p_1(x) &= 1
\end{aligned}
$$

  Note that in this case, the price is equal to the realized cash flow value and the firm cannot make any trading profit because of the full revelation.

- $z_1 = 2x$

$$
\begin{aligned}
p_1(2x) &= 1 \times \frac{1 - p_1(2x)x}{1 - x} \\
\Longrightarrow p_1(2x) &= 1
\end{aligned}
$$

Now, we consider period-2 pricing rules:

1. $z_1 = -x$

   (a) $z_2 = -x$

$$
p_2(-x) = 0
$$

   This intuition is similar to the first period. $z_1 = -x, z_2 = -x$ implies that the firm does repurchase in either period, so the market makers can infer the the realized cash flow is 0 and set the corresponding price.

   (b) $z_2 = 0$. If $z_1 = -x$ and $z_2 = 0$, market makers still need to pose a credible threat to deter the firm's deviation under the scenario of $A = A_H$. In other words, simply observing $z_1 = -x$ cannot rule out the possibility that the cash flow is high, so the market makers will still set the price based on their prior beliefs on the cash flow distribution as follows:

$$p_2(0) = \frac{1}{2} \cdot \frac{1 - p_2(0)x}{1-x} + \frac{1}{2} \cdot 0$$
$$\Longrightarrow p_2(0) = \frac{1}{2-x}$$

Note that the pricing rule is the same as in the first period. Intuitively, $z_1 = 0$ does not convey valid information about the realized cash flow and market makers do not update their beliefs on the cash flow distribution.

(c) $z_2 = x$. The same intuition applies for $z_1 = -x$ and $z_2 = x$ or $2x$. Market makers can infer that the firm did not trade in the first period but trades in the second period. They can therefore infer the cash flow is high and set prices accordingly.

$$p_2(x) = 1 \times \frac{1 - p_2(x)x}{1-x}$$
$$\Longrightarrow p_2(x) = 1$$

(d) $z_2 = 2x$

$$p_2(2x) = 1 \times \frac{1 - p_2(2x)2x}{1-x}$$
$$\Longrightarrow p_2(2x) = 1$$

2. $z_1 = 0$:

(a) $z_2 = -x$. In this case, after observing $z_1 = 0$ and $z_2 = -x$, market makers can infer that the informed manager does not trade in the second or the first period. They can further infer that $A = A_L$ because otherwise the firm should have traded in both periods. So, they set the price as the low cash flow value.

$$p_2(-x) = 0$$

(b) $z_2 = 0$

$$\begin{aligned} p_2(0) = \mathrm{P}(A = A_H) \cdot E(V_3|A = A_H, z_1 = 0, z_2 = 0) \\ + \mathrm{P}(A = A_L) \cdot E(V_3|A = A_L, z_1 = 0, z_2 = 0) \end{aligned}$$

$$p_2(0) = \frac{1}{2} \cdot \frac{1 - p_1(0)x - p_2(0)x}{1 - 2x} + \frac{1}{2} \cdot 0$$

$$\Longrightarrow p_2(0) = \frac{1 - p_1(0)x}{2 - 3x}$$

In this case, the realized cash flow still has two possibility. In the high cash flow state (with probability 1/2), market makers would infer that the firm repurchased x with price $p_1(0)$ in the first period. They therefore adjust the expected value per share by considering the repurchase cash spent $(p_1(0)x + p_2(0)x)$ and the reduction in share outstanding $(1-2x)$. In the low cash flow state, they can infer that the firm's value is zero and the firm does not repurchase.

(c) $z_2 = x$

$$p_2(x) = 1 \times \frac{1 - p_1(0)x - p_2(x)x}{1 - 2x}$$

$$\Longrightarrow p_2(x) = \frac{1 - p_1(0)x}{1 - x}$$

In this case, market makers can infer that the cash flow is in the high state, and they can also infer the firm's first-period trading activity that it repurchased x with the price $p_1(0)$. They therefore adjust the expected value per share by considering the repurchase cash spent $(p_1(0)x + p_2(x)x)$ and the reduction in share outstanding $(1 - 2x)$.

(d) $z_2 = 2x$

$$p_2(2x) = 1 \times \frac{1 - p_1(0)x - p_2(2x) * 2x}{1 - 3x}$$

$$\Longrightarrow p_2(2x) = \frac{1 - p_1(0)x}{1 - x}$$

This case is similar to the last case. The only difference is that the quantity adjustment is now $1 - 3x$ in the denominator. Note that, the set price is the same as in the case of $z_2 = x$. This is because in either case, market makers can fully infer $A = A_H$ and therefore the firm's value. In other words, there is no information asymmetry between the firm and market makers. So, the pricing rule is flat in $z_2 = x$ and $z_2 = 2x$.

3. $z_1 = x$: when market makers observe the first-period order flow to be x or $2x$, they already infer that the cash flow is high. So, they will set the price as the $t = 3$ value per share. In other words, the firm cannot make profit in this situation.

(a) $z_2 = -x$

$$p_2(-x) = \frac{1 - p_1(x)x}{1 - x} = 1$$

(b) $z_2 = 0$

$$p_2(0) = \frac{1 - p_1(x)x - p_2(0)x}{1 - 2x}$$

$$\Longrightarrow p_2(0) = \frac{1 - p_1(x)x}{1 - x} = 1$$

(c) $z_2 = x$

$$p_2(x) = 1 \times \frac{1 - p_1(0)x - p_2(x)x}{1 - 2x}$$

$$\Longrightarrow p_2(x) = \frac{1 - p_1(x)x}{1 - x} = 1$$

(d) $z_2 = 2x$

$$p_2(2x) = 1 \times \frac{1 - p_1(x)x - p_1(2x) * 2x}{1 - 3x}$$
$$\Longrightarrow p_2(2x) = \frac{1 - p_1(x)x}{1 - x} = 1$$

4. $z_1 = 2x$: this is the same as if $z_1 = x$.

(a) $z_2 = -x$

$$p_2(-x) = \frac{1 - p_1(2x)2x}{1 - 2x} = 1$$

(b) $z_2 = 0$

$$p_2(0) = \frac{1 - p_1(2x)x - p_2(0)x}{1 - 3x}$$
$$\Longrightarrow p_2(0) = \frac{1 - p_1(2x)2x}{1 - 2x} = 1$$

(c) $z_2 = x$

$$p_2(x) = 1 \times \frac{1 - p_1(2x)2x - p_2(x)x}{1 - 3x}$$
$$\Longrightarrow p_2(x) = \frac{1 - p_1(2x)2x}{1 - 2x} = 1$$

(d) $z_2 = 2x$

$$p_2(2x) = 1 \times \frac{1 - p_1(2x)2x - p_1(2x) * 2x}{1 - 4x}$$
$$\Longrightarrow p_2(2x) = \frac{1 - p_1(2x)2x}{1 - 2x} = 1$$

Now, we discuss the best response by the firm. In case of $A = A_L = 0$, it is obvious that she will not repurchase any shares in either period because as long as $p > 0$, repurchasing any shares is always suboptimal:

$$\frac{0 - p * x}{1 - x} < 0 \quad \text{for any } p > 0 \tag{C.2}$$

$$\frac{0 - p * 2x}{1 - 2x} < 0 \quad \text{for any } p > 0 \tag{C.3}$$

Suppose $A = A_H = 1$, we first show that repurchasing x in both periods is better than repurchasing only in one period.

$$EV_3(q_1 = x, q_2 = x) =$$

$$\frac{1}{2} \cdot \frac{1 - p_1(0)x - \frac{1}{2}(p_2(0|z_1 = 0) + p_2(x|z_1 = 0))x}{1 - 2x} + \frac{1}{2} \cdot \frac{1 - p_1(x)x - \frac{1}{2}(p_2(0|z_1 = x) + p_2(x|z_1 = x))x}{1 - 2x}$$

$$= \frac{1}{2} \cdot \frac{1 - p_1(0)x - \frac{1}{2}(\frac{1-p_1(0)x}{2-3x} + \frac{1-p_1(0)x}{1-x})x}{1 - 2x} + \frac{1}{2} \cdot \frac{1 - x - x}{1 - 2x}$$

$$EV_3(q_1 = x, q_2 = 0) = EV_3(q_1 = 0, q_2 = x) = \frac{1}{2} \cdot \frac{1 - p_1(0)x}{1 - x} + \frac{1}{2} \cdot \frac{1 - p_1(x)x}{1 - x}$$

$$EV_3(q_1 = x, q_2 = x) - EV_3(q_1 = x, q_2 = 0) = \frac{1}{2}\left[\frac{1 - p_1(0)x - \frac{1}{2}(\frac{1-p_1(0)x}{2-3x} + \frac{1-p_1(0)x}{1-x})x}{1 - 2x} - \frac{1 - p_1(0)x}{1 - x}\right]$$

Note that in general,

$$\frac{1 - ax - bx}{1 - 2x} - \frac{1 - ax}{1 - x} = \frac{x[(1 - b) + (b - a)x]}{(1 - 2x)(1 - x)} \tag{C.4}$$

Because $(1-2x) > 0$, $1-x > 0$, to show $\frac{1-ax-bx}{1-2x} - \frac{1-ax}{1-x} > 0$, we only need to show that $b < 1$ and $b > a$; that is, $a = p_1(0) < b = \frac{1}{2}(\frac{1-p_1(0)x}{2-3x} + \frac{1-p_1(0)x}{1-x})$, and that $b = \frac{1}{2}(\frac{1-p_1(0)x}{2-3x} + \frac{1-p_1(0)x}{1-x}) <$

1. First note that:

$$b > a \Leftrightarrow \frac{1 - p_1(0)x}{2 - 3x} + \frac{1 - p_1(0)x}{1 - x} > 2p_1(0)$$

$$\text{Then, we show} \frac{1 - p_1(0)x}{2 - 3x} > p_1(0) \text{ and } \frac{1 - p_1(0)x}{1 - x} > p_1(0):$$

$$\frac{1 - p_1(0)x}{1 - x} - p_1(0) = \frac{1 - p_1(0)x - p_1(0) + p_1(0)x}{1 - x} = \frac{1 - p_1(0)}{1 - x} > 0$$

$$2 - 3x > 1 - 2x \quad \text{because} \quad 0 < x < \frac{1}{4}$$

$$\Longrightarrow \frac{1 - p_1(0)x}{2 - 3x} - p_1(0) > \frac{1 - p_1(0)x}{1 - x} - p_1(0) > 0$$

Again, we use the regulatory constraint that $0 < x < \frac{1}{4}$ because otherwise the firm may fully repurchase itself, rendering the denominator zero. So, we have proven that $b > a$. Then, we need to show that $b = \frac{1}{2}(\frac{1-p_1(0)x}{2-3x} + \frac{1-p_1(0)x}{1-x}) < 1$. To see this, we have that:

$$\frac{1 - p_1(0)x}{1 - x} + \frac{1 - p_1(0)x}{2 - 3x} - 2 = \frac{12x^2 - 13x + 3}{-6x^3 + 13x^2 - 9x + 2} - 2 \triangleq F(x)$$

$$F(x) = \frac{12x^3 - 14x^2 + 5x - 1}{-6x^3 + 13x^2 - 9x + 2}$$

The denominator is $D(x) = -6x^3 + 13x^2 - 9x + 2$, and we have that $D'(x) = -18x^2 + 13x - 9$. Letting $D'(x) = 0$ shows that $x_1, x_2 = \frac{1}{18}(13 \pm \sqrt{7})$. Note that $1 < x < \frac{1}{4} < \frac{1}{18}(13 \pm \sqrt{7}) \approx 0.575$, we can determine that $D'(x) < 0$ when $x \in (0, \frac{1}{4})$. Finally, note that $\min_{x \in (0, \frac{1}{4})} D(x) = D(\frac{1}{4}) = 0.46875 > 0$, so we can determine that $D(x) > 0$ when $x \in (0, \frac{1}{4})$.

The numerator is $N(x) = 12x^3 - 14x^2 + 5x - 1$, and we have that $N'(x) = 36x^2 - 28x + 5$. Letting $N'(x) = 0$ gives us $x_3 = \frac{5}{18}$ and $x_4 = \frac{1}{2}$. Since $x \in (0, \frac{1}{4})$, we know that $N'(x) > 0$ when $x \in (0, \frac{1}{4})$. So, $\max_{x \in (0, \frac{1}{4})} N(x) = N(\frac{1}{4}) = -0.4375 < 0$. Therefore, we can determine that $N(x) < 0$ when $x \in (0, \frac{1}{4})$. Finally, we can determine that $F(x) = \frac{N(x)}{D(x)} < 0$ when $x \in (0, \frac{1}{4})$. So, we have proven that $b = \frac{1}{2}(\frac{1-p_1(0)x}{2-3x} + \frac{1-p_1(0)x}{1-x}) < 1$.

Therefore, from equation C.4, we know that $EV_3(q_1 = x, q_2 = x) > EV_3(q_1 = x, q_2 = 0)$. Then, we need to verify that it is never optimal to repurchase $2x$ in the fist period. This is simplify because repurchasing $2x$ will reveal her identity and the aggregate order flow is either $2x - x = x$ or $2x + 0 = 2x$. Explicitly,

$$EV_3(q_1 = 2x) = \frac{1 - \frac{1}{2}(p_1(x) + p_1(2x))2x}{1 - 2x} = 1 < EV_3(q_1 = x, q_2 = 0) < EV_3(q_1 = x, q_2 = x)$$

Finally, note that if $q_1 = x$ and $z_1 = x$, the firm is indifferent in the second period between repurchasing $0, x$, or $2x$. As a result, the firm will repurchase $2x$ to exploit other benefits of share repurchase as we assume. To see this, simply note that:

$$EV_3(q_1 = x, q_2 = 0|z_1 = x) = \frac{1 - p_1(x)x}{1 - x} = 1 = EV_3(q_1 = x, q_2 = x|z_1 = x)$$
$$= EV_3(q_1 = x, q_2 = 2x|z_1 = x)$$

This ends the proof.

C.2 Proofs of Proposition 2

Now, let us consider the firm's best strategy under a more frequent disclosure. We follow the same procedures that we first assume the firm's strategy to derive the pricing rules, and then verify the strategy under such pricing rules. Under a more frequent disclosure, the first-period pricing rules are the same as those for the quarterly one. We only need to consider the second-period pricing rules. Recall that q_1 is the informed trading quantity in the first period, which will be disclosed after the first trading round. So, there are only three possible cases: $q_1 = 0$, $q_1 = x$, and $q_1 = 2x$. After seeing the disclosure, market makers would update their beliefs about the firm's future cash flow. We discuss it case by case.

- $q_1 = 0$. In this case, the firm did not trade any quantity in the first period, so market makers would keep the same beliefs about the distribution of the cash flow. Market makers do not simply infer that the cash flow is low, which prevents the firm's deviation. Therefore, the second-period pricing rule is the same as in the non-disclosure case.

  1. $z_2 = -x$

  $$p_2(-x) = 0$$

  2. $z_2 = 0$

  $$\begin{aligned} p_2(0) &= \frac{1}{2} \cdot \frac{1 - p_2(0)x}{1 - x} + \frac{1}{2} \cdot 0 \\ \Longrightarrow p_2(0) &= \frac{1}{2 - x} \end{aligned}$$

  3. $z_2 = x$

  $$\begin{aligned} p_2(x) &= 1 \times \frac{1 - p_2(x)x}{1 - x} \\ \Longrightarrow p_2(x) &= 1 \end{aligned}$$

  4. $z_2 = 2x$

  $$\begin{aligned} p_2(2x) &= 1 \times \frac{1 - p_2(2x)x}{1 - x} \\ \Longrightarrow p_2(2x) &= 1 \end{aligned}$$

- $q_1 = x$. In this case, z_1 could be 0 or x. The market makers update their beliefs of the realized cash flow as follows:

$$
\begin{aligned}
P(A_H|q_1 = x) &= \frac{P(A_H)P(q_1 = x|A_H)}{P(A_H)P(q_1 = x|A_H) + P(A_L)P(q_1 = x|A_L)} \\
&= \frac{\frac{1}{2}\cdot 1}{\frac{1}{2}\cdot 1 + \frac{1}{2}\cdot 0} = 1
\end{aligned}
\tag{C.5}
$$

The intuition is that once market makers know the firm has repurchased in the first period, they would infer the cash flow is high, as consistent with the firm's trading strategy. Note that, if $z_1 = 0$, the market makers will set the second-period price higher to incorporate the value added from share repurchase in the first period. Therefore, the second-period pricing rules are as follows:

1. $z_2 = -x$:

$$
\begin{aligned}
p_2(z_2 = -x; q_1 = x, z_1) &= 1 \cdot \left(\frac{1 - p_1(z_1)x}{1 - x} \right) \\
\implies p_2(z_2 = -x; q_1 = x, z_1) &= \frac{1 - p_1(z_1)x}{1 - x}, \quad z_1 = 0 \text{ or } x
\end{aligned}
$$

2. $z_2 = 0$:

$$
\begin{aligned}
p_2(z_2 = 0; q_1 = x, z_1) &= \frac{1 - p_1(z_1)x}{1 - x} \\
\implies p_2(z_2 = 0; q_1 = x, z_1) &= \frac{1 - p_1(z_1)x}{1 - x}, \quad z_1 = 0 \text{ or } x
\end{aligned}
$$

After observing $q_1 = x$, the market makers infer the high cash flow, and the firm would repurchase $2x$ in the second period. Therefore, observing $z_2 = 0$ is an off-equilibrium path. Market makers also need to set the price based on their expected value per share to prevent the firm's deviation.

3. $z_2 = x$:

$$p_2(z_2 = x; q_1 = x, z_1) = 1 \cdot \frac{1 - p_1(z_1)x - p_2(z_2 = x; q_1 = x, z_1)2x}{1 - 3x}$$
$$\implies p_2(z_2 = x; q_1 = x, z_1) = \frac{1 - p_1(z_1)x}{1 - x}, \ z_1 = 0 \text{ or } x$$

4. $z_2 = 2x$:

$$p_2(z_2 = 2x; q_1 = x, z_1) = 1 \cdot \frac{1 - p_1(z_1)x - 2p_2(z_2 = 2x; q_1 = x, z_1)x}{1 - 3x}$$
$$\implies p_2(z_2 = 2x; q_1 = x, z_1) = \frac{1 - p_1(z_1)x}{1 - x}, \ z_1 = 0 \text{ or } x$$

- $q_1 = 2x$. In this case, z_1 could be x or $2x$. This is similar to the case under $q_1 = x$.

1. $z_2 = -x$:

$$p_2(z_2 = -x; q_1 = 2x, z_1) = 1 \cdot \left(\frac{1 - p_1(z_1)2x}{1 - 2x}\right), \ z_1 = x \text{ or } 2x$$
$$\implies p_2(z_2 = -x; q_1 = 2x, z_1) = \frac{1 - p_1(z_1)2x}{1 - 2x} = 1$$

2. $z_2 = 0$:

$$p_2(z_2 = 0; q_1 = 2x, z_1) = \frac{1 - p_1(z_1)2x}{1 - 2x}, z_1 = x \text{ or } 2x$$
$$\implies p_2(z_2 = 0; q_1 = 2x, z_1) = 1$$

3. $z_2 = x$:

$$p_2(z_2 = x; q_1 = 2x, z_1) = 1 \cdot \frac{1 - p_1(z_1)2x - p_2(z_2 = x; q_1 = 2x, z_1)2x}{1 - 4x}, z_1 = x \text{ or } 2x$$
$$\implies p_2(z_2 = x; q_1 = 2x, z_1) = 1$$

4. $z_2 = 2x$:

$$p_2(z_2 = 2x; q_1 = 2x, z_1) = 1 \cdot \frac{1 - p_1(z_1)2x - 2p_2(z_2 = 2x; q_1 = 2x, z_1)x}{1 - 4x}, z_1 = x \text{ or } 2x$$
$$\implies p_2(z_2 = 2x; q_1 = 2x, z_1) = 1$$

Finally, we need to verify the firm's strategy. In the first-period, she will repurchase x to exploit her private information. In the second period, she cannot make extra profit following the disclosure. Note that, from the firm's perspective,

$$EV_3(q_1 = 0, q_2 = x|\text{disclosure}) = EV_3(q_1 = x, q_2 = 0|\text{disclosure})$$
$$= \frac{1}{2} \cdot \frac{1 - p_1(0)x}{1 - x} + \frac{1}{2} \cdot \frac{1 - p_1(x)}{1 - x} = \frac{1}{2 - x} + \frac{1}{2}$$

$$EV_3(q_1 = x, q_2 = x|\text{disclosure}) = \frac{1}{2} \cdot \frac{1 - p_1(0)x - \frac{1}{2}(p_2(0|z_1 = 0, q_1 = x) + p_2(x|z_1 = 0, q_1 = x))x}{1 - 2x}$$
$$+ \frac{1}{2} \cdot \frac{1 - p_1(x)x - \frac{1}{2}(p_2(0|z_1 = x, q_1 = x) + p_2(x|z_1 = x, q_1 = x))x}{1 - 2x}$$
$$= \frac{1}{2} \cdot \frac{1 - p_1(0)x - \frac{1 - p_1(0)x}{1 - x}x}{1 - x} + \frac{1}{2}$$
$$= \frac{1}{2} \cdot \frac{1 - 2x + 2p_1(0)x - p_1(0)x}{(1 - x)(1 - 2x)} + \frac{1}{2}$$
$$= \frac{1}{2} \cdot \frac{1 - 2x + \frac{2x^2}{2 - x} - \frac{x}{2 - x}}{(1 - x)(1 - 2x)} + \frac{1}{2}$$
$$= \frac{1}{2 - x} + \frac{1}{2} > EV_3\left(q_1 = 2x, q_2 = \{0, x, 2x\}\,|\text{disclosure}\right) = 1$$

Similarly, from the firm's perspective, we have that

$$EV_3(q_1 = x, q_2 = 2x|\text{disclosure}) =$$

$$\frac{1}{2} \cdot \frac{1 - p_1(0)x - \frac{1}{2}\left[p_2(x|z_1 = 0, q_1 = x) + p_2(2x|z_1 = 0, q_1 = x)\right] 2x}{1 - 3x} + \frac{1}{2} \cdot 1$$

$$= \frac{1}{2 - x} + \frac{1}{2} \tag{C.6}$$

That is, firm is indifferent among no repurchasing, repurchasing small or large. In other words, paying cash dividend or repurchasing shares does not affect the firm's value, implying that $q_2 = 0, x, 2x$ are all possible equilibrium. We refine the equilibrium based on our assumption that the firm prefers share repurchase over dividend and randomizes repurchase size when payout policy is irrelevant to the its value. We therefore conclude that the firm will randomize among x and $2x$ with probability ρ and $1 - \rho$, respectively, in the second period. Therefore, the expected repurchase quantity is $\rho \cdot x + (1 - \rho) \cdot 2x = (2 - \rho)x$. This refinement reflects that after the information asymmetry is no longer a binding constraints, other benefits of share repurchases come into effects. This ends the proof.